IV. ENVIRONMENTAL CONSEQUENCES

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A. Assessment of Programmatic Concerns

1. Department of Defense Use Areas

Gulf of Mexico Region

Military activities in Gulf of Mexico waters have been summarized in U.S. Department of Interior (USDOI), Minerals Management Service (MMS) (2002a). These activities normally consist of various air-to-air, air-to-surface, and surface-to-surface fleet training and air force exercises. The U.S. Navy uses the Gulf for shakedown cruises on newly built ships, and for ships completing overhaul or extensive repairs in Gulf shipyards such as those located in Pascagoula, Mississippi. No aircraft carriers are currently stationed in the Gulf, but carriers may from time to time conduct flight operations there. Of the 17 Military Warning Areas in the northern Gulf of Mexico area, 7 are designated by the U.S. Air Force for the conduct of various testing and training missions, and 10 are designated by the U.S. Navy for various naval training and testing operations. The Air Force operations are controlled out of the Eglin Military Air Force Base (located in northwest Florida) and through Air National Guard offices (located in Corpus Christi and Houston, Texas; and Gulfport, Mississippi). Naval operations are controlled and coordinated through facilities in Key West (Florida), Corpus Christi (Texas), and New Orleans (Louisiana). Live ordnance air-to-surface training is currently accomplished on the land ranges administered by the Eglin Military Complex.

Although offshore oil and gas activities have the potential to affect military activities, the U.S. Department of Defense (USDOD) and the USDOI have cooperated on these issues for many years and have developed mitigation measures that minimize such conflicts. For example, stipulations are applied to oil and gas leases in critical military use areas. Whenever possible, close coordination between oil and gas operators and the military authorities for specific operational areas is encouraged and, in some cases, is required under these lease stipulations. In some instances where the military requires unimpeded access to specific areas on the Outer Continental Shelf (OCS), specific lease blocks have been deleted from one or more proposed lease sales.

The greatest potential conflict with military activities occurs in the Western Gulf of Mexico Planning Area, based on the number of lease sales expected and the current use of the area by the U.S. Navy. The USDOI will continue to coordinate with the USDOD regarding future lease offerings, new areas of industry interest, and current or proposed areas of military operations. As part of this coordination, applicable stipulations would continue to be routinely evaluated and modified, as necessary, to minimize or eliminate conflicts. An example of this process was the inclusion of three previously deferred blocks (Mustang Island Blocks 793, 799 and 816) in the Western Gulf of Mexico Planning Area in OCS Lease Sales 192 and 196, subject to a recently revised Lease Stipulation of Operations in the Naval Mine Warfare Area.

Alaska Region

Offshore oil and gas development under the proposed 2007-2012 OCS Leasing Program within the Alaska Region would not interfere with standard or routine military practices. Additional vessel traffic resulting from industry development and exploration would simply increase existing traffic, and not impact military activities. The MMS works in cooperation with the U.S. Coast Guard (USCG) regarding industry exploration and development in waters off the coast of Alaska.

Atlantic Region

In the mid-Atlantic offshore area, the USDOD and other organizations (e.g., National Aeronautics and Space Administration) make use of surface danger zones and restricted areas within Atlantic coastal waters and offshore for rocket launching weapons testing, swimmer exercises, small arms firing and other training and readiness operations. The U.S. Navy conducts various training activities at sea such as sinking exercises of surface targets and mine warfare exercises. Aircraft operated by the USDOD train within special use airspace overlying the coast and offshore. The activities and restrictions on both surface waters and airspace have the potential to conflict with OCS oil and gas drilling activities and the location of infrastructure. Established mitigation measures and coordination procedures between the USDOD and USDOI help to minimize these conflicts, as outlined in Appendix D. As in the Gulf of Mexico, the standard clauses in the stipulation relate to limitation of liability (hold harmless), control of electromagnetic emissions, and operational agreements between the lessee and the relevant military authority.

The U.S. Army Corps of Engineers (COE) has established 13 surface danger zones and restricted areas within the mid-Atlantic coast. **Danger zones** are defined water areas used for target practice, bombing, rocket firing or other especially hazardous operations. The danger zones may be closed to the public on a fulltime or intermittent basis, as stated in the Code of Federal Regulations (CFR) (33 CFR 334.2(a)). A **restricted area** is a defined water area for the purpose of prohibiting or limiting public access. Restricted areas generally provide security for Government property and/or protection to the public from the risks of damage or injury arising from the Government's use of that area (33 CFR 334.2(b)). The regulations pertaining to these areas are at 33 CFR Part 334. These areas are shown along with military reservations in Figure IV-1.

The U.S. Navy conducts other organized shipboard training in open waters of the Atlantic, beyond these restricted areas. Such exercises include:

- naval surface fire support training exercises involving use of a Virtual At-Sea Training/Integrated Maritime Portable Acoustic Scoring and Simulator to qualify and recertify ships in naval surface fire support. The system is a portable system of sonabuoys that serve as a virtual target and can be deployed anywhere in the open ocean.
- mine warfare exercises involving vehicles "neutralizing" mine shapes on the sea floor or in the water column with an underwater detonation of ordnance (net explosive weights of up to 20 lbs). These exercises occur at three locations along the east coast; two are in the Mid-Atlantic Planning Area: immediately offshore of NAS Oceana, Dam Neck Detachment and immediately offshore of MCB Camp Lejeune in Onslow Bay.
- sinking exercises of surface targets involving use of Navy vessels firing live ordnance at a target (usually a vessel) or test platform to train personnel, test weapons, and study the survivability of ship structures.

Figure IV-1 also shows the locations of various military installations along the mid-Atlantic shore, which have the potential to interfere with or interrupt exploration and drilling operations (NAVFACENGCOM, October 2005).

There are also military training routes, military operating areas, restricted airspace, and warning areas along the Atlantic coast and offshore, which are designated by the Federal Aviation Authority (Department of the Navy, 2004). Warning areas are the most relevant to the OCS oil leasing program because they are largely located offshore extending from 3 nautical miles outward from the coast over international waters and in international airspace. These areas are designated as airspace for military activities, but because they occur over international waters, there are no restrictions on nonmilitary aircraft. The purpose of such areas is to warn nonparticipating pilots of the potential danger. When in use for military exercises, the controlling agency notifies civil, general, and other military aviation through notice-to-airmen and notice-to-mariner advisories, which specify the current and scheduled status of the area and warn other aircraft (Department of the Navy, 2004). Warning areas and military operating areas are generally used for air-to-air training operations and aerobatic flight (Department of the Navy, 2002).

Within the Mid-Atlantic Planning Area, warning areas W-72, W-122, and W-386 extend from the mouth of the Chesapeake Bay south to Pamlico Sound in North Carolina and offshore. The primary users of these areas include aircraft squadrons stationed at NAS Oceana (Department of the Navy, 2002) and MCAS Cherry Point. Aircraft operations conducted in warning areas primarily involve air-to-air combat training, such as air combat maneuvers and air intercepts, and are rarely conducted at altitudes below 5,000 feet (Department of the Navy, 2002). These areas are controlled by the Fleet Area Control and Surveillance Facility, Virginia Capes, Virginia Beach.

2. Global Climate Change

The temperature of the earth's atmosphere is regulated by a balance between the radiation received from the sun, the amount reflected by the earth's surface and clouds, and the amount of radiation absorbed by the earth and atmosphere. The so-called greenhouse gases, which include carbon dioxide (CO_2) and water vapor, keep the earth's surface warmer than it would be otherwise because they absorb infrared radiation from the earth and, in turn, radiate this energy back down to the surface. While these gases occur naturally in the atmosphere, there has been a rapid increase in concentrations of greenhouse gases in the earth's atmosphere from anthropogenic sources since the start of industrialization, which has caused concerns over potential changes in the global climate. The primary anthropogenic greenhouse gases are CO_2, methane (CH_4), nitrous oxides (N_2O), and halocarbons.

The atmospheric concentration of CO_2 is presently about 370 parts per million (ppm), which is an increase of 31 percent since 1750. The rate of increase of CO_2 since 1980 is about 1.5 ppm (0.4%) per year. Most of the anthropogenic CO_2 emissions are attributed to fossil fuel burning, while 10-30 percent is predominantly due to land use changes, especially deforestation (Intergovernmental Panel on Climate Change [IPCC], 2001a). The level of CO_2 in the atmosphere is determined by a complex cycle that involves the exchange of carbon between the atmosphere, the biosphere, and the oceans. It is estimated that the oceans and terrestrial biota absorb about half of all CO_2 emissions, while the rest accumulates in the atmosphere (IPCC, 2001a).

Atmospheric CH_4 concentrations have increased by about 150 percent since 1750 (IPCC, 2001a). At present, the atmospheric concentration is about 1.75 ppm. Methane is a greenhouse gas with both natural (e.g., wetlands) and anthropogenic sources (e.g., agriculture, natural gas activities, and landfills). Slightly more than half of the emissions are anthropogenic. The rate of increase in CH_4 concentrations is highly variable, and emission rates are difficult to quantify (IPCC, 2001a).

Concentrations of N_2O have risen about 16 percent since 1750 to a current level of about 310 parts per billion (ppb). There are significant interannual variations in the upward trend of N_2O concentrations. Nitrous oxide is produced by both natural and anthropogenic sources. Anthropogenic sources of N_2O are agricultural soil management, animal manure management, sewage treatment, mobile and stationary sources of fossil fuel, adipic acid production, and nitric acid production. Nitrous oxide is also produced naturally from a wide variety of biological sources in soil and water, particularly microbial action in wet tropical forests (http://www.epa.gov/nitrousoxide/).

Global concentrations of halocarbons (carbon compounds that contain fluorine, chlorine, bromine, or iodine) have generally peaked as a result of the implementation of regulations under the Montreal Protocol. The most important of the halocarbons, both in terms of global warming and ozone-depleting potential, are the chlorofluorocarbons (CFC's). However, the observed concentrations of the substitutes for CFC's, which include hydrochlorofluorocarbons and hydrofluorocarbons, are rising; these are also greenhouse gases. At present, their concentrations are relatively low, and future emissions of these gases are limited by the Montreal Protocol (IPCC, 2001a). Perfluorocarbons (e.g., carbon tetrafluoride [CF_4] and hexafluoroethane [C_2F_6]) and sulfur hexafluoride are other sources of anthropogenic emissions and have extremely long residence times (CF_4 resides in the atmosphere at least 50,000 years) and a high greenhouse gas potential. Current atmospheric concentrations are small, but they have a significant growth rate. Ozone (O_3) is also one of the greenhouse gases. The observed losses of O_3 in the stratosphere as a result of CFC's have caused some cooling of the atmosphere, which offsets to some extent the warming due to greenhouse gases (IPCC, 2001a). On the other hand, an observed increase in global O_3 concentrations in the lower atmosphere since pre-industrial times tends to lead to warming.

Scientists continue to assess and estimate the total global effects on warming or cooling from the various greenhouse gases and other impacting agents. These estimates consider the radiative properties of the gas, the emission rate, and their residence time in the atmosphere. Based on the latest scientific data, the largest effect on global warming is from CO_2 emissions. The others, ranked in order of importance, are CH_4, O_3, halocarbons, and N_2O. Stratospheric ozone has a slight cooling effect. Anthropogenic aerosols in the atmosphere (which include sulphate particles, organic carbon and carbon black from fossil fuel burning, biomass burning, and mineral dust) also have a net cooling effect, but there is a significant uncertainty in the figures. Secondary effects from aerosols (which may affect cloud properties and cloud cover) could also result in surface cooling. Changes in solar radiation may also have contributed to global temperature increases in the early part of the twentieth century, but the importance has been difficult to evaluate (IPCC, 2001a). The advent of space-borne measurements of total solar irradiance in the late 1970's has now made it possible to quantify the natural variations in solar output.

The IPCC has concluded that the global averaged surface temperature has increased by 0.6 ± 0.2 degrees Celsius (^oC) since the late 19th century. Most of the increase has occurred in two distinct periods: 1910-1945 and since 1976 (IPCC, 2001a). The increase has been most pronounced in the 1990's. The largest increases in temperature have occurred over the mid- and high latitudes of the Northern Hemisphere. The diurnal temperature range over land has been decreasing, with average minimum temperatures increasing at about twice the rate of the maximum temperatures. Annual land precipitation has increased in the middle and high latitudes of the Northern Hemisphere (about 0.5-1.0% per decade). It also appears that there has been an increase in the frequency of heavy precipitation events in the mid- and high latitudes of the Northern Hemisphere. Observations show a decrease in snow cover and land-ice extent. Northern Hemisphere sea-ice amounts are decreasing, but there is no significant trend in Antarctic sea-ice (IPCC, 2001a).

A number of different naturally occurring climate forcing agents can affect the global climate. These include changes in solar radiation, volcanic eruptions, and feedbacks from the ocean. The IPCC examined each of these factors over large time scales and determined that natural variability could not account for all of the warming observed in the 20th century. The IPCC in their 2001 report made the following conclusion: "In the light of new evidence and taking into account the remaining uncertainties, most of the observed warming over the last 50 years is likely to have been due to the increase in greenhouse gas concentrations."

Future projections of greenhouse gas emissions over the 21st century have been made using a range of assumptions about economic growth, population, and technological emphasis (IPCC, 2001a). The various projections provide a large range in projected emissions of greenhouse gases for the 21st century. The estimated CO_2 concentrations for the year 2100 range from 540 to 970 ppm (a 90-250% increase above year 1750 levels). Uncertainties in the magnitude of the feedback from the terrestrial biosphere could make the figures either somewhat lower or higher. The climate system response to increases in greenhouse gases is investigated by the use of computer models of the earth's climate system, known as atmosphere-ocean global climate models. The ability of the models to predict future climate is limited by their relatively coarse resolution (about 250 kilometers [km] in the horizontal for the atmospheric component). The effects on a finer scale, such as those caused by clouds, cannot be modeled directly, but have to be approximated on a grosser scale. Furthermore, clouds introduce significant uncertainties because they can result in either warming or cooling depending upon cloud height, thickness, and other properties. The effects of sulphate aerosols are also difficult to quantify.

Based on simulations using models of various degrees of complexity applied to a number of different greenhouse gas emission scenarios, the IPCC projected an increase of the globally averaged surface temperature of 1.4 to 5.8 ^{o}C for the period 1990 to 2100 (IPCC, 2001a). The models showed that land areas will warm more rapidly than the global average, especially in the northern high latitudes in the cold season. Globally average precipitation is predicted to increase, with some differences by region as well as season. There is also evidence that an increase in precipitation would correlate with greater variability from year to year. It also appears likely that the continental interiors would experience more frequent and intense summer droughts. The global mean sea level is projected to rise by 0.11 to 0.77 meters (m) due to thermal expansion and melting from glaciers and ice caps.

While most analyses of climate change focus on scenarios of steady warming of the climate, there is also the possibility that gradual warming could trigger an abrupt change in climate resulting from non-linear processes in the climate system (National Research Council [NRC], 2002; Arctic Climate Impact Assessment [ACIA], 2004). Such a change could be triggered when a critical threshold is passed. The mechanisms are not adequately represented in current climate models; thus, there is the possibility of surprises. In the arctic, very large shifts in climatic patterns have occurred over short timescales in the past. Ice core records indicate that temperatures over Greenland dropped by as much as 5 ºC within a few years during the period of warming that followed the last ice age, before abruptly rising again (ACIA, 2004).

a. Potential Consequences of Global Climate Change

The IPCC has assessed the potential consequences of global climate change (IPCC, 2001b). The report includes discussions on the sensitivity, adaptive capacity, and vulnerability of natural and human systems to climate change. According to the IPCC projections, crop yields in most tropical and subtropical regions would decrease, as would water availability for populations in water-scarce regions, particularly in the subtropics. The exposure to vector-borne and water-borne diseases would expand, and the risk of flooding due to higher incidences of heavy precipitation and sea-level rise would increase. If the global temperature increase were to rise by more than a few degrees Celsius, reduced crop yields would be likely in the mid-latitudes as well. There would also be some beneficial aspects to climate change. The increase in CO_2 levels may increase crop yields in the mid-latitudes if the increase in temperature stays relatively small. The global timber supply may increase from appropriately managed forests. There would be a reduction in winter mortality from cold weather stress in the mid and high latitudes.

The developing countries would be more vulnerable to climate change because more of the economy is sensitive to climatic variations. Many areas are prone to destructive droughts and floods. Population and agricultural centers in the tropics are often located in low-lying coastal areas, which are vulnerable to sea-level rise. Nutrition is deficient, and the health infrastructure is relatively poor. There is less capacity to adapt because of limited technological, financial, and institutional resources.

The IPCC investigated various strategies for reducing greenhouse gas emissions (IPCC, 2001c). Costs depend strongly on technological development and the timing and level of greenhouse gas stabilization. Lower emissions will require switching to lower-carbon fuels and increasing the energy efficiencies of buildings, transportation, energy production, and manufacturing. Appropriate management of forests, agricultural lands, and ecosystems could be used to sequester carbon. Progress is being made in the technological development of wind turbines, hybrid vehicles, and fuel cells. Some emission reductions, such as those resulting from increased energy efficiencies, could result in net cost savings. Other measures would have varying degrees of cost. The reduction in greenhouse gas emissions would have some other direct benefits, such as improved air quality. The use of emissions trading would likely reduce the cost of reaching emission reduction goals.

The National Assessment Synthesis Team (NAST, 2000) has summarized the consequences of climate change for the various regions in the United States. The report presents impacts by geographical regions as well as by resource (i.e., water resources, agriculture, ecosystems, coastal resources, human health). More recently, a report on the impacts of climate change in the Arctic was released (ACIA, 2004). We use these reports and others as a guide in describing qualitatively any potential regional climate change impacts. There are considerable uncertainties in the magnitude of any future climate change and even greater uncertainties about impacts in specific regions. Moreover, the IPCC, NAST, and ACIA make future projections over a 100-year period, while the activities associated with the proposed 5-year program span only about 30-40 years. Nevertheless, if the IPCC future climate change projections are accurate, a certain degree of climate change and their related impacts could occur within the period of the proposed 5-year program activities. The following sections describe some plausible environmental effects by region. It must be noted that climate change is one of a number of anthropogenic and natural impacting agents. Significant stresses on the environment will occur with or without climate change. However, climate change may exacerbate a variety of environmental problems.

(1) Gulf of Mexico Region

Climate models generally predict a rise in temperatures in the Gulf Coastal States this century. This would result in higher summertime heat index values and greater power demand for air conditioning (NAST, 2000). Model predictions of precipitation are less certain. In general, the models predict a slight decrease in precipitation in coastal areas, while model predictions vary widely in the upland areas, with one predicting an increase in precipitation and another a decrease. The models also predict more intense rainfall events and a higher frequency of droughts (Twilley et al., 2001).

Significant increases or decreases of river runoff would affect salinity and water circulation. Increased runoff would likely deliver increased amounts of nutrients such as nitrogen and phosphorous to estuaries, while also increasing the stratification between warmer fresher and colder saltier water (Boesch et al., 2000). This would increase the potential for algal blooms that deplete the water of oxygen and increase stresses on sea grasses, fish, shellfish and benthic communities. A significant increase in discharge from the Mississippi River could cause an expansion of the hypoxic zone in the Gulf of Mexico off Louisiana. Decreased runoff could diminish flushing, decrease the size of estuarine nursery zones, and allow an increase in predators and pathogens (Boesch et al., 2000). Permanent reductions of freshwater flows in rivers could substantially reduce biological productivity in Mobile Bay, Apalachicola Bay, Tampa Bay, and the lagoons of Texas (Twilley et al., 2001). More frequent or longer lasting droughts and reduced freshwater inflows could increase the salinity in coastal ecosystems, resulting in a decline in mangrove and seagrasses habitats.

Sea-level rise would affect the availability and distribution of high-quality freshwater because many Gulf Coast aquifers are susceptible to saltwater intrusion. Wetlands and mangroves are highly productive systems that are strongly linked to fisheries productivity. These habitats provide important nursery and habitat functions to many important fish and shellfish populations. Infilling, subsidence, altered hydrology, and a decrease in sediment supply have caused dramatic losses of wetlands in the region. With sea-level rise, wetland losses would likely be accelerated, particularly in coastal Louisiana, which would threaten the region's fisheries and agriculture. Loss of wetlands would have adverse effects on coastal navigation and infrastructure. While offshore oil and gas development may not be directly affected, indirect effects may occur due to stresses on coastal industrial infrastructure affected by sea-level rise. It is not known whether warming would lead to an increase in the number or intensity of hurricanes. An increase in hurricane activity would adversely affect oil and gas production in the Gulf due to platform shutdowns associated with such events. Even without an increase in hurricane activity, damage to the coastline from storms could be aggravated due to the loss of wetlands and barrier islands which would otherwise act as buffers.

Many Gulf of Mexico commercial fish populations are already subject to stresses, and global climate change may aggravate the impacts of ongoing and future commercial fishing and human use of the coastal zone. Fish, including shellfish, respond directly to climate fluctuations, as well as to changes in their biological environment including predators, prey, species interactions, disease, and fishing pressure. Fish are not only influenced by temperature and salinity conditions but also by mixing and transport processes. Climate would only be one of several factors that regulate fish abundance and distribution. Projected changes in water temperatures, salinity, and currents can affect the growth, survival, reproduction, and spatial distribution of marine fish species and of the prey, competitors, and predators that influence the dynamics of these species (Watson et al., 1998). Changes in primary production levels in the ocean because of climate change may affect fish stock productivity. However, it is still unclear how climate-induced changes in primary productivity would affect the next trophic link, zooplankton. Changes in zooplankton biomass are known to affect fish productivity.

Recreational fishing is a highly valued activity that could have losses in some regions because of climate-induced changes in fisheries. The net economic effect of changes in recreational fishing opportunities because of climate-induced changes in fisheries is dependent on whether projected gains in cool- and warm-water fisheries offset losses in cold-water fisheries. Anadromous species, such as striped bass, rely on marine and freshwater aquatic systems at different points in their life cycles. Projected changes in marine and freshwater temperatures, ocean currents, and freshwater flows are more likely to impact growth, survival, reproduction, and spatial distribution of these species than of other species.

The survival, health, migration, and distribution of marine mammals and sea turtles may be impacted by projected changes in climate through impacts on their food supply and breeding habitats. The availability of necessary habitats and prey species that results from climate change will have the greatest impact on marine mammal and sea turtle populations that are already under endangered species status. Marine mammal calving and pupping grounds and sea turtle nesting beaches would be threatened by rising sea level (Watson et al., 1998).

(2) Alaska Region

A discussion of information about Arctic climate change and potential related impacts on species that could also be affected by oil and gas related activities in the Beaufort Sea OCS is provided in Appendices C and I of the Environmental Assessment (EA) for Beaufort Lease Sale 195 (MMS, 2004a). The reader is referred specifically to Appendix I and Section IV.C.4 of the Biological Evaluation in Appendix C of the EA. We hereby incorporate these sections of the EA by reference.

The average annual surface temperature in Alaska has been rising at the rate of about 1 ºC (1.5 ºF) per decade over the last three decades, with the largest warming occurring in the interior and arctic regions (Alaska Regional Assessment Group, 1999). The temperature increases are larger in winter. Precipitation has increased by about 30 percent overall, but there is more spatial variability. The two general circulation models used in the National Assessment predict an increase in the mean temperature in Alaska of 1.5-3.5 ºC (3-6 ºF) by the year 2030. Satellite data have shown that arctic sea-ice extent has decreased by about 2.9 percent per decade during the period of 1978 through 1996 (Cavalieri et al, 1997). Submarine sonar records have shown that sea ice thickness has decreased by more than 1.2 m (4 feet) between the 1970's and the 1990's (Rothrock et al., 1999). The IPCC has noted that there has been widespread retreat of glaciers worldwide, with the exception of western Norway and New Zealand (IPCC, 2001a). Annual snowfall has increased by about 11 percent over Alaska, but annual snow cover has decreased due to more rapid melting in spring and summer (Alaska Regional Assessment Group, 1999). Along a transect following the Trans-Alaska Pipeline route, permafrost temperatures at 15- to 20-m depths have increased between 0.6 and 1.5 ˚C over the past 20 years. Borehole measurements have shown an increase of the mean annual ground surface temperatures of 2.5 ˚C since the 1960's, while discontinuous permafrost has begun thawing downward at a rate of 0.1 m/yr at some locations (ACIA, 2005). Sea ice has already declined considerably over the past 50 years, and additional declines of 10-50 percent in annual average sea ice extent are projected by the year 2100, while summer sea ice is projected to decrease by 50 percent (ACIA, 2004). Retreat of sea ice would increase impacts to coastal areas from storms. Furthermore, coastlines where permafrost has thawed are more vulnerable to erosion from wave action. Aerial photo comparison has revealed total erosive losses up to 457 m (1,500 feet) over the past few decades along some stretches of the Alaskan coast (Alaska Regional Assessment Group, 1999). Several villages have been sufficiently threatened by increased erosion and inundation that they must be protected or relocated (Alaska Regional Assessment Group, 1999). At Barrow, Alaska, coastal erosion has been measured at the rate of 1-2.5 m/yr since 1948 (ACIA, 2005), and it has been causing severe impacts on the community.

Loss of sea ice could cause large-scale changes in marine ecosystems and could threaten populations of marine mammals, such as polar bears and ringed seals that depend on the ice. Ice edges are biologically productive systems where ice algae form the base of the food chain. The ice algae are crucial to arctic cod, which is a pivotal species in the arctic food web. As ice melts, there is concern that there would be loss of prey species of marine mammals, such as arctic cod and amphipods, that are associated with ice edges (MMS, 2004a). Changes in the extent, concentration, and thickness of the sea ice in the Arctic may alter the distribution, geographic ranges, migration patterns, nutritional status, reproductive success, and, ultimately, the abundance of ringed seals and other ice-dependent pinnipeds that rely on the ice platform for pupping, resting, and molting (MMS, 2004a). Reductions in sea ice coverage would adversely affect the availability of pinnipeds as prey for polar bears. More polar bears may stay onshore during the summer (MMS, 2004a). If the arctic climate continues to warm and early spring rains become more widespread, ringed seal lairs might collapse prematurely, exposing ringed seal pups to increased predation by polar bears and arctic foxes, negatively impacting the ringed seal population and, therefore, eventually the polar bear population (MMS, 2004a). Additionally, some birds have life history strategies adapted to sea ice. Impacts to marine mammal, fish, and bird populations may adversely impact Native subsistence harvests.

The loss of sea ice could have some potential effects on bowhead whales. These would include increased noise and disturbance related to increased shipping, increased interactions with commercial fisheries, including noise and disturbance, incidental intake, and gear entanglement; changes in prey species concentrations and distribution; and changes in subsistence-hunting practices.

There are some benefits associated with reduced sea ice. Reductions in sea ice would increase the possibilities for navigation during the open-water season, and there would be greater opportunity for the development of offshore oil and gas resources. With a longer ice-free season, exploratory drilling and construction activities would be less restricted by ice. Vessels would be able to reach facilities for longer periods during the year. Structures would not be subjected as frequently to severe stresses induced by sea ice. On the other hand, any gravel islands used for the placement of an oil production facility could be subject to greater erosion from an increase in wave action.

Changes in permafrost have caused failure of buildings and costly increases in road damage and road maintenance in Alaska (Alaska Regional Assessment Group, 1999). Present costs of thaw-related damage to structures and infrastructure in Alaska have been estimated at $35 million per year. A continued warming of the permafrost is likely to increase the severity of permafrost thaw-related problems. Thawing of any permafrost increases groundwater mobility, reduces soil bearing strength, and increases susceptibility to erosion and landslides. Thawing could disrupt petroleum exploration and production by shortening the availability of time for minimal-impact operations on ice roads and pads.

Ocean ecosystems and fisheries are highly vulnerable to changes in sea temperature and sea-ice conditions (Alaska Regional Assessment Group, 1999). The Bering Sea and Gulf of Alaska have shown marked fluctuations in their physical and ecological characteristics over time. Observed fluctuations have included large-scale shifts in the abundance and distribution of many important fish, invertebrates, and marine mammals. The warming brought about ecosystem shifts that favored herring stocks and enhanced productivity for Pacific cod, skates, flatfish, and non-crustacean invertebrates. The species composition of living things on the ocean floor changed from being crab-dominated to a more diverse mix of starfish, sponges, and other life forms. Many changes appear to show clear association with interdecadal climate variability (Alaska Regional Assessment Group, 1999). If the Arctic continues to warm at the present rate, large changes in the ocean ecosystems and fisheries can be expected, although the precise nature of the changes would be difficult to predict.

Climate change in the region would likely alter the habitat and the diversity, distribution, and abundance of fishes. Several species of Pacific salmon have been observed in the Arctic. Possible shifts in ocean circulation in the future would likely affect the migration routes of some fishes. Some species, such as Pacific salmon, would likely become more widespread and/or abundant, while other species, such as Arctic cod, may become less abundant or modify their distribution. Regional climate change would likely bring additional fishing activity to the Beaufort and Chukchi Seas where commercial operations have been minimal in the past (MMS, 2004a).

Native subsistence livelihoods could be threatened by changes in the ocean ecosystem and sea ice. Settlements may be threatened by sea-ice melt, permafrost loss, and sea-level rise. Traditional hunting locations would likely be altered, and subsistence travel and access may become more difficult. Game patterns may shift, and their seasonal availability may change (MMS, 2004a). The season for transportation by ice roads could be shortened significantly. For subsistence hunters, ice-based seal species have been more difficult to access and harvest (North Slope Borough [NSB], 2005). Continued reductions in sea ice would hinder future hunting activities. Retreat of sea ice would impact some species on which subsistence hunters depend, including bearded seals and walrus (Alaska Regional Assessment Group, 1999). Polar bears would be seriously impacted and may be threatened with extinction (Alaska Regional Assessment Group, 1999). Native residents have utilized ice cellars cut into the thermafrost for harvested fish and game. In several communities, the cellars are melting and becoming unusable. Residents unable to store large quantities of food must hunt more often. This results in more expense, time away from home and cash jobs, and more exposure to dangers of hunting in the harsh arctic environment (NSB, 2005).

Rapid and long-term impacts from climate change would likely disrupt long-standing, traditional hunting and gathering practices that promote health and cultural identity. Because of the limited capacities and choices for adaptation and the ongoing cultural challenges of globalization to indigenous communities, arctic communities would experience significant cultural stresses in addition to major impacts to population, employment, and local infrastructure (MMS, 2004a).

(3) Atlantic Region

The following discussion is based on a report by the National Oceanic and Atmospheric Administration (NOAA) produced as part of the U.S. National Assessment of the Potential Consequences of Climate Variability and Change (Boesch et al., 2000). Global climate models predict a warming of air temperatures in the Atlantic Coast region. The models are less certain about changes in precipitation and freshwater runoff. One model used in the U.S. National Assessment predicts wetter conditions, while another predicts a drying trend. The primary potential effects of climate change in the mid-Atlantic region include sea-level rise, impacts on estuaries, changes in the hydrologic cycle, and changes in fishery resources.

Sea-level rise would result in increased erosion of shorelines and beaches, increased salinity of estuaries and freshwater aquifers, altered tidal ranges in rivers and bays, changes in sediment and nutrient transport, and increased coastal flooding during storms. Barrier islands would tend to be shifted shoreward or breached. Wetlands and their habitats would be shifted or suffer loss. Damage to homes and infrastructure from coastal flooding would have substantial economic impacts. Studies have shown that the economic costs of a 50-cm (18-inch) rise in sea level could be $20 billion to $200 billion nationwide by the year 2100.

Most estuaries in the mid-Atlantic region are already stressed as a result of water pollution and agricultural runoff. Warming of estuaries would affect species distribution. For example, species that are near their southern limits, such as the soft clam *Mya arenaria*, may no longer survive or be prolific in the Chesapeake Bay, while warm temperature species such as penaeid shrimp found in estuaries in the Carolinas may become more common. Due to the combined effects of global sea-level rise and regional land subsidence, the relative rate of rise in the Chesapeake Bay has been about 3.3 mm (0.13 inches) per year over the past 60 years. This would cause inundation of tidal wetlands, shoreline erosion, and loss of islands and other tidewater lands. The rise in water level could also result in intrusions of higher salinity in the estuaries and their tributaries. Possible consequences of this include changes in the ecosystem and increased potential for salinization of ground water.

There is no consensus among scientists about the effect of global climate change on the frequency and severity of hurricanes and tropical storms. There is also uncertainty about the effects on extratropical cyclones (such as the northeasters). An increase in the activity of such storms would exacerbate beach erosion and flooding along the Atlantic coast. An increase in regional precipitation, as is predicted by some models, would result in increased fresh flow into the estuaries, which would raise nutrient levels, making management of the estuaries more difficult. Increased winter-spring discharges may deliver more nutrients and increase the density stratification causing hypoxia. Warmer temperatures may also affect stratification and rates of plankton production and nutrient regeneration.

Poleward shifts in distribution of marine populations can be expected with increasing water temperatures. Species temperature preferences and overall habitat requirements would determine the extent of potential distribution shifts. For some species, the habitat requirements related to spawning and nursery areas can limit adaptation, which could result in loss of populations. Temperature changes may also affect the food web dynamics of the ecosystem. For example, substantial shifts in the distribution of small pelagic fishes such as herring and mackerel off the east coast of the United States can be expected. This would affect the forage base for many piscivorous (fish eating) fishes, marine mammals, and sea birds.

b. Contribution of OCS Activities to Greenhouse Gas Emissions

Estimates were made of the total emissions of CO_2 and CH_4 for all projected activities associated with the proposed 5-year program. Emission estimates for the various activities were largely based on a comprehensive inventory of air emissions from OCS activities in the Gulf of Mexico for the year 2000 (Wilson et al., 2004). Air emissions resulting from the proposed 5-year program were estimated by considering the exploration and development scenarios presented in Tables IV-1 through IV-3. Emissions are given in terms of teragrams (Tg) of CO_2 equivalent, where one Tg is 10^{12} grams (10^6 metric tons). This measure takes into account a global warming potential (GWP) factor, which accounts for the relative effectiveness of a gas to contribute to global warming with respect to the same amount CO_2. In these calculations, CH_4 is given a GWP of 21.

Table IV-5 lists the total calculated emissions of CO_2 and CH_4 from activities associated with the proposed five-year program and compare them with current U.S. greenhouse gas emissions from all sources. The 5-year program emissions were averaged over a 40-year period. The projected CO_2 emissions from the proposed 5-year program are about 0.06-0.12 percent of all current CO_2 emissions in the United States. The 5-year program CH_4 emissions are about 0.43-0.82 percent of the current CH_4 emissions in the United States, which is a significantly higher percentage than that for CO_2. If one combines the CO_2 and CH_4 emissions, the 5-year program emissions are about 0.09-0.18 percent of the current nationwide figures. The estimated global CO_2 emission rate from combustion of fossil fuels for the year 2000 is approximately 24,240 Tg (USEPA, 2005). The U.S. contribution to this total is about 23 percent (USEPA, 2005). The estimated 5-year program CO_2 emissions are about 0.08-0.016 percent of the global CO_2 emissions from fossil fuel combustion.

A number of mitigation strategies could be adopted by operators with the goal to reduce greenhouse gas emissions from OCS oil and gas development activities. Use of more energy-efficient engines, turbines, and boilers would reduce CO_2 emissions. Use of gas instead of diesel fuel to provide power on platforms would significantly reduce emissions. However, many operators already primarily rely on produced gas once production starts. More efficient scheduling of transport of material and personnel could lower service vessel CO_2 emissions by reducing the number of vessel and helicopter trips. Application of optimum power settings on vessels would reduce fuel use and, hence, greenhouse gas emissions.

As noted above, the percentage contribution of CH_4 to the nationwide emissions is significantly greater than that for CO_2. Reductions in CH_4 emissions appear to have the greatest potential in achieving reductions of greenhouse gas emissions from OCS sources. Venting natural gas currently contributes about 59 percent to the total CH_4 emissions in the Gulf of Mexico. Fugitive emissions sources contribute another 19 percent. Flaring excess gas rather than venting it would significantly lower overall greenhouse gas emissions from OCS platforms (Herkhof, 2005), though flaring gas would increase CO_2 emissions. More intensive programs to check for fugitive leaks on platforms would also lower CH_4 emissions. Other possible measures to reduce CH_4 emissions would include use of a lighter color of paint on storage tanks to reduce vapor losses and, in cases where crude oil is transported by tanker, use of vapor balance lines during oil transfer operations.

3. Invasive Species

Nationwide, invasive species are associated with environmental damages and losses totaling over $138 billion annually (Pimentel et al., 2000). Over 50,000 invasive species have been documented to date in the United States. Roughly 42 percent of threatened and endangered species are considered at risk primarily because of invasive species. Effects of invasive species can be devastating on both habitat and native species and may (1) include a decrease in biological diversity of native ecosystems, (2) decrease the quality of important habitats for native fish and invertebrate species, (3) reduce habitats needed by threatened and endangered species, (4) increase direct and indirect competition with aquatic plants and animals, and (5) pose human health risks.

Oil and gas activities may play a part in the introduction of invasive species or may provide substrate and habitat encouraging the establishment of invasive species. Drillships and semisubmersibles are used and relocated throughout the world's oceans. Over time, fouling, encrusting, and boring organisms will attach to these devices. Unintentional introductions may occur when these drilling rigs are relocated to a new region such as the Gulf of Mexico. These same drillships and semisubmersibles may transport and release ballast water containing invasive plankton and larval invertebrates, which may then become established due to the availability of acceptable habitat, plentiful food supply, and lack of predators.

Since 1998, there are at least 16 documented cases of rigs being brought into the Gulf of Mexico from other parts of the world. Some rigs operating in the Gulf of Mexico were constructed or recently modified in Singapore, Taiwan, and Scotland. Newly built rigs undergoing their last year of construction stand in waters of surrounding shipyards. A year is sufficient time for fouling and encrusting organisms to colonize rig surfaces. One large semisubmersible was kept in Mobile Bay for 1 year. Prior to Mobile Bay, it had spent 6 months drilling off the coast of Trinidad.

Oil and gas drilling rigs, platforms, and pipelines provide substrate and habitat for sessile organisms. Invasive mussels, barnacles, and corals are known to use rigs and platforms as attachment sites. Many marine organisms require hard surfaces to use as attachment sites for all or part of their natural history. Jellyfish have a polyp stage that requires hard substrate. Polyps settling on rigs in one location and then transported to another region can asexually reproduce. One polyp can produce up to 300 new jellyfish. Currently in the Gulf of Mexico, oil and gas platforms provide 12.1 square kilometers (km^2) of hard substrate (Louisiana State University, Coastal Marine Institute, ongoing). No-activity-zone natural reefs provide 104.5 km^2 of hard substrate, which could be used for settlement sites.

Above-water platform structures may also encourage the colonization of new habitat by invasive species. Many migratory bird species use the platform structures as stopover spots while crossing the Gulf of Mexico. The cattle egret colonized North America in the last half-century. This is also one of the most common species observed on platforms in the Gulf of Mexico. Use of the platforms as rest stops may have been the catalyst that allowed the cattle egret to expand its range. Ongoing research funded by the MMS is studying the interactions between migrating birds and oil and gas structures off the Louisiana coast.

Gulf of Mexico Region

The edible brown mussel (*Perna perna*) is native to Africa and South America and is similar to the zebra mussel in its habit of fouling hard substrates, including native mollusks. Unlike the zebra mussel, however, it is a marine/estuarine organism and may have been introduced either through the dumping of ballast water or transported attached to the hulls of ocean-going vessels. The brown mussel was discovered on the Texas coast in 1990 at Port Arkansas and, since that time, has spread southward to Veracruz, Mexico, and northeast to the Freeport, Texas, area. Range expansion southward has been more rapid and extensive than northward. This is believed to have been due to the prevailing east to west long-shore surface currents on the Texas coast, and possibly due to temperature effects during the winter seasons.

The Australian spotted jellyfish (*Phyllorhiza punctata*) and the pink jellyfish (*Drymonema dalmatina*), both from Caribbean waters, were found in tremendous concentrations in the Gulf of Mexico in the summer of 2000. They were observed concentrated in the passes between the barrier islands that separate Mississippi Sound and the Gulf of Mexico. This area also has high concentrations of planktonic larvae and eggs of shrimp, crabs, and many important fish species drifting on the currents to inshore nursery areas of the Sound from offshore spawning areas. The results of ongoing MMS-funded research shows that the mass occurrence of these jellyfish happened during a short time period when all jellyfish concentrations were elevated in the Gulf. The high concentration of these jellyfish has not been repeated.

Other invertebrates not native to the area have been found in the Gulf of Mexico, including hydroids (*Cordylophora caspia* and *Garveia franciscana*), sea anemone (*Diadumene lineata*), and polychaete worms (*Hydroides elegans* and *Ficopomatus enigmaticus*). All may cause fouling problems on marine surfaces (Carlton, 1997).

The Atlantic copepod (*Centropages typicus*) was found in Texas in the 1980's and was probably introduced by ballast water. Four invasive barnacle species (Balanus *amphitrite, B. reticulatus, B. trigonus,* and *Tetraclita stalactifera stalactifera*) are now abundant in the Gulf of Mexico. *Sphaeroma walkeri, S. terebrans, Limnoria spp.* and *Ligia exotica* are four species of isopod, (two native to the Indian Ocean). Sphaeroma terebrans is having negative impacts on mangrove development areas (Carlton, 1997).

Wood-boring bivalve mollusks of the genus *Lyrodus* (shipworms) were likely introduced to the Gulf of Mexico from the Indo-Pacific region during the days of wooden-hulled ships. An eastern Atlantic limpet-like snail (*Siphonaria pectinata*) was probably introduced with ballast rocks during the 19th century.

Alaska Region

Although invasive species are a worldwide problem, Alaska is still relatively pristine compared to the rest of the nation (Piorkowski, 2003a). Relatively few aquatic invasive species have been introduced and become established in Alaska compared to other States. This is, in part, due to Alaska's plant and animal transportation laws, geographic isolation, northern climate, small human population, and relatively few concentrated disturbed habitat areas (Fay, 2002). While invasive species impacts, to date, are low, potential threats must be monitored as a significant portion of Alaska's economy, including sport and commercial fishing depends upon the pristine and natural quality of its aquatic ecosystems.

Several aquatic alien species that have the potential to reach Alaskan waters include the Atlantic salmon (*Salmo* salar), the New Zealand mudsnail (*Potamopyrgus antipodarum*), the Chinese mitten crab (Eriocheir *sinensis*), and the European green crab (*Carcinus maenas*) (Piorkowski, 2003a,b; Lassuy, 2003; Seeb et al., 2003). There has been monitoring in the Alaskan areas most prone to invasive species, mainly in Prince William Sound and Kachemak Bay (Homer, Alaska). These monitoring activities include surveys made to detect European green crabs (*Carcinus maenus*), which have yet to establish an Alaska population beyond their current introduced range along the Pacific Northwest (British Columbia, Washington, and Oregon).

Exploratory drilling of Federal leases offshore of Alaska requires bringing rigs and/or vessels to Alaska. Such rigs/vessels may come from the Gulf of Mexico, the West Coast, or foreign waters and may be contaminated with species alien to Alaska. Such species may be attached to the hull structure (e.g., sponges and barnacles), hitch a ride on the vessel (e.g., rats, insects, crustaceans, and mollusks), or be transported via ballast water (e.g., crustaceans and mollusks). Once brought to Alaska, alien species contaminating a rig/vessel may subsequently disperse into Alaska's ecosystems.

Although introduction of invasive species could occur through the import and placement of offshore oil/gas structures, the threat has not been considered significant. The Alaska Aquatic Nuisance Species Management Plan (Fay, 2002) considers activities other than oil/gas structures as major pathways for the introduction of aquatic alien species, including aquaculture; aquarium trade; biological control; boats, ships and aircraft; channels, canals, and locks; live bait; nursery industry; scientific research institutions, schools, and public aquariums; recreational fisheries enhancement; restaurants; and seafood retail and processing. Additionally, a recent recommendation by the MMS Scientific Committee found the introduction of alien species to Alaskan waters through oil and gas activities to be a low-priority issue, based on their risk assessment.

Vessels, including those used by the oil/gas industry, do pose more potential for introducing invasive species than oil/gas structures. For example, Hines and Ruiz (2000) reported finding 13 species of crustaceans and 1 species of fish arriving to Port Valdez in the ballast water of oil tankers voyaging from San Francisco Bay or Long Beach, California. However, the issue of invasive species and ballast water is managed by the USCG under the National Invasive Species Act of 1996. The USCG has promulgated regulations (33 CFR 151) to make compliance with ballast water guidelines mandatory. Therefore, oil-/gas-related vessels are required to abide by these requirements in order to reduce the potential for introduction of invasive species.

Atlantic Region

Exploring for oil and natural gas offshore of Virginia will require bringing drillships or drilling rigs into the area. These vessels would come from the Gulf of Mexico or foreign waters and may be contaminated with species alien to the mid-Atlantic. Such species may be attached to the hull structure (e.g., sponges and barnacles), hitch a ride on the vessel (e.g., rats, insects, crustaceans, and mollusks), or be transported via ballast water (e.g., crustaceans and mollusks). Once brought to Virginia waters, nonnative species may disperse into the mid-Atlantic ecosystems. Since the recognition of this problem nationwide, there have been hundreds of documented accounts in which harmful aquatic species have been introduced and consequently survived in ports, harbors, estuaries and coastal waters (U.S. Environmental Protection Agency [USEPA], 2001b). However, the issue of invasive species and ballast water is managed by the USCG under the National Invasive Species Act of 1996. The USCG has promulgated regulations (33 CFR 151) making compliance with ballast water guidelines mandatory. Therefore, oil-/gas-related vessels are required to abide by these requirements in order to reduce the potential for introducing invasive species.

The invasive plants and animals that now live in and around the Chesapeake Bay include mammals such as the Norway rat (*Rattus norvegicus*), plants such as watermilfoil (*Myriophyllum spicatum*), birds such as the mute swan (*Cygnus olar*), and fish such as the grass carp (*Ctenopharyngodon idella*) (Maryland Sea Grant, 2005). The Asiatic clam (*Corbicula fluminea*), which entered the Bay in ballast water, is, like the zebra mussel, a fouler of power plant pipes. Other species were brought here intentionally. Nutria (*Myocaster coypus*) was introduced to enhance the fur industry, and smallmouth bass (*Micropterus dolmieui*) were imported for sportfishing.

Also invading the Chesapeake is the brackish water clam (*Rangia cuneata*) and, in higher salinity areas, the Japanese shore crab (*Hemigrapsus sanguineus*) and, newly discovered in the southern Bay, the Rapa whelk (*Rapana venosa*), a large, predatory marine snail. In freshwater streams that feed the Bay's rivers, introduced brown trout (*Salmo trutta*) often out-compete the native brook trout. Though more rare, the green crab (*Carcinus maenas*) now ranges as far south as the lower Chesapeake Bay (Maryland Sea Grant, 2005). Lionfish (*Pterois volitans*), first introduced intentionally or unintentionally released from the aquarium trade, are known to cause severe pain, swelling, numbness and occasionally paralysis in humans through stings (National Oceanic and Atmospheric Administration [NOAA], 2004).

The oyster parasites MSX (*Haplosporidium nelsoni*) and Dermo (*Perkinsus marinus*) were inadvertently introduced as exotics to the Chesapeake Bay, perhaps on oysters used for planting (Maryland Sea Grant, 2005). This effect includes not only a decimated oyster fishery with direct economic losses, but also the degradation of the Bay ecosystem because of the oyster's essential role in removing algae from the water.

Nonnative tunicates (*Botryllus schlosseri*, *Didemnum* spp., and *Styela* spp.) attach to docks, pilings, or other hard substrates and cause fouling problems. Other invertebrates not native to the area have been found in the Mid-Atlantic, including hydroids (*Cordylophora caspia* and *Garveia franciscana*), sea anemone (*Diadumene lineata*), a barnacle species (*Balanus amphitrite*), a species of jellyfish (*Blackfordia virginica*), and a polychaete worm (*Ficopomatus enigmaticus*) (MIT Sea Grant, 2003; NISbase, 2003; U.S. Geological Survey [USGS], 2005b). All may cause fouling problems on marine surfaces. Filamentous red alga (*Neosiphonia harveyi*) is a weedy, fouling species associated with boating and aquaculture.

4. Effects of the Physical Environment on Oil and Gas Operations

Exploration, development and production activities on the OCS must be conducted in accordance with an approved exploration or development and production plan. The operator must submit an analysis of seafloor and subsurface geologic and manmade hazards; historic weather patterns and other meteorological conditions; physical oceanography including currents, tides, and sea states of offshore areas; and measures to minimize or mitigate their potential effects.

These and other environmental conditions are taken into consideration during the design, fabrication, transportation, and installation of the platform. Design considerations are based on an assessment of the conditions expected to occur at the installation site over the life of the structure. The design reflects the consideration of various environmental factors that represent the most severe conditions that are anticipated. Specific consideration is given to wave conditions, wind velocities, current velocities, temperature, sea ice and snow conditions, and earthquake information.

a. Geological Hazards

Gulf of Mexico

Geologic hazards are any geologic features or processes that can inhibit the exploration for and development of petroleum resources. The main geohazards on the shelf and slope and their principal results are as follows:

- faults—sediment tectonics, halokinesis (salt dome movement);
- slope stability—slope steepening, slumps, creep, debris flow;
- gassy sediments—strength reduction, hydrates (frozen gas and water), liquefaction;
- fluid and gas expulsion features—strength reduction, liquefaction;
- diapiric structures—salt, mud, hydrates;
- seafloor depressions—blowouts, pockmarks;
- seafloor feature—sediment waves, differential channel fill, brine-low channels, seabed furrows;
- shallow water flow—strength reduction, liquefaction; and
- deep high-velocity currents—megafurrows, seabed erosion.

These geohazards have been discussed in more detail in Section III.A.1 which describes Gulf of Mexico geology.

Water currents can be a problem to structures on the continental shelf and upper slope. Deepwater high-velocity currents may be a major problem to structures such as platforms, bottom assemblies, and pipelines at the base of the Sigsbee Escarpment (1,200-3,300 m) in the Central Gulf of Mexico Planning Area. Recent studies have revealed the presence of large megafurrows at the base of the Sigsbee Escarpment. These large bedforms, 20-30 m wide and as deep as 10 m, occur along the base of the Sigsbee Escarpment and extend to a distance of 20 km south of the escarpment. They are the result of high-velocity bottom currents occurring along the base of the escarpment (Bryant and Liu, 2000).

Alaska

Various geologic hazards may inhibit petroleum exploration and development in the Alaskan OCS planning areas. These hazards can be generally categorized into subsurface hazards, active processes, or tectonic processes. These hazards have been discussed in more detail in Section III.B.1 which describes the geology in Alaska.

Atlantic

Certain geologic features are considered to pose only a low risk to offshore oil and gas operations because they can be managed satisfactorily using proper engineering practices. Several examples of such geologic constraints in the mid-Atlantic include sand waves, stream channels on the seafloor that have become filled over time with sediment, erosion or scour around the base of offshore structures, and surface and near-surface sediments on the shelf and slope containing dissolved gases that can cause foundational problems for structures. These constraints can be effectively mitigated with appropriate engineering practices.

Geologic hazards on the OCS include shallow faulting, shallow gas deposits, hydrated gas, and mass movement of sediments. Shallow faulting within the unconsolidated sediments near the seafloor surface may serve as a conduit for shallow, high-pressure gas that can lead to cratering or liquefaction of foundation sediments. Shallow gas deposits in surficial sediments can cause structural failures of drilling platforms or well blowouts, but such deposits seem to be rare on the mid-Atlantic shelf and slope. Similar risks may be posed by hydrated gas, or clathrates, which are ice-like crystalline structures of water molecules containing gas molecules under pressure. The mass movement of sediment from beneath an offshore platform could create serious foundational problems.

Section III.C.1 includes additional information about potential geohazards in the Mid-Atlantic Planning Area.

b. Physical Oceanography

Gulf of Mexico

As noted previously in the discussion of geohazards, water currents can be a problem to structures on the continental shelf and upper slope. Deepwater high-velocity currents may be a major problem to structures such as platforms, bottom assemblies, and pipelines in certain portions of the Gulf of Mexico. Bryant and Liu (2000) have identified large megafurrows in the Central Gulf of Mexico Planning Area at the base of the Sigsbee Escarpment and Bryant Fan (i.e., in 1,200-3,300 m of water, measuring tens of meters wide and up to 10 m deep, and extending tens of kilometers), which have resulted from high-velocity bottom currents occurring along the base of the escarpment.

Oceanographic currents of greatest concern are those resulting from strong, episodic wind events such as tropical cyclones (especially hurricanes), extratropical cyclones, and cold-air outbreaks. Such wind events can result in extreme waves and cause currents with speeds of 100-150 centimeters per second (cm/s) over the continental shelf. Recent examples for the Texas-Louisiana shelf and upper slope are given in Nowlin et al. (1998). Other researchers (e.g., Molinari and Mayer, 1982; Brooks, 1983, 1984) have measured the effects of such phenomena down to depths of 700 and 980 m, respectively, over the continental slopes in the northwestern and northeastern Gulf. Additional information on wind-generated waves is discussed in the following section dealing with meteorology. Episodic wind events can also cause major currents in the deep waters of the Gulf.

The phenomena of most concern to deepwater operations in the Gulf of Mexico are surface-intensified currents associated with the Loop Current, Loop Current eddies detached from the Loop Current, and other eddies (both anticyclonic and cyclonic). Currents associated with the Loop Current and Loop Current eddies extend into the water column to as deep as 1,000 m and, in the case of the Loop Current itself, perhaps to depths approaching the sill depth of the Yucatan Channel (2,000 m). These currents can have surface speeds of 150-200 cm/s or more; speeds of 10 cm/s are not uncommon at 500 m (Cooper et al., 1990).

During the mid-1980's, deep currents were observed to exist in the Gulf from depths near 1,000 m to the bottom. Hamilton (1990) described such currents at three locations (i.e., in deepwater portions of the eastern, central, and western Gulf). These deep currents were seen to be essentially depth-independent, though some energy intensification was noted with increasing depth near the seafloor. Deep circulation patterns distinct from those associated with the surface-intensified eddies have also been seen in numerical model studies by Hurlbert and Thompson (1982) and Inoue and Welsh (1997). Public and proprietary measurements have indicated such barotropic currents have maximum speeds from near 40 to 100 cm/s. This class of barotropic currents, with possible bottom intensification, is of high interest to offshore operators attempting oil production in water depths of 1,000 m and greater; measurements of these oceanographic features are ongoing in the Western and Central Gulf of Mexico Planning Areas by MMS and offshore operators.

Several deepwater oil and gas operators have observed very high-speed, subsurface-intensified currents lasting as long as a day at locations over the upper continental slopes (i.e., water depths of 700 m or less). Such currents may have vertical extents of less than 100 m, and they generally occur within the depth range of 100-300 m. Maximum speeds exceeding 150 cm/s have been reported.

Meteorological data from NOAA's National Data Buoy Center have been used to compute significant wave height and wave period in the Gulf of Mexico. Maximum monthly significant wave heights in deep water range from 2.9 to 10.7 m. Maxima are associated with the energetic, episodic wind events such as hurricanes, which occur between June and November, or cyclogenesis events, which occur mainly between November and May (Nowlin et al., 1998).

Engineering concerns are integrated into facility design to address the potential problems associated with the unique physical oceanographic conditions of the Gulf of Mexico. For example, as development activity moves into deeper water and alternate production systems are considered, anchoring and seafloor production components for floating systems must be designed to withstand the effects of high-velocity bottom currents in those areas of the Gulf where they may occur. For conventional and alternate production systems alike, episodic wind and surface events must be considered in the design of various components for platforms and deepwater development systems.

Alaska

Ocean currents, tides, waves, and storm surges can affect offshore operations on the Alaska OCS. Ocean currents produce a steady force against vessels and structures. Currents generally do not threaten the physical integrity of production equipment or structures unless the currents push large quantities of sea ice. All offshore structures are designed to withstand forces greater than the maximum measured currents, as well as sea ice. Tides with high range, like those in Cook Inlet, may disrupt support vessel traffic during periods of low water. Waves and storm surges may also disrupt vessel traffic associated with offshore activities. Storms may require various activities to be halted, including personnel transfer and offloading of oil from platforms to tankers. Extreme weather and ocean conditions may occur off Alaska, particularly in the Pacific Margin. Winter storms frequently have sea waves greater than 16 m. Freezing spray on vessels can affect their buoyancy and stability, resulting in ship sinkage.

Sea ice is another oceanographic factor that affects offshore development of OCS reserves in the Arctic Subregion of Alaska. Moving ice floes, sheets, pressure ridges, and ice ride-up can exert strong lateral pressure on development structures. The force that ice exerts on structures depends on the strength, size, and shape of the ice, and the magnitude of the force moving the ice. Sea-ice events such as ice gouging, strudel scour, and ice ride-up can cause hazardous conditions and damage to structures within a project area. Permanent drilling structures in the landfast and pack-ice zones have to resist the forces generated by first-year and multiyear ice. Northstar, an artificial gravel island, was constructed with protective concrete matting and a berm to break up ice before it contacts the island. Drilling units constructed of heavy steel or concrete that rest on the bottom and floating vessels strengthened to withstand ice could also be used in some situations. Platform designs developed for arctic production must resist seawater, ice, and freeze-thaw cycles.

Pipeline placement in shallow arctic waters requires special consideration be given to strudel scour and ice gouging, which can disturb the seafloor. Ice gouging is an environmental hazard for underwater structures on the Arctic Alaska OCS (COE, 1999). Ice gouging is caused by grounded ice keels within pressure ridges and icebergs moving in response to wind and currents (Palmer et al., 1990). Weeks et al. (1983) observed gouges as deep as 2.6 m below the seafloor in 38-m water depths. Strudel scour occurs when river water floods over sea ice, flows through holes or cracks in the ice, and erodes the seafloor. Strudel scour can create deeper depressions in the seafloor than ice gouging (INTEC, 1999). Subsea pipelines in areas where these ice events occur must be buried to sufficient depths to prevent exposure of the pipeline to an ice event, and require routing of the pipeline to create minimal exposure to ice events.

Sea-ice forecasting and ice observations are used to produce maps showing the various ice types, ages, concentrations, and directions of movement. These forecasts may allow time for the well to be shut in safely if weather and ice conditions threaten operations. Ice breakers and icebreaking supply boats can, in some circumstances, perform ice management tasks to minimize hazards from sea ice during routine operations.

Atlantic

Ocean currents and waves could have effects on offshore oil and gas structures in the Mid Atlantic similar to the effects described previously for the Gulf of Mexico. Between Cape Hatteras and Nantucket Shoals, an elongated cyclonic gyre of slope water is generated by the stress of the northward flowing Gulf Stream and the southwest flow of coastal water. This slope water gyre is present during approximately 85 percent of the year, and surface currents on the western side of the gyre move to the southeast at an average of about 10 cm/s. Section III.C.3 includes information about bottom currents on the mid-Atlantic OCS.

In the eastern portion of the Mid-Atlantic Planning Area, at depths greater than 200 m, air-sea interaction provides the primary source of energy for waves that affect the entire area westward to the coast. Wave heights under typical fair-weather conditions are in the range of 0.6-0.9 m nearshore and 0.9-1.8 m further offshore.

c. Meteorology

Gulf of Mexico

Storms and associated high winds and waves are the primary meteorological conditions that affect offshore operations in the Gulf of Mexico. In addition to the concerns noted over currents, storms (e.g., hurricanes, cyclones, etc.) also produce surface waves that contain considerable energy. Significant wave height represents one measure of this energy potential. For example, Tracy and Cialone (1996), presenting meteorological data from Hurricane Opal (an intense category 4 hurricane in October 1995), cited maximum significant wave heights of 10 and 8 m at sites in deep and shallow water, respectively, in the Gulf. Hurricane Andrew generated significant surface waves of 4 to greater than 6 m over both the deep water and the Texas-Louisiana shelf (Stone et al., 1993; Breaker et al., 1994).

The MMS works to reduce potential hurricane-associated risks to workers, structures, and the environment. When a hurricane threatens offshore activities, Notice to Lessees (NTL) 2004-G14 (Hurricane and Tropical Storm Evacuation and Production Curtailment Statistics) and its earlier versions require operators to notify MMS of employee evacuations, production curtailment, and resumption. This information is shared with the USCG who would respond to any rescue calls or oil spills. In advance of Hurricane Ivan (September 16, 2004), operators reported to MMS that 575 platforms (75% of manned platforms in the Gulf of Mexico) and 69 operating rigs (59% of operating rigs in the Gulf of Mexico) had been evacuated prior to the arrival of the hurricane. The storm track of Hurricane Ivan passed through many MMS leases before making landfall at Gulf Shores, Alabama. Three NTL's were issued immediately after Hurricane Ivan to ensure that structures and pipelines remained safe and retained integrity, and pollution was minimized following the hurricane.

The NTL concerning damage caused by Hurricane Ivan (NTL 2004-G18) specified three levels of inspection for platforms and structures. Operators must perform a Level I survey (above-water visual inspection) on those platforms that were exposed to hurricane force winds (74 miles per hour [mph] or greater). A Level II survey (general underwater visual inspection by divers or a remotely operated vehicle) must be performed if the platform is located within 35 miles of the hurricane's eye center storm track or when the Level I survey indicates that underwater damage may have occurred. When a Level II survey detects significant structural damage, a Level III survey (underwater visual inspection of areas of known or suspected damage) must be performed. For those platforms where the inspection indicated damage, restrictions on activities were listed in the NTL. This same NTL also specified inspections of above-water risers and underwater tie-ins, risers, catenary risers, and a plan of corrective action for OCS pipelines. The NTL included maps to illustrate the required level of inspection by location relative to the hurricane track.

Another NTL (2004-G19) described how inspections and findings should be reported to MMS. Because of the extensive pipeline damage discovered, MMS prepared NTL 2004-G20 to further detail the necessary pipeline inspections according to water depth.

In addition to hurricanes, winter cyclones develop over the Gulf of Mexico approximately ten times each year, in a process called cyclogenesis (G.A. Johnson et al., 1984; Hsu, 1988). Significant wave heights associated with these cyclones have been measured at greater than 9 m, comparable to a Category-1 hurricane (Shumann et al., 1995).

Tropical conditions normally prevail over the Gulf from May or June until October or November. The nominal hurricane season is June 1 through November 30. From October or November until March or April, the Gulf experiences intrusions of cold, dry continental air masses. These result in the formation of extratropical cyclones and cold-air outbreaks, both of which can cause highly energetic surface currents. On average, about 10 to 12 extratropical cyclones are formed over the northern Gulf per year; the number of frontal passages varies from 1 to 2 per month in summer to over 10 per month in winter.

Energetic events, which produce the larger waves, are of great concern in the design of offshore structures. Using the Cardone et al. (1976) wave hindcast model validated by Ward et al. (1978), Haring and Heideman (1978) estimated rare wave heights associated with 22 severe hurricanes occurring in the Gulf of Mexico between 1900 and 1977. They found the model results varied little between the three sectors studied off the coasts of south Texas, east Texas-west Louisiana, and east Louisiana-Mississippi-Alabama. They found 100-year significant wave heights of 12-13 m in water depths of 70-700 m, with wave heights of 11-12 m in shallower water. Maximum 100-year wave heights were estimated to be 20-22 m.

Alaska

Storms and associated high winds, ice, snow, fog, and extreme cold are the primary meteorological conditions that affect offshore operations in the Alaska planning areas. Extreme weather and ocean conditions may occur off Alaska, particularly across the Pacific Margin. In the Gulf of Alaska, a deep low-pressure system can bring winds of devastating magnitude (> 25 meters per second [m/s]), although average wind speed is 8-11 m/s from October through February (Wilson and Overland, 1986). Winter storms frequently have sea waves greater than 16 m. Freezing spray on vessels can affect their buoyancy and stability, jeopardizing crew safety and, in extreme circumstances, causing the vessel to sink.

Storms, particularly those with high winds, interfere with the movement and installation of drilling rigs and can disrupt communication, surface and air support vessels, and evacuation traffic. Rough seas may directly damage equipment and disrupt boat traffic.

Fog, rain or snow often restricts visibility in the coastal regions of Alaska. Lowered visibility increases the danger of collisions with both offshore and onshore structures, and may curtail support vessel traffic. The Cook Inlet and Gulf of Alaska Planning Areas have high precipitation rates along the coast, with the maximum mean monthly precipitation (8-10 cm/month) during December, January, and February (Wilson and Overland, 1986). Fog occurs over the area during every month of the year, but is most prevalent in the summer and early winter months (Grubbs and McCollum, 1968).

Extreme cold (-51 ^{o}C) in arctic locations with additional cold from wind-chill (equivalent of -73 ^{o}C) may affect equipment and personnel performance. Below freezing temperatures are experienced during more than 80 percent of the year and have been recorded during every calendar month (COE, 1999). The lack of natural wind barriers in the Alaskan Arctic results in unrestricted winds, at an annual average of 21.3 km per hour near the Northstar development (COE, 1999). Gusting winds are highest and most frequent between September and November (COE, 1999). Inupiat residents have relayed many accounts of their experiences with extreme storms. Weather is described as unpredictable and constantly changing. With little warning, sudden and extreme storms can occur in the Alaskan Beaufort Sea (J. Ningeak in, MMS, 1990c).

Analysis of historical weather patterns and meteorological conditions are important in the design of platforms and equipment used in the Alaskan OCS Region. Design is set to withstand events expected to occur within a 100-year timeframe. Monitoring of weather conditions usually provides ample warning to offshore operators and service vessel operators of approaching dangerous conditions.

Atlantic

Hurricanes and extratropical storms, or nor'easters, affect the mid-Atlantic region. Hurricanes are tropical cyclones with wind speeds of at least 74 mph. Hurricane season on the east coast is from June through October, and most hurricanes affecting the mid-Atlantic States move north or northeastward. Hurricanes are classified into five categories based on wind speed. Category-3, 4, and 5 hurricanes, with winds exceeding 110 mph, are considered major. Between 1851 and 2004, 12 hurricanes hit the Virginia coast; only one was a major hurricane (National Hurricane Center, 2006).

Nor'easters occur more frequently than hurricanes but have lower wind and wave heights. However, nor'easters generally move slower and cover a much larger area than hurricanes. Historically, nor'easters have been most common between October and April and least common from June to August.

d. Ordnance Hazards

Gulf of Mexico

Obsolete munitions as well as toxic waste and possibly radioactive materials have been dumped into several sites in the Gulf of Mexico. This type of dumping was prohibited after 1970, but these materials may remain active for many years, and they still pose a definite hazard to oil and gas exploration and development in those areas. Live munitions are still dropped in specific areas of the Gulf during military live-fire exercises, and occasionally when emergencies force aircraft in trouble to jettison their load of live munitions. Shallow geohazard surveys are required in areas where these types of materials may be present. If such materials are discovered, special precautions must be taken.

Alaska

There are no known ordnance hazards located in the OCS off of Alaska.

Atlantic

The USDOD has, in the past, disposed of weapons and ordnance offshore the east coast. Prior to 1972, the U.S. Army had disposed of nerve and mustard agents, chemical-filled bombs, land mines, rockets, and more than 500 tons of radioactive waste—either overboard or packed into the holds of scuttled vessels—at 26 or more sites off the coasts of 11 States, including Maryland and Virginia (Bull, 2005). The Army Chemical Materials Agency at Aberdeen Proving Ground in Maryland is the best source of information on the locations of such disposal areas.

After 1972, Title I of the Marine Protection, Research, and Sanctuaries Act (i.e., the Ocean Dumping Act) prohibited all unpermitted ocean dumping in any ocean waters under U.S. jurisdiction by any U.S. vessel, or by any vessel sailing from a U.S. port. The Act now bans any dumping of radiological, chemical, and biological warfare agents, any high-level radioactive waste, and medical wastes. Permits for dumping other materials can be issued by the USEPA (or the COE for dredge material) after due process. The USEPA also designates sites for ocean dumping (Congressional Research Service, undated).

B. Environmental Impacts of Alternative 1—Proposed Action

1. Scenario

The analyses of environmental impacts that follow are based on a schedule of sales associated with the proposed action (Alternative 1) and four alternatives to the proposed action. The analyses use hypothetical scenarios of expected oil and gas exploration, development, transportation, and decommissioning activities and associated accidental events that could lead to impacts on environmental resources. At this preliminary stage of the 2007-2012 Outer Continental Shelf (OCS) Oil and Gas Leasing Program, we do not know with any degree of certainty the amount and specific locations of leasing activity that will take place within individual OCS planning areas during the 5-year period under consideration. Nor do we know the details of individual exploration, development, pipeline or decommissioning activities that will result from the lease sales. Tables IV-1 through IV-3 show the estimated amounts of OCS and associated support activities that are likely to occur as a result of the 2007-2012 OCS Program (proposed action). This information is a reasonable estimate for use in the analyses that follow.

The analyses in this programmatic environmental Impact statement (EIS) adopt a broad regional perspective. More detailed and geographically focused National Environmental Policy Act (NEPA) analyses will be done as the 5-year program progresses from the planning to the leasing to the exploration and development stages. While this EIS considers environmental impacts at a national and regional scale, the lease sale EIS's that follow will focus on an individual planning area. As exploration and development occur after a lease sale, NEPA analyses will focus on the immediate area around a well, pipeline, or platform and its associated support and transportation infrastructure.

a. Basic Assumptions

The environmental analyses in this document evaluate the following potential impact producing activities and events that could occur as a result of oil and gas activities associated with the proposed action.

- oil spills;
- air emissions from drilling, transportation, oil spills and other sources;
- discharges of produced water, wastes and drilling materials;
- bottom disturbances from platform and pipeline emplacements and from anchors;
- employment income and population changes;
- noise effects from seismic, operational and decommissioning activities;
- explosive removal of retired structures; and
- construction of new onshore infrastructure.

The analyses assume the implementation of all mitigation measures required by statute, regulation and/or lease stipulation that have applied in past lease sales to prevent or mitigate impacts from activities and events listed above. Appendices C and D describe the applicable stipulation, statutes, and regulations.

b. Exploration and Development Assumptions

As discussed above, hypothetical scenarios of exploration and development activities were developed to provide a framework for the impact analysis. The estimates of offshore and onshore infrastructure required to support exploration and development of the hydrocarbon resources are based on existing conditions for each region.

(1) Gulf of Mexico Region

Offshore leasing and development has been occurring in the Gulf of Mexico for over 50 years. The predictable patterns of activity that have become established there were used to estimate future activity. In keeping with the regional programmatic perspective of this EIS, the scenario information is presented for the entire Gulf of Mexico OCS Region, and not for individual planning areas (Table IV-1). In some analyses in which the resource is located preferentially in certain areas of the Gulf, planning-area specific information will be used based on the assumption, derived from historical patterns, that 70-80 percent of the activity will occur in the Central Gulf of Mexico Planning Area and that 20-30 percent will occur in the Western Gulf of Mexico of Mexico Planning Area.

In addition, based on leasing and development trends in the Gulf of Mexico during the past few decades, we assume that 7 percent of all the activity listed in Table IV-1 will occur in deepwater areas of the Gulf (defined as 1,000 feet or deeper) and 25 percent will occur in shallower water depths. Furthermore, we assume that 10 percent of the leasing, exploration, and development activities will occur in ultra-deepwater areas (defined as greater than 5,000 feet) during the proposed action.

Because an extensive onshore infrastructure to support offshore operations has been developed in the Gulf of Mexico during the past 50 or so years, we assume that most of the shore-based service activities will occur at existing facilities.

(2) Alaska Region

There is one production site, Northstar, in Alaskan State waters that is producing from a reservoir that extends into Federal jurisdiction; however, to date, no development activity has occurred from a structure on the OCS. In previous documents, scenarios based on subjective geologic assessments resulted in modeled economically recoverable resource volumes and exploration and development activities that far exceeded the amount of activity that has actually occurred. Other factors, including permitting difficulties and global competition for industry investments, were not factored into the economic model or the scenario forecast model. This EIS uses a more realistic set of assumptions resulting in smaller amounts of activity on the Alaskan OCS as a result of this 5-year program.

Table IV-2 presents the Alaska exploration and development scenario. The proposed action for the Arctic Subregion includes only the Chukchi Sea and Beaufort Sea Planning Areas. However, we cannot predict how much of the activity indicated for the Arctic Subregion applies to either planning area. The Chukchi Sea is thought to have a higher resource potential, but logistics and operating conditions are much more difficult. The Beaufort Sea area is closer to existing oil and gas infrastructure on the North Slope, but offshore operations are more costly and controversial than onshore operations. If production does occur in the Chukchi area, it will be, by necessity, from a large oil field because of the large minimum-size reservoir required to justify development there. Costs are less in the Beaufort area, so smaller reservoirs are more economic there compared to the Chukchi area. Table IV-2 also shows the scenario for the Bering Sea and South Alaska Subregions. The proposed action for the Bering Sea Subregion includes only the North Aleutian Basin Planning Area, and the South Alaska Subregion includes only the Cook Inlet Planning Area.

We assume that new onshore facilities will be constructed to support development and then expanded to include waste and processing infrastructure for production operations. These facilities will be co-located with pipeline landfalls and other transportation facilities (docks and airstrips). Coastal barge traffic will occur to support and supply service bases.

(3) Atlantic Region

The proposed 5-year program includes one lease sale in the Mid-Atlantic Planning Area offshore Virginia. The scenario developed for the Atlantic lease sale is based on the assumption that the area under consideration for leasing is actually leased and then developed (Table IV-3). These events will require that the existing moratorium on leasing in the Atlantic Region be lifted prior to the lease sale. The MMS has not offered the Atlantic area for leasing since the mid-1980's. Because of the minimal amount of offshore activity that has occurred there, the scenario is based on limited geological and geophysical information, and not on actual exploration and development data.

New onshore facilities to support offshore operations would include a service base, processing facility, and pipecoating yard in Virginia. These facilities would be located at existing industrial sites in the Norfolk area. Vessels and helicopters servicing offshore facilities would operate out of the same area. Offshore platforms would be constructed outside the region, probably in the Gulf of Mexico.

c. Transportation and Other Assumptions

The mode of transport of oil and gas from offshore projects to various processing and market destinations cannot be determined until the amount of recoverable reserves is known and judgments are made as to what is environmentally preferable and technically and economically feasible. This EIS considers the assumptions listed below, however, as a reasonable scenario about oil and gas transportation to shore and whether production would be transported by tanker or pipeline to markets inside or outside of Alaska. In developing these assumptions, we reviewed the current and proposed transportation networks to demand areas.

Assumptions about the use of pipelines, barges, and/or tankers to transport OCS oil and gas to shore take into consideration technological and environmental constraints and economic issues. Although pipelines are generally preferred, in some instances where economic and other considerations do not justify their construction, the use of tankers or barges is assumed.

(1) Gulf of Mexico Region:

- Approximately 90 percent of the oil will be transported to shore by the extension and expansion of the existing pipeline system in the Central and Western Gulf Planning Areas.
- Approximately 10 percent of the oil will be transported via shuttle tanker to shore from deepwater and ultra-deepwater areas; only 1 percent of the oil will be transported to shore by barge.
- Gas would be transported to shore by pipeline through the extension and expansion of the existing pipeline system.

(2) Alaska Region

- Oil from the Arctic areas would be transported by new subsea and overland pipelines to the Trans-Alaska Pipeline System (TAPS). The TAPS would carry the oil south to the marine terminal in Valdez where it would be loaded on tankers and shipped primarily to west coast ports.
- The lifting of the export ban on Alaskan crude oil has led to some shipments to East Asia, but the majority of oil transported from the North Slope will be sent to the U.S. West Coast.
- In the Arctic, oil development will occur before gas because TAPS is an established oil transportation system. Associated natural gas recovered with oil production will be reinjected to maximize oil recovery or used for fuel by facilities. The reinjected gas could eventually be recovered when a new gas export system is constructed from the North Slope (2015 at the earliest).
- Oil from the Cook Inlet Planning Area would be transported from offshore production platforms to shore using new subsea pipelines. Onshore common-carrier pipeline systems would deliver oil and gas to existing local refineries and the transmission pipeline grid. The oil and gas products would be marketed and consumed in Alaska.
- Natural gas production from the North Aleutian Basin area will be converted to Liquefied Natural Gas (LNG) and then transported to the U.S. west coast. A new LNG facility will be constructed on the Alaska Peninsula.

(3) Atlantic Region

- Natural gas would be transported to shore by a single subsea pipeline coming ashore in the Norfolk area.
- The small amount of oil potentially produced as a result of the proposed action would not justify the construction of an oil pipeline. Liquid hydrocarbons, including oil and gas condensate, will be transported to shore by either barge or tanker.

d. Oil-Spill Assumptions

This section presents assumptions about the occurrence and location of large and small oil spills associated with exploration and development that could be expected to occur as a result of the 2007-2012 Program. The previous EIS for the 2002-2007 Program (MMS, 2002c) includes descriptions of the methodology that was used to develop these assumptions. The reader is referred to this document and others referenced therein for more information on this matter.

(1) Large Oil Spills

To provide a framework for the impact analysis of oil spills, the EIS includes assumptions about the chance of one or more oil spills of 1,000 bbl or greater occurring. Since the accidental discharge of oil can occur during almost any stage of exploration, development, or production, we use spill rates based on historical accidents to estimate the mean number of spills assumed to occur.

Table IV-4 presents the estimated number of large oil spills assumed to occur as a result of the production and transportation of oil from the planning areas. The source and number of assumed spills were based on the volume of anticipated oil production, the assumed mode of transportation (pipeline and/or tanker), and the spill rates for large spills. It is also assumed that these spills would occur with uniform frequency over the life of the proposed action.

Assumptions regarding the location of spills are based on the source of the spill, the transportation and market assumptions, location of existing infrastructure, and the location of the resources being analyzed. Platform spills were assumed to occur in the areas proposed for consideration for lease. Pipeline spills were assumed to occur between the area proposed for lease consideration and the existing infrastructure. Tanker and barge spills were assumed to occur along the tanker and barge routes. Additional assumptions concerning oil spills may be stated by the analyst within the impact analysis of the specific resource being evaluated.

Spills from tankers carrying oil produced in the Beaufort and Chukchi Sea Planning Areas are assumed to occur outside of those planning areas. Oil produced in the Beaufort and Chukchi Sea Planning Areas would be transported by the TAPS to the Valdez terminal facilities and then transported by tanker to west coast ports. Tanker spills could occur along these tanker routes.

The size of an oil spill can vary greatly depending on the amount of oil released over a period of time as a result of a single accidental event. For purposes of analysis, hypothetical spill sizes were developed using the OCS and U.S. tanker spill databases and estimates from actual development plans. The sizes of the assumed spills are approximately equal to the mean of the historical spills for each spill type (platform, pipeline, tanker, or barge). The assumed spill sizes are: platforms—1,500 bbl; pipeline—4,600 bbl; tankers—5,300 bbl for the Gulf of Mexico and 7,800 bbl for tankers carrying Alaska OCS oil.

(2) Small Oil Spills

For purposes of analysis, small spills are defined as spills greater than 1 bbl and less than 1,000 bbl, and are usually the result of transferring or lightering operations, pipeline leaks or breaks, and platform mishaps. The number of small spills that could occur as a result of the proposed action in all the planning areas (Table IV-4) was estimated using data on historical spills associated with oil production in the Pacific and Gulf of Mexico Regions. Similar estimates are not available for the Alaska and Atlantic areas because there has been no oil production on the OCS in these areas to use as a basis to calculate small spill rates. Small spill estimates were generated for Alaska and the Atlantic OCS using historic OCS spill rates as a proxy for otherwise unidentified rates. Small spills are further subdivided into two categories: spills greater than 1 bbl and less than 50 bbl, and spills greater than or equal to 50 bbl and less than 1,000 bbl. Smaller spills usually occur near ports, and often the spill effects are only short-term. Seventy-six percent (76%) of these smaller spills are less than 10 bbl. These spills, while more numerous, are more easily contained or cleaned up and usually are of limited damage potential.

2. Gulf of Mexico Region

a. Air Quality

Air Emissions: In the Gulf of Mexico west of 87.5° W. longitude, Outer Continental Shelf (OCS) air emissions are regulated by MMS in 30 CFR 250.302-304. MMS reviews projected air emissions information from an operator submitting a plan for exploration or development activities. If the projected annual emissions exceed a certain threshold, which is determined by distance from shore, the operator needs to perform a modeling analysis to assess air quality impacts to onshore areas. If the modeled concentrations exceed defined significance levels in an attainment area, which is an area that meets the national ambient air quality standards (NAAQS), best available control technology would be required on the facility. If the affected area is classified nonattainment, further emission reductions or offsets may be required. Projected contributions to onshore pollutant concentrations are also subject to the same limits that the U.S. Environmental Protection Agency (USEPA) applies to the onshore areas under their Prevention of Significant Deterioration (PSD) program.

Facilities located east of 87.5° W. longitude would be under the USEPA jurisdiction, which regulates air emissions as prescribed in 40 CFR Part 55. For facilities located within 25 miles of a State's seaward boundary, the regulations are the same as would be applicable if the emission source were located in the corresponding onshore area and would include State and local requirements for emission controls, emission limitations, offsets, permitting, monitoring, testing, and monitoring. For facilities located beyond 25 miles of a State's seaward boundary, the basic Federal air quality regulations apply, which include the USEPA emission standards for new sources and the PSD regulations. The USEPA has established NAAQS for nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter less than 10 microns in diameter (PM_{10}), fine particulates less than 2.5 microns in diameter ($PM_{2.5}$), carbon monoxide (CO), lead (Pb), and ozone (O_3) because of their potential adverse effects on human health and welfare. The health and environmental effects of air pollutants have been summarized by the USEPA (USEPA 1999, 1998a, 1997). Ambient levels of NO_2, SO_2, PM_{10}, and O_3 can contribute to respiratory illnesses, especially in persons with asthma and the elderly, and can also aggravate heart disease.

Ozone Formation: Ozone in the atmosphere is formed by photochemical reactions involving primarily nitrogen oxide (NO_x) and volatile organic compounds (VOC). It is formed most readily in the summer season, particular with high temperatures and limited mixing in the lower atmosphere. Ozone can irritate the respiratory system, reduce lung function, and aggravate asthma. Repeated exposure to O_3 pollution for several months may cause permanent lung damage. Children, adults who are active outdoors, and people with respiratory problems are the most at risk from O_3. High levels of O_3 are also accompanied by a mix of organic radicals, which also causes adverse health effects. Ozone interferes with the ability of plants to produce and store food, which makes them more susceptible to disease, insects, other pollutants, and harsh weather. It may also cause damage to the leaves of trees and other plants, thereby affecting the health and appearance of vegetation in cities, national parks, and recreation areas. Ozone may reduce crop and forest yields and may make plants more vulnerable to disease, pests, and harsh weather.

Acid Deposition and Visibility: Gaseous pollutants undergo various chemical reactions in the atmosphere to form small particles, which remain airborne for extended periods of time. NO_x compounds react with ammonia and moisture to form ammonium nitrate particles, which contribute to $PM_{2.5}$ concentrations. SO_2 combines with moisture to form tiny sulfate particles, which may also contribute to adverse health effects. NO_x and SO_2 combine with moisture in the atmosphere to form acidic aerosols, which eventually return to the ground in the form of acid precipitation. The deposition often takes place hundreds of miles from the source. Acid rain can damage forests and crops, change the makeup of soil, and in some cases, may make lakes and streams acidic and unsuitable for fish. Deposition of nitrogen from NO_x emissions also contributes to nitrogen load in water bodies, especially estuaries. Acid rain as well as ambient SO_2 accelerates the decay of building materials and paints, including irreplaceable monuments, statues, sculptures, and other cultural resources. Particulate matter, including sulfate and nitrate particles and aerosols that form part of photochemical smog, significantly reduce atmospheric visibility. Atmospheric pollutants adversely affect visibility in many of the nation's national parks and monuments.

The most important source of visibility degradation is from $PM_{2.5}$ in the 1- to 2-micron size range. These particles are directly emitted into the atmosphere through fuel burning. However, other sources arise through chemical transformation of NO_2, SO_2, and VOC into nitrates, sulfates, and carbonaceous particles. Existing visibility in the eastern United States, including the Gulf States, is impaired due to $PM_{2.5}$ containing primarily sulfates and carbonaceous material. High humidity is an important factor in visibility impairment in the Gulf coastal areas. The absorption of water by the particulate matter makes them grow to a size that enhances their ability to scatter light, and hence aggravates visibility reduction.

A study of visibility from platforms off Louisiana revealed that significant reductions in Louisiana coastal and offshore visibility are almost entirely due to transient occurrences of fog (Hsu and Blanchard, 2005). Episodes of haze are short-lived and affect visibility much less. Offshore haze can result from plume drift generated from coastal sources.

Routine Operations

Impacts from Air Emissions: Air emissions from OCS oil and gas development arise from production platforms, drilling activities, construction, support vessels, and helicopters. A comprehensive inventory of air emissions from OCS activities in the Gulf of Mexico was constructed for the year 2000 (Wilson et al., 2004). The inventory includes NO_x, sulfur oxides (SO_x), PM_{10}, $PM_{2.5}$, CO, and VOC. There are no significant emissions of Pb from OCS activities, so this pollutant is not discussed here further. The inventory showed that the largest source of NO_x emissions is from platforms, while the second largest source is from support vessels. The largest source of NO_x emissions on platforms is natural gas reciprocating engines. The largest source of sulfur oxides is from support vessels. Other significant sources of SO_x are exploration/delineation well drilling, production platforms, and construction activities. The primary SO_x emission sources on platforms are amine units (for gas sweetening) and diesel engines used in drilling. The largest sources of PM_{10} or $PM_{2.5}$ emissions are support vessels, production platform, and drilling activities. The VOC emissions primarily arise from fugitive sources and from venting of gas on platforms. Fugitive emissions arise from oil/gas processing, pump and compressor seals, valves, connectors, and storage tanks. The CO emissions occur primarily from natural gas reciprocating engines on platforms.

Air emissions resulting from the proposed action were estimated by considering the exploration and development scenario for the Gulf of Mexico Region presented in Table IV-1. The $PM_{2.5}$ emission figures are not included in the table since they were not available for all source categories. However, the $PM_{2.5}$ emissions would be the same or slightly lower than the PM_{10} figures since most of the latter consist of particulate matter less than 2.5 microns in diameter. Platform emissions were estimated by taking the ratio of the number of proposed platforms and the number of facilities with emissions in the year 2000 inventory and multiplying this value times the total year 2000 platform emissions. This was a reasonable assumption since the average yearly oil and gas production per platform over the lifetime of the projected activities was close to the average oil and gas production per platform for the year 2000. Emissions from exploratory/delineation drilling, platform installation/removal, pipeline installation, and support vessels were calculated from emission factors for the various activities that were developed from the year 2000 emission inventory. Projected emissions associated with the proposed activities are presented in Table IV-6. The range of values given reflects the low and the high end of the exploration and development scenario. The emissions from platform production, support vessels, helicopters, tankers, and survey vessels are averaged over the projected 40-year duration of activities. The emissions from exploratory drilling and pipe-laying activities are averaged over a 10-year period.

The projected emissions from the proposed action would be about 18-19 percent of the Year 2000 emissions for the low-case development scenario and about 27-38 percent of the Year 2000 emissions for the high-case scenario. This does not necessarily imply that the total OCS emissions would increase incrementally by these percentages. Over time, some of the existing platforms are removed, while new ones are installed. The net change in emissions would be ruled by the changes in the overall activity levels. Also, this EIS assumes that 75 percent of the activity from the proposed action will occur in deep and ultradeep water. As old facilities are decommissioned and new facilities are installed during the life of the 2007-2012 Program, there will be a movement of facilities and air and water support traffic farther away from the coast and population centers. For more discussion about this, see the cumulative analysis discussion.

It is estimated that about 10 percent of the crude oil produced in deepwater in the Gulf of Mexico would be transported to shore via tanker, while in shallow waters about 1 percent of production would be transported by barge. The transport of crude oil would result in VOC emissions from loading operations and breathing losses during transit. Volatile organic compound emissions would also occur during unloading and ballasting in port. There would also be emissions of NO_x, SO_2, and PM_{10} from the ships' engines.

Emissions in any given year may be higher or lower depending on the level and type of activity. Exploratory drilling and construction activities would be concentrated early on in the period. After the drilling and construction peaks, emissions would arise primarily from production platforms and support vessels. During the first few years, emissions from the proposed program would be relatively low as the first few exploration wells are drilled. Emissions increase as platforms and pipelines are installed, production wells are drilled, and platforms start producing oil and gas. In the latter half of the 40-year period, there would be a gradual decline in emissions as the overall production rate decreases and some of the platforms are removed. There is considerable amount of uncertainty in these emissions estimates because the actual number of platforms and their oil/gas production rates assumed in the calculations may differ substantially from the projected figures. Emissions from individual platforms would vary significantly. Emissions from deepwater operations would tend to be highest due to the scale of the production operations.

The MMS performed a cumulative air quality modeling analysis of platform emissions in a portion of the Gulf of Mexico in 1992 (MMS, 1997b). The area modeled included most of the coastline of Louisiana and extended eastward to include coastal Mississippi and Alabama. Facility emissions were obtained from the emissions inventory used in the Gulf of Mexico Air Quality Study (MMS, 1995c). The emission values were multiplied by a factor of 1.4 to account for growth. The modeled onshore annual average NO_2 concentrations were generally somewhat greater than 1 microgram per cubic meter ($\mu g/m^3$). The highest values appeared in the Mississippi River Delta region, where a maximum concentration of 6 $\mu g/m^3$ was calculated, which is 6 percent of the national standard for NO_2. The highest predicted annual, maximum 24-hour, and maximum 3-hour average SO_2 concentrations were

1.1, 13, and 98 $\mu g/m^3$, respectively. These values are 1, 4, and 7 percent of the NAAQS for the respective averaging periods. Modeling was not performed for PM_{10} or $PM_{2.5}$ but the concentrations would be lower because of lower emission rates. The projected emissions for the proposed activities would be lower than the emissions used in the modeling, and the impacts would be correspondingly lower. Existing concentrations of NO_2, SO_2, PM_{10}, and $PM_{2.5}$ in the Gulf Coast States are well within the NAAQS, so emissions from the proposed action would not result in any exceedance of the NAAQS.

The highest predicted NO_2 and SO_2 concentrations in the 1992 emissions modeling were well within the maximum allowable PSD Class II increments for those pollutants. Any concentrations resulting from the emissions associated with the proposed action should also be within the PSD Class II increments.

The maximum allowable increases for the annual average NO_2 concentration in the Breton National Wilderness Area, which is a Class I area, is 2.5 $\mu g/m^3$. The highest predicted annual average NO_2 concentration in Breton from the year 1992 emission sources was 3.6 $\mu g/m^3$ (MMS, 1997b). However, it is not possible to determine whether the PSD Class I increment at Breton has actually been exceeded as one needs to consider the cumulative effect of all other emission sources in the area with respect to the baseline year. Also, the emissions effects from the proposed action would be lower because of the lower emission rates. The highest predicted SO_2 concentrations in Breton were 0.3, 4.5, and 9.7 $\mu g/m^3$ for the annual, maximum 24-hour average, and maximum 3-hour average concentrations, respectively. The maximum allowable concentration increases for PSD Class I areas are 2.0, 5.0, and 25 $\mu g/m^3$, respectively. Based on this information, the SO_2 concentrations from the proposed action would be within the Class I maximum allowable increases.

Because of continuing concern about the combined impact of offshore and onshore emission sources on the PSD Class I increments in Breton, the MMS has collected an emission inventories for OCS facilities located within 100 kilometers (km) of the Breton Class I area. A modeling study is presently ongoing that will determine the contribution of OCS emissions to concentrations of NO_2 and SO_2 in the Breton Class I area. This study is scheduled to be completed in 2006. In addition, the MMS consults with the Fish and Wildlife Service (FWS), which is the Federal land manager of the Breton Class I area, for plans within 100 km of Breton that exceed a certain emission threshold. Mitigation measures, such as the use of low-sulfur fuel, may be applied.

No modeling has been performed for CO. In OCS waters, CO emission sources less than about 7,000 tons/year would not have any significant effect on onshore air quality and are exempt from air quality review under the MMS air quality regulations. This is based on air quality modeling that was performed to support the MMS air quality rules. The average annual CO emission rate for the whole Gulf of Mexico is about 12,100 to 19,900 tons/yr. Therefore, no significant impacts from CO would be expected.

In summary, the incremental concentrations of NO_2, SO_2, and PM_{10} would be within the maximum allowable PSD increases. The concentrations of NO_2, SO_2, PM_{10}, and CO would remain well within the NAAQS.

Impacts on Ozone: The impacts from OCS activities on O_3 were evaluated in the Gulf of Mexico Air Quality Study (MMS, 1995c). The study focused on the O_3 nonattainment areas in southeast Texas and the Baton Rouge, Louisiana, areas. It was determined through modeling that OCS sources contributed little to onshore O_3 concentrations in either of these areas. At locations where the model predicted 1-hour average O_3 levels above 120 parts per billion (ppb), which was the national ambient standard in existence at the time, the OCS emissions contributed less than 2 ppb to the total concentrations. These contributions occurred in only a small geographic area during any particular episode. At locations where the model predicted O_3 levels were much less than 120 ppb, the highest OCS contributions was around 6-8 ppb. When the modeling was performed after doubling the OCS emissions, the highest OCS contributions at locations where the predicted O_3 levels exceeded the standard was 2-4 ppb.

More recently, ozone modeling was performed using a preliminary Gulfwide emissions inventory for the year 2000 to examine the O_3 impacts with respect to the new 8-hour O_3 standard of 80 ppb. One modeling study focused on the coastal areas of Louisiana extending eastward to Florida (Haney et al., 2004). This study showed that the impacts of OCS emissions on onshore O_3 levels were very small, with the maximum contribution of 1 ppb or less at locations where the standard was exceeded. The other modeling effort dealt with O_3 levels in southeast Texas (Yarwood et al., 2004). The results of this study indicated a maximum contribution of 0.2 ppb or less to areas exceeding the standard.

The projected emissions from the proposed action would be smaller than the emissions used in the models. The contributions to O_3 levels would, therefore, be even smaller than the figures above.

Impacts on Visibility: The application of the VISCREEN visibility screening model (USEPA, 1988) to individual OCS facilities has shown that the emissions are not large enough to significantly impair visibility. It is not known to what extent aggregate OCS sources contribute to visibility reductions. However, the individual emission sources from the proposed action are relatively small and scattered over a large area, and it is not expected that they would have a measurable impact on acid deposition or visibility. The impacts on visibility would be negligible.

Accidents

Small accidental oil spills would cause small, localized increases in concentrations of VOC due to evaporation of the spill. Most of the emissions would occur within a few hours of the spill and would decrease drastically after that period. Large spills would result in emissions over a large area and a longer period of time. Hanna and Drivas (1993) modeled the emissions of various hydrocarbon compounds from a large spill. A number of these compounds, including benzene, ethylbenzene, toluene, and o-xylenes, are classified by the USEPA as hazardous air pollutants. The results showed that these compounds evaporate almost completely within a few hours after the spill occurs. Ambient concentrations peak within the first several hours after the spills starts and are reduced by two orders of magnitude after about 12 hours. The heavier compounds take longer to evaporate and may not peak until about 24 hours after spill occurrence. Total ambient VOC concentrations are significant in the immediate vicinity of an oil spill, but concentrations are much reduced after the first day.

In situ burning of a spill results in emissions of NO_2, SO_2, CO, and PM_{10}, and would generate a plume of black smoke. Fingas et al. (1995) describes the results of a monitoring program of a burn experiment at sea. The program involved extensive ambient measurements during two experiments in which approximately 300 barrels (bbl) of crude oil were burned. It found that during the burn, CO, SO_2, and NO_2 were measured only at background levels and were frequently below detection levels. Ambient levels of VOC were high within about 100 meters (m) of the fire, but were significantly lower than those associated with a nonburning spill. Measured concentrations of polyaromatic hydrocarbons (PAH’s) were low. It appeared that a major portion of these compounds was consumed in the burn.

McGrattan et al. (1995) modeled smoke plumes associated with in situ burning. The results showed that the surface concentrations of particulate matter did not exceed the health criterion of 150 ug/m^3 beyond about 5 km downwind of an in situ burn. This is quite conservative as this health standard is based on a 24-hour average concentration rather than a 1-hour average concentration. This appears to be supported by field experiments conducted off of Newfoundland and in Alaska.

In summary, any air quality impacts from oil spills would be localized and of short duration. Emissions do not appear to be hazardous to human health. The impacts from in situ burning are also very temporary. Pollutant concentrations would not be expected to be within the NAAQS. The air quality impacts from oil spills and in situ burning would, therefore, be minor.

An accidental release of hydrogen sulfide (H_2S) in the atmosphere could present a serious hazard to platform workers and persons in close proximity to a platform. Hydrogen sulfide concentrations of 20 parts per million (ppm) cause irritation to exposed persons within minutes and concentrations of 500 ppm are deadly. Facilities where H_2S is present are required to file an H_2S Contingency Plan with MMS that contains measures to prevent serious injury or death to personnel. Under a worst-case scenario of an accidental release at a very large facility with a throughput of 100 million cubic feet of gas per day with high H2S concentration levels (on the order of 20,000 ppm) and assuming near-calm wind and stable atmospheric conditions, the H_2S levels are predicted to be 500 ppm at about 1 km from the facility and 20 ppm at several kilometers from the source (MMS, 2001c). Most "sour gas" facilities have H_2S concentrations below 500 ppm, which would result in H_2S levels of 20 ppm that are confined to an area within the dimensions of a typical platform.

In the case of an aquatic H_2S release, the gas is soluble in water so a small gas leak would result in almost complete dissolution into the water column. Larger leaks would result in less dissolution and could result in release into the atmosphere if the surrounding waters reach saturation. Because the oxidation of HS in water takes place slowly, there should not be any appreciable zones of hypoxia (MMS, 2001c). Hydrogen sulfide levels can have adverse impacts to mammals, birds, and fish (MMS, 2001c).

Conclusion

Routine operations associated with the proposed action would result in levels of NO_2, SO_2, PM_{10}, and CO that are well within national air quality standards. While an accidental release of H_2S could present a hazard to persons in the vicinity, the requirement of contingency plans would effectively mitigate this. The contributions to O_3 levels, when the standards are exceeded, would be less than 1 percent of the total concentrations. Air quality impacts from accidental oil spills or in situ burning would be localized and short term.

b. Water Quality

This section analyzes impacts to Gulf of Mexico coastal and marine waters. Coastal waters, as defined here, include the bays and estuaries along the coast and State waters extending out to the inward boundary of the territorial seas. Marine waters extend from this boundary out to the Exclusive Economic Zone, or approximately 200 miles from the coast.

(1) Coastal Waters

Routine Operations

Routine activities potentially affecting coastal water quality include pipeline landfalls and operation discharges. Under the proposed action scenario, seven pipeline landfalls would occur in the Gulf of Mexico. Trenching operations to bury the pipelines would produce turbidity (i.e., increased suspended solids) in the coastal waters along pipeline corridors. Increased water turbidity would also result from placing drilling units and platforms. The disturbance of bottom sediments caused by these operations would be unavoidable. However, these impacts would be temporary, and water quality would return to normal (i.e., background concentrations), without mitigation, once these activities were completed because of settling and mixing.

Vessel-associated discharges could also impact the water quality. These discharges would include sanitary wastes and bilge water. Bilge water discharges from support vessels could contain petroleum and metals from machinery. Bilge water and sanitary discharges to larger coastal water channels would produce local and temporary effects because of the large volume of water available to dilute the discharges and the presence of currents that would promote mixing. However, in confined portions of some channels, there might be insufficient water volume or currents for mixing and dilution. In such regions, water quality could be degraded. Compliance with applicable National Pollutant Discharge Elimination System (NPDES) permits and U.S. Coast Guard (USCG) regulations would prevent or minimize most impacts on receiving waters, and water quality would quickly recover to background conditions.

Accidents

Accidental releases could affect the quality of coastal water in the Gulf of Mexico. The magnitude and severity of impacts would depend on spill location and size, type of product spilled, weather conditions, and the water quality and environmental conditions at the time of the spill.

Oil spills in any of the Gulf of Mexico Planning Areas would not persistently degrade water quality because of weathering processes that transform the oil, such as volatilization, emulsification, dissolution, chemical oxidation, photooxidation, and microbial oxidation (National Research Council, 2003; National Oceanic and Atmospheric Administration [NOAA], 2005). Dissolution, which is a small component of weathering, can be important to biological communities because the most soluble fractions are often the most toxic (Shen and Yapa, 1988). Because oil is generally less dense than water, it would tend to float on the sea surface. Lighter oil fractions, such as benzene, toluene, ethylbenzene, and xylene (often referred to as BTEX), would readily evaporate from the surface and, therefore, would not be a continuing source of potential water contamination. Following a spill, light crude oils can lose as much as 75 percent of their initial volume to evaporation as the lighter components (e.g., BTEX) change from the liquid to the gas phase; medium weight crude oils can lose as much as 40 perent (National Research Council, 2003).

If a large spill (4,600 bbl from a pipeline or 1,500 bbl from a platform) occurred in enclosed coastal waters or was driven by winds, tides, and currents into an enclosed coastal area, water quality would be adversely affected. Similarly, if a large tanker spill (5,300 bbl) were to happen near port, adverse impacts could occur to coastal waters. In such a low-energy environment (i.e., an environment in which there is limited wave and current activity), the oil would not be easily dispersed, and weathering could be slower than it would be in the open sea. Effects on water quality could persist if oil reached coastal wetlands and was deposited in fine sediments, becoming a long-term source of pollution because of remobilization. In such locations, spill cleanup might be necessary for the recovery of the affected areas. Shoreline cleanup operations could involve crews working with sorbents, hand tools, and heavy equipment. Oiled shorelines might also be washed with warm or cold water, depending on the shore's location.

Small oil spills (< 1,000 bbl) or very small oil spills (< 50 bbl) would produce small, but measurable, impacts on water quality. However, assuming that all small and very small spills would not occur at the same time and place, water quality would rapidly recover without mitigation because of mixing, dilution, and weathering.

Conclusion

Coastal water quality impacts from routine operations, such as pipeline placement and operational discharges, would be unavoidable. These impacts would be localized and short-term; the greatest likelihood for adverse impacts is in the Central Planning Area, where most activities would be expected to occur. Oil spills in coastal waters could reduce water quality temporarily. These impacts would be unavoidable. Small spills would result in short term, temporary impacts to coastal water quality. A large spill could result in longer term impacts to water quality, but cleanup efforts would reduce the likelihood of water quality impairment extending for several years.

(2) Marine Waters

Marine waters can be divided into Continental Shelf waters and deep waters. Continental Shelf waters are defined as those waters that lie outside of the coastal waters and have a depth less than 305 m. Deep waters are located in regions that are equal to or deeper than 305 m (MMS, 2004c).

Routine Operations

Routine operations that could affect water quality include activities such as anchoring, mooring, drilling and well completion activities, well testing and cleanup operations, flaring/burning, facility installation and operations, support service activities, decommissioning, and site clearance.

Sanitary and domestic waste and deck drainage would occur from platforms, drilling vessels, and service vessels as part of normal operations and could contribute to water quality degradation. However, sanitary and domestic wastes would be routinely processed through on-site waste treatment facilities before being discharged overboard, and deck drainage would be treated onsite to remove oil and then discharged. Sand and sludge recovered from the treatment processes would be containerized and shipped to shore for disposal. Impacts to water quality from such discharges would require no mitigation because of the treated nature of the wastes, the small quantities of discharges involved, and the mixing and dilution of the wastes with large volumes of water.

During drilling, drilling fluid is circulated down a hollow drill pipe, through the drill bit and up the annulus between the drill pipe and the borehole. The fluid carries drill cuttings (i.e., crushed rock produced by the drill bit) to the surface. The drilling fluid is then processed on the platform to remove the cuttings and recycled back down the well. The separated cuttings are, in most cases, discharged to the ocean. There are three classes of drilling muds used in the industry: water-based muds (WBM's), oil-based muds (OBM's), and synthetic-based muds (SBM's) (Neff et al., 2000). The WBM's used in most offshore drilling operations in U.S. waters consist of fresh- or saltwater, barite, clay, caustic soda, lignite, lignosulfonates, and/or water-soluble polymers. The OBM's use mineral oil or diesel oil as the base fluid rather than fresh- or saltwater. They offer several technical advantages over WBM's for difficult drilling operations; however, because of their persistence and adverse environmental effects, OBM's and cuttings have never been permitted for ocean discharges in U.S. waters (Neff et al., 2005) and must be transported to shore for disposal. The synthetic-based fluids (SBF's) are a family of products that were developed in the 1990's to provide drilling performance similar to that of oil-based fluids, but with improved biodegradation characteristics and decreased ecotoxicity. The types that would be used most frequently would be those that meet the requirements of the NPDES permit. The SBF-wetted cuttings are permitted for ocean discharge while the spent fluid is transported to shore for reuse or disposal.

Discharges of drilling muds and cuttings during normal operations are regulated by NPDES general permits issued by the USEPA. In areas where disposal of drilling muds and cuttings at sea is permitted under an NPDES general permit and MMS regulations, their environmental effects would be localized and reversible because of settling, mixing, and dilution (Neff et al., 1987; Candler et al., 1993; Montagna and Harper, 1996; Neff et al., 2000; Continental Shelf Associates, 2004).

Produced water is water that is brought to the surface from an oil-bearing formation during oil and gas are extraction. It is the largest individual discharge produced by normal operations. Generally, the amount of produced water is low when production begins but increases over time near the end of the field life. In a nearly depleted field, production may be as high as 95-percent water and 5-percemt fossil fuels (Read, 1978; Stephenson, 1991). Produced water may contain specialty chemicals added to the well for process purposes (e.g., biocides and corrosion inhibitors) and chemicals added during treatment of the produced water before its release to the environment (e.g., water clarifiers).

Produced water can have elevated concentrations of several constituents, including salts, petroleum hydrocarbons, some metals, and naturally occurring radioactive material (NORM). Petroleum hydrocarbons in produced water discharges are a major environmental concern. The most abundant hydrocarbons in produced water are BTEX and low molecular-weight saturated hydrocarbons. The BTEX compounds would rapidly evaporate into the atmosphere, leaving behind less volatile compounds (weathering) (National Research Council, 2003). The polycyclic aromatic hydrocarbons (PAH's) in produced water are a concern because of the toxicity of some PAH's and their persistence in the marine environment (Neff, 1987). Naphthalene, phenanthrene, and their alkyl homologues are the only PAH's occasionally present at higher levels than trace concentrations.

The NORM waste in produced water includes the radium isotopes Ra-226 and Ra-228 and is a concern because it is radioactive. Radium co-precipitates with barium sulfate and is not available for uptake by organisms (Continental Shelf Associates, Inc., 1997; Neff, 2002). Any environmental effects would be localized because of mixing and dilution.

The discharge of produced water into the sea may degrade water quality in the immediate vicinity of the discharge point because of its potential constituents. The USEPA modeling performed in conjunction with laboratory tests indicates that produced water discharges reach nontoxic levels within about 100 m of the discharge point, assuming discharge rates up to 25,000 barrels per day (Avanti Corporation, 1993) because of dilution, dispersion, and settling. Because discharge points are typically much farther apart than 100 m, no interactions that would measurably affect water quality are expected between them, and background concentrations are expected to exist away from the immediate area of the discharge location. Because it is expected that the types, volumes, and concentrations of the produced waters and discharges under the proposed action would be the same as those observed historically, impacts to the environment would be the same as those presently seen.

Normal operations for the proposed action would also involve the use of vessels with associated impacts, such as those discussed above in Section IV.B.2.b(1). Compliance with NPDES permits and USCG regulations would prevent or minimize most impacts to the environment.

The placement of drilling units and platforms would disturb bottom sediments and produce turbidity in the water. Pipeline trenching, required in water depths less than 61m, would also produce turbidity along pipeline corridors. This impact would be unavoidable; however, these impacts would be temporary and water quality would return to normal (e.g., background concentrations of suspended solids) within minutes to hours without mitigation because of mixing, settling, and dilution.

As discussed in Section III.A.4.b, hypoxic conditions exist on the Louisiana-Texas shelf. The size of the hypoxic zone varies from year to year. The hypoxic zone attained a maximum measured extent in 2002, when it encompassed about 22,000 square kilometers (km^2). In 2003, it decreased in size to about 8,000 km^2 (U.S. Geological Survey [USGS], 2005). Normal operations from oil and gas production in the Gulf of Mexico could affect the extent and severity of the hypoxic zone through discharges and accidental releases. Very preliminary calculations reveal that ammonium and oil and grease contained in produced water are a small percentage of that contributed by the Mississippi River to the hypoxic zone (Rabalais, 2005). The companies operating in the hypoxic zone have completed a study that will monitor oxygen-demanding substances and nutrients in the produced water discharges from 50 platforms (Veil et al., 2005). The data from this study will be used by USEPA to model the impacts of produced water discharges on dissolved oxygen levels in the hypoxic zone.

For the proposed action, the compositions and volumes of discharges would be expected to be about the same as those observed historically, and compliance with existing NPDES permits would minimize impacts on receiving waters (e.g., through limitations on concentrations of toxic constituents). Water quality likely would recover without mitigation when discharges ceased because of dilution and dispersion.

Although deepwater operations and practices are similar to those used in shallower environments, there are some significant differences. Three of these are seafloor discharges from pre-riser and riserless drilling operations; discharge of cuttings wetted with SBF's; and more extensive and frequent use of chemical products to enhance oil and gas throughput because of the temperatures and pressures present at the seafloor, including their use within pipelines to facilitate the transport of large quantities of methanol and other chemicals to and from the shore. Almost all deepwater wells use an SBF drilling mud (Neff et al., 2000). The potential effects from disposing of SBF-wetted cuttings in deep water are related to their deposition and degradation on the seafloor. The plume resulting from SBF-wetted cuttings, as compared with the discharge of water-based muds and cuttings, should have fewer water-column effects because the SBF does not disperse in the water column. Adverse effects from the discharge of SBF-wetted cuttings have not been observed in the water column and are not expected because of the low water solubility and toxicity of the adhered SBF's and the rapid settling of cuttings to the bottom (Neff et al., 2000; Neff et al., 2005).

Floating production facilities are used in deep water rather than conventional, bottom-founded (i.e., fixed) platforms. These deepwater facilities include floating production semi-submersibles, tension leg platforms, and spars (Arabe, 2003). Often these facilities are surface hubs for several sub-sea systems. Therefore, in deepwater, there will be far fewer and more widely spaced surface facilities than on the shelf, but these facilities will have increased discharges of produced waters over time due to the larger volume being processed. Floating production, storage, and offloading vessels may be used in the future (MMS, 2004c, d).

Deepwater activities could incrementally increase support activities and the expansion, construction, or modification of onshore support bases due to the deeper draft of these support vessels. The impacts resulting from this growth would be common to all OCS support facilities (point-source waste discharges, runoff, dredging, and vessel discharges) and not specific to deepwater activities. Short-term degradation of water quality might increase at a few support base locations that would be expected to grow as a consequence of deepwater activities (including Corpus Christi, Galveston, and Port Fourchon).

Accidents

As in the case of coastal waters, accidental releases could affect the quality of marine waters in the Gulf of Mexico Planning Areas. The magnitude of these impacts, and the rate of recovery, would depend on the location and size of the spill, type of product spilled, weather conditions, and environmental conditions at the time of the spill.

Generally, oil spilled below the surface rises rapidly as droplets, which coalesce to form a slick. At one time, it was postulated that oil released in deepwater (> 305 m) could result in hydrate formation and prevention of the surfacing of the oil. An experiment conducted in Norway in 844 m of water demonstrated that this would not be the case and that a deepwater blowout would result in a surface slick near the source (Johansen et al., 2001). Standard response procedures for a spill could then be used.

In order to enhance the throughput of oil and gas in deep water, more extensive and frequent use of some chemical products is anticipated because of the temperatures and pressures encountered at the seafloor. Limited information is available about the types and amounts of chemicals being used in deepwater operations or about the potential impact of such spills. Studies conducted to date have identified that most chemicals used are unlikely to be a concern (Boehm et al., 2001b).

Because deepwater operations can be located far from shore, tankers could be used to shuttle crude oil to shore stations. This transport of oil from operations in deep water has the potential to produce spills that could impact coastal waters within a very short time if the spill occurred near the port. It is expected that such spills would release approximately 5,300 bbl of oil. Such a release could retain a large volume of oil in the slick at the time it contacted land.

Small oil spills (< 1,000 bbl) or very small oil spills (< 50 bbl) would have measurable impacts on water quality. If it is assumed that all small and very small spills would not occur at the same time and place, water quality would rapidly recover without mitigation because of mixing, dilution, and weathering.

Conclusion

Marine water quality impacts resulting from routine operations (including installation and removal of structures) and operational discharges under the proposed action would be unavoidable. These impacts would be localized and short-term; the greatest likelihood for adverse impacts is in the Central Gulf of Mexico Planning Area, where most of the activities would be expected to occur. Compliance with NPDES permit requirements would minimize or prevent most impacts to receiving waters caused by discharges from normal operations. Water quality would recover when discharges ceased because of dilution, settling, and mixing. Impacts of accidental releases to water quality would depend on the size of the spill, type of material or product spilled, and environmental factors at the time of the spill.

A large spill would have temporary impacts to water quality. Cleanup efforts and evaporation, dilution, and dispersion would prevent persistent impacts.

c. Marine Mammals

There are 29 species of marine mammals, including six endangered whale species and the endangered West Indian manatee, that may occur in the northern Gulf of Mexico, and which therefore could be affected by normal operations associated with the proposed action. For information on marine mammals found in the Gulf of Mexico Regions, see Section III.A.6.

Routine Operations

Normal operations that may affect these species include (1) seismic surveys, (2) construction of offshore facilities and pipelines, (3) operations of offshore facilities and drilling rigs, (4) operational discharges and waste generation, (5) OCS service vessel and helicopter traffic, and (6) platform removal.

Because of differences in their distribution and ecology, not all species of marine mammals reported from the northern Gulf of Mexico would be expected to be equally exposed to or affected by routine operations under the proposed action. Among those reported, all of the mysticetes (baleen whales), except for the Bryde's whale, are considered extralimital or rare in the Gulf (Würsig et al., 2000). Because of their rarity, it is unlikely that individuals of these species would be present in areas where OCS-related activities would be occurring, and thus would not be affected by normal operations of the proposed action. Although considered uncommon, the Bryde's whale is the most frequently sighted mysticete whale and is present in the Gulf of Mexico Region throughout the year, occurring primarily in the Eastern Planning Area (R.W. Davis et al., 2000; Würsig et al., 2000; MMS, 2004b).

In contrast to the mysticetes, many of the odontocetes (toothed whales) are considered relatively common in the Gulf of Mexico OCS (R.W. Davis et al., 2000; MMS, 2004b). Thus, there is a greater potential that some individuals of these species may occur in areas where OCS-related activities are occurring and could be affected during normal operations.

All of the mysticete whales listed as endangered are considered extralimited or very rare in the Gulf of Mexico. The only odontocete whale listed as endangered is the sperm whale, which is the most common large whale in the Gulf of Mexico. Sperm whales occur year-round in all deep water areas of the U.S. Gulf, but a well-documented aggregation has been consistently found in the shelf-edge waters around the 1000-ft depth contour south of the Mississippi River Delta (R.W. Davis et al., 2000; MMS, 2004b). Thus, this species may encounter OCS-related activities occurring within the northern Gulf of Mexico, especially in deepwater areas of the Central Gulf of Mexico Planning Area.

The endangered West Indian manatee occurs mainly in the Eastern Planning Area along coastal marine, brackish, and freshwater habitats of Florida (Fig. III-6) but can also be found along the Gulf Coast to Texas. Although manatees appear to prefer nearshore habitats, animals have also rarely been sited around structures at offshore sites. No impacts are expected though because the 2007-2012 Leasing Program does not include lease sales in the Eastern Gulf of Mexico Planning Area. The greater potential for any impacts would occur in nearshore habitats where interactions with OCS-related activities (i.e., vessels) exist. Service vessel impacts would only occur in the Central and Western Planning Areas where manatees are only occasionally observed.

Seismic Surveys: Noise generated by seismic surveys may have physical and/or behavioral effects on marine mammals, such as (1) hearing loss, discomfort, and injury; (2) masking of important sound signals; and (3) behavioral responses such as fright, avoidance, and changes in physical or vocal behavior (Richardson et al., 1995; R.A. Davis et al., 1998b; Gordon et al., 1998). However, there have been no documented instances of deaths, physical injuries, or physiological effects on marine mammals from seismic surveys (MMS, 2004b). Because of its restriction to nearshore coastal marine and freshwater habitats, the endangered West Indian manatee would be unlikely to come in contact with offshore seismic surveys. Marine mammals most likely to be exposed to and affected by routine seismic surveys are the cetaceans.

Physical impacts of seismic survey noise on marine mammals may range from temporary hearing impairment to gross physical injury (Richardson et al., 1995). Airgun sources (see Section III.A.5), however, are unlikely to produce gross physical damage (in the form of organ injury) unless the marine mammal is very near the airgun (where highest energy levels would occur) and especially if the airgun started up immediately next to an animal. In most cases, marine mammals would not be expected to be present so close to an array (MMS, 2004b).

Seismic surveys have the potential to result in temporary or permanent hearing loss. The sound frequencies generated by seismic surveys are known or inferred to be within the hearing frequencies of some of the marine mammals found in the Gulf of Mexico (MMS, 2004b); this suggests that such species may not only be able to detect sounds generated by seismic surveys, but may also be susceptible to auditory masking (Richardson et al., 1995; Goold and Jones 1995; R.A. Davis et al., 1998b; Gordon et al., 1998). Auditory masking occurs when a sound signal that is important to a marine mammal (e.g., communication calls, echolocation, environmental sound cues) is rendered undetectable due to the high noise-to-signal ratio in a relevant frequency band. In the case of seismic surveys, where potential masking noise takes a pulsed form with a low duty cycle (about 10%, or a 1-second disturbance in the sound field in every 10 seconds of ambient noise [MMS, 2004b]), the potential for auditory masking may be low relative to continuous sounds such as ship noise.

A number of studies have documented behavioral reactions of marine mammals to noise generated by seismic surveys (Richardson et al., 1995). Behavioral reactions may include avoidance of/flight from the sound source and its immediate surroundings, disruption of feeding behavior, interruption of vocal activity, and modification of vocal patterns (Watkins and Scheville 1975; Malme et al., 1984; Bowles et al., 1994). The biological importance of such responses (e.g., effects on energetics, survival, reproduction, population status) is unknown. Although seismic surveys have been conducted in the northern Gulf with some regularity for decades, there is currently no evidence that significant adverse behavioral impacts attributable to seismic surveys are occurring to marine mammals in the Gulf of Mexico (MMS, 2004b).

While a seismic survey may affect more than one individual, routine surveys are not expected to result in population-level effects. Individuals disturbed by or experiencing masking due to a survey would likely return to normal behavioral patterns after the survey has ceased (or after the animal has left the survey area). Because cetaceans are highly mobile species, they may be expected to quickly leave an area when a seismic survey is initiated, thereby greatly reducing their exposure to maximal sound levels and, to a lesser extent, masking frequencies.

With the possible exception of the endangered sperm whale, odontocetes generally demonstrate relatively poor low-frequency hearing sensitivity, and thus would not be expected to experience hearing loss from seismic surveys (unless they are in close proximity to airgun arrays). Odontocetes could, however, respond behaviorally to seismic surveys, by leaving an area where seismic surveys are being conducted. Such behavioral changes would be temporary and would not be expected to adversely affect either the individual or the population (MMS, 2004b).

Among the odontocetes, the endangered sperm whale, the pygmy and dwarf sperm whales, and the beaked whales may incur impacts to their hearing under some conditions during routine seismic surveys. These species are known or believed to be deep diving (MMS, 2004b), and because of this behavior, they may on occasion be present directly below an airgun array and, thus, be exposed to a maximal airgun output. The potential for this situation to occur is greater in that these deep diving animals spend less time at the surface; therefore, opportunities for the animals to either become aware of the presence of the seismic vessel or for observers to note the presence of the animals and impose additional mitigation measures are decreased. Ultimately, such exposure could result in short-term or long-term hearing loss.

In contrast, the mysticetes are considered to possess good hearing sensitivity at low frequencies down to approximately 10 hertz (Hz), and many of their vocalizations occur in the low tens to a few hundred hertz (Thompson et al., 1990; Richardson et al., 1995; Crane and Lashkari, 1996; Rivers, 1997; Ketten 1998; Stafford et al., 1998, 1999). Seismic survey airgun arrays are configured to output maximal energy in the region of a few tens of hertz, which overlaps with the expected hearing sensitivity of mysticetes. Thus, mysticetes may be affected during routine seismic surveys. However, with the exception of the Bryde's whale (*Balaenoptera edeni*), the mysticetes are classified as extralimital or rare in the Gulf of Mexico (MMS, 2004b), and would not be expected to encounter (and be affected by) OCS-related seismic surveys in the Gulf. The Bryde's whale is the most frequently seen mysticete in the Gulf of Mexico although this species is considered uncommon with an abundance estimate of only 40 individuals in the U.S. Gulf (Waring et al., 2004). Exposure of this species to maximal airgun output during a seismic survey may result in behavioral changes or short-term or long-term hearing loss, while less than maximal exposure could result in masking effects. Bryde's whale sightings have occurred almost exclusively in the Desoto Canyon area of the Eastern Gulf Planning Area, which is not included in the 2007-2012 Leasing Program.

The MMS currently requires a ramp-up for seismic activities (NTL No. 2004-G01) in all U.S. Gulf of Mexico OCS waters greater than 200 m deep. Ramp-up entails gradually increasing the intensity of a sound source (such as an airgun array) over a 15- to 30-minute period, until maximum source sound levels are reached. The use of a ramp-up greatly reduces or prevents the sudden exposure of cetaceans to maximum airgun output levels, and permits cetaceans in the area to leave the immediate vicinity of the array before maximum output levels are reached. Therefore, seismic surveys using airgun sources would not be expected to result in gross physical injury to marine mammals.

The MMS stipulations also require that visual monitoring and clearance be conducted for a 500-m (radial distance) exclusion zone around an array and in the immediate vicinity of the survey vessel, with monitoring beginning 30 minutes prior to ramp-up and continuing until seismic operations cease or until environmental conditions (e.g., rain, fog, darkness) hinder observation of the sea surface. If a cetacean is observed within or traveling towards the exclusion zone, an immediate shutdown of the seismic array is required. These stipulations further reduce the potential for cetaceans to be exposed to sound levels that could affect hearing or behavior.

Construction of Offshore Facilities and Pipelines: Under the proposed action, up to 1,500 new exploration wells, 6,000 new production wells, and 4,000 miles of new pipeline could be constructed within the Gulf of Mexico OCS (Table IV-1). Noise and human activity associated with the construction of these offshore facilities and pipelines could disturb marine mammals that may be present in the vicinity of the construction activity. Construction activities could disturb normal behaviors (e.g., feeding, social interactions), mask calls from conspecifics, disrupt echolocation capabilities, and mask sounds generated by predators. Animals may either temporarily or permanently leave the vicinity of a constructions area. In cases where the specific habitat is not essential to the animal, the effects would be considered short-term and sublethal. In cases where the animal(s) has a strong affinity for the habitat within the construction area (i.e., prime habitat for mating, feeding, calving), the impacts are unknown. If other suitable habitat is available in the area with little energetic costs to the animal(s), then the impacts would be expected to be short-term and sublethal. However, the potential exists for greater impacts if additional suitable habitat is not available.

Currently in the Gulf of Mexico Region, the West Indian manatee is the only marine mammal that has a federally designated critical habitat, and this habitat is limited to specific coastal marine and freshwater areas in peninsular Florida (Fig. III-6). Because of this designation, construction activities (e.g., trenching) would not be allowed in this habitat, and any construction activities in the vicinity of the habitat would require coordination with the National Marine Fisheries Service (NMFS) to ensure that neither the habitat nor the manatee would be affected.

Preferred habitats for the endangered sperm whale include, but are not limited to, the continental slope waters off the Mississippi River Delta in the Central Gulf of Mexico Planning Area (R.W. Davis et al., 2000; MMS, 2004b). Portions of the Gulf that would be disturbed by the construction of new wells and pipelines would be largely limited to the immediate footprint of the new structure and its surroundings. Unless these areas are specifically critical to sperm whales, animals would be expected to locate other suitable habitat nearby. Some permanent displacement may occur, but would be largely limited to the local environment surrounding individual wells or areas with well aggregations, and thus not be expected to affect overall habitat availability or cetacean access.

Operations of Offshore Facilities and Drilling Rigs: Noise associated with OCS drilling and production is of relatively low frequency, typically between 4.5 and 30 Hz. (Richardson et al., 1995). Potential effects on marine mammals include disturbance (e.g., changes in behavior, short- or long-term displacement) and masking of calls from conspecifics or other natural sounds (e.g., surf, predators).

Odontocetes use sounds at frequencies that are generally higher than the dominant sounds generated by offshore drilling and production activities, and thus may not be sensitive to or affected by these sounds. However, the endangered sperm whale may have good low-frequency hearing, and thus could be affected by drilling and production noise. Effects would be similar to those identified for construction activities, namely behavioral disruption and short- or long-term avoidance or displacement from the immediate vicinity of the operating facility. Because the mysticetes are considered to possess good hearing sensitivity and exhibit vocalizations at low frequencies, these species may be affected by drilling and production noise. However, with the exception of the Bryde's whale, the mysticetes in the Gulf of Mexico OCS are classified as extralimital or rare (MMS, 2004b), and are not expected to encounter (and not be affected by) operating offshore facilities. If present, individuals would likely avoid the operating facility.

Neither behavioral disturbance nor the displacement of individuals by normal operations at offshore facilities would be expected to result in long-term effects to either individuals or populations of cetaceans. The endangered West Indian manatee is mostly found in coastal and offshore waters of the Eastern Planning Area; however, due to their smaller numbers in the Central and Western Planning Areas and the animals' preference for nearshore waters, impacts from operations at offshore facilities would be minimized.

Operational Discharges and Waste Generation: Produced water, drilling muds, and drill cuttings are routinely discharged into offshore marine waters in compliance with applicable regulations and permits, and would continue to be so under the proposed action. The discharge of production wastes into open water is prohibited in coastal waters, but permitted in marine waters under the NPDES program. Marine mammals could be affected directly through exposure to operational discharges or ingestion of contaminated prey, or indirectly as a result of discharge impacts on prey species (NRC, 1983; API, 1989; Kennicutt, 1995). However, while these materials may contain a variety of constituents (e.g., trace metals, hydrocarbons) that may be toxic to marine mammals, these discharges would be rapidly diluted and dispersed in the open water. Furthermore, cetaceans may avoid active production facilities where permitted discharges are occurring, thereby greatly reducing the likelihood for their direct exposure. Thus, it is unlikely that marine mammals would be directly exposed to operational discharges at concentrations sufficient to result in direct lethal or sublethal effects.

Operational discharges from OCS service and construction vessels, when permitted, would be released into the open ocean where they would be rapidly diluted and dispersed. Sanitary and domestic wastes are routinely processed through onsite waste treatment facilities before being discharged overboard. Deck drainage is processed on site to remove oil and is then discharged. Thus, permitted waste discharges from OCS service and construction vessels would not be expected to directly affect marine mammals.

Some contaminants present in permitted discharges may biomagnify or bioaccumulate in the food chain, resulting in a higher exposure than might be incurred through direct contact. Permitted discharges may also result in a reduction of prey in the immediate vicinity of the discharges. Because cetaceans are wide ranging biota, a localized reduction in prey would not be expected to affect individuals or populations, nor would their diet be expected to consist solely or primarily of prey that may have accumulated toxic materials from a permitted discharge. While the bioaccumulation of toxic materials is documented in cetaceans (API, 1989), the source of the accumulated materials is poorly understood. Contaminants are introduced throughout the Gulf of Mexico from a variety of national and international sources, and the principal sources and levels of contaminants to which cetaceans in the Gulf of Mexico OCS are exposed are unknown.

Solid debris can adversely impact marine mammals through ingestion or entanglement (Marine Mammal Commission, 2003). Mammals that have ingested debris, such as plastic, may experience intestinal blockage, which in turn may lead to starvation, while toxic substances present in the ingested materials (especially in plastics) could lead to a variety of lethal and sublethal toxic effects. Entanglement in plastic debris can result in reduced mobility, starvation, exhaustion, drowning, and constriction of, and subsequent damage to, limbs caused by tightening of the entangling material. The discharge or disposal of solid debris into offshore waters from OCS structures and vessels is prohibited by the MMS (30 CFR 250.40) and the USCG (International Convention for the Prevention of Pollution from Ships [MARPOL], Annex V, P.L. 100-220 [101 Statute 1458]). Thus, entanglement in or ingestion of OCS-related trash and debris by marine mammals would not be expected under the proposed action during normal operations.

OCS Service Vessel and Helicopter Traffic: There may be up to 500 surface vessels and 5,000 helicopter trips per week under the proposed action. Marine mammals may be affected by this traffic either by direct collisions with vessels or by disturbances from either vessels or helicopters. At least 11 species of cetaceans have been documented as being hit by ships in the Atlantic Ocean (including the U.S. and European waters and the Gulf of Mexico) (Laist et al., 2001). In most cases, the whales were not seen beforehand or are seen too late to avoid collision. Most lethal or severe injuries involved ships traveling 14 knots or faster, and collisions with vessels greater than 80 m in length were usually either lethal or result in severe injuries (Laist et al., 2001). In addition, a majority of ship strikes seemed to occur over or near the continental shelf.

The most frequently struck species in the Atlantic have been the endangered fin whales; in addition, the endangered humpback, right, and sperm whales are commonly hit (Laist et al., 2001). While these species have all been reported from the Gulf of Mexico OCS, only the sperm whale is a common resident of the northern Gulf, and the others are considered rare or extralimital. Thus, among these species, only the sperm whale is likely to encounter OCS-related vessels. Although sperm whales are capable of avoiding vessels, collisions with fast moving vessels may occur, especially in the Central Planning Area where aggregations of this species are commonly found over the shelf edge in the vicinity of the Mississippi River Delta.

Among the nonlisted cetaceans, the Bryde's whale is the more common mysticete in the northern Gulf of Mexico, while several species of odontocetes (primarily delphinids such as the pantropical spotted dolphin) are abundant in the northern Gulf. Thus, these species have the potential to encounter OCS-related vessels that are in transit. In fact, many of these species, particularly the delphinids, are commonly attracted to moving vessels and spend periods of time following these vessels or swimming within the bow waves of ships traveling at high speeds. Because these species are agile, powerful swimmers, they are capable of avoiding collisions with oncoming vessels, although some may be injured by contacting propellers while following ships. Such injuries may or may not be lethal, and are believed to be uncommon and not result in population-level effects.

Vessel strikes in inland waterways are a major cause of death in the manatee population (FWS, 2002c). This species occurs primarily along the Florida coast adjacent to the Eastern Gulf of Mexico Planning Area. There are currently no shore bases in the Eastern Planning Area, and under the proposed action no new bases would be built in this area. Thus, manatees would not be expected to encounter OCS vessel traffic in the Eastern Planning Area under the proposed action. The manatee is rare in coastal areas of the Central and Western Gulf of Mexico Planning Areas, but if present in these areas could encounter OCS-related vessels traveling between offshore facilities and shore bases, and could be injured or killed in the event of a vessel collision. Because this species is rare in these planning areas, encounters with OCS-related vessels in these areas would be unlikely.

In addition to vessel collisions, marine mammals may be affected by the noise generated by OCS-related surface vessels and helicopters. While there is a certain background level of ship noise in the Gulf of Mexico, exposure of marine mammals to individual OCS support vessels and helicopters would be transient, and the noise intensity would vary depending upon the source and specific location. Reactions of cetaceans, including both odontocetes and mysticetes, may include apparent indifference, cessation of vocalizations or feeding activity, and evasive behavior (e.g., turns, diving, etc.) to avoid approaching vessels (Richardson et al., 1995; Nowacek and Wells, 2001). Such altered behaviors would likely return to normal after passage of the vessel or helicopter, and it is unlikely that such short-term effects would result in long-term population-level impacts.

Platform Removal: Under the proposed action, up to 700 platforms may be removed from the Gulf of Mexico planning areas using explosives. During such platform removal, marine mammals in close proximity to the detonations could be injured from pressure- and noise-related effects. Mitigation measures, in the form of guidelines for explosive platform removals in the Gulf of Mexico Region, have been established by the MMS (NTL. No. 2004-G06) with the cooperation of the NMFS. These guidelines specify limits on the type and size of explosives that can be used and the times when detonations can occur, require explosives to be placed at a minimum depth of 15 m below the sediment surface, and require a monitoring plan that uses qualified observers to monitor the detonation area for protected species, including all marine mammals, prior to and after each detonation. The detection of a marine mammal (or other applicable biota) within the blast zone would, without exception, delay explosive detonation. In addition, any structure removal that proposes to conduct explosive removal that does not comply with these guidelines or proposes to use larger charges in depths of 200 m (656 feet) or greater would be required to initiate a new Endangered Species Act Section 7 consultation with the NMFS. Thus, explosive platform removals conducted under the proposed action and complying with MMS guidelines would not be expected to adversely affect marine mammals in the Gulf of Mexico Region.

Accidents

Accidental oil spills could occur in the Gulf of Mexico planning areas under the proposed action. In addition, it is assumed that approximately 25 percent of activities under the proposed action, and consequently 25 percent of potential spills, would occur in waters less than 200 m in depth, with the remaining potential spills occurring in deeper waters. Oil spills could affect marine mammals in a number of ways, and the magnitude and severity of potential impacts would depend on the location and size of the spill, the type of product spilled, the weather conditions, the water quality and environmental conditions at the time of the spill, and the species and habitats exposed to the spill. Marine mammals may be exposed to spilled oil by direct contact, inhalation, and ingestion (directly, or indirectly through the consumption of oiled prey species), and such exposures may result in a variety of lethal and sublethal effects (Geraci, 1990; MMS, 2001, 2002a).

For cetaceans (and probably sirenians as well), direct contact of oil may irritate, inflame, or damage skin and sensitive tissues (such as eyes and other mucous membranes) (Geraci and St. Aubin, 1982). Prolonged contact to petroleum products may reduce food intake; elicit agitated behavior; alter blood parameters, respiration rates, and gas exchange; and depress nervous functions (Lukina et al., 1996). Under less extreme exposures (lower concentrations or shorter durations), oil does not appear to readily adhere to or be absorbed through cetacean skin, and may actually provide a barrier to the uptake of oil-related aromatic hydrocarbons through the body surface (Geraci and St. Aubin, 1982, 1985; Harvey and Dahlheim, 1994).

Fresh crude oil releases toxic vapors that when inhaled may irritate or damage respiratory membranes, congest lungs, and cause pneumonia. Following inhalation, volatile hydrocarbons may be absorbed into the bloodstream and accumulate in the brain and liver, leading to neurological disorders and liver damage (Geraci and St. Aubin, 1982; Geraci, 1990). Toxic vapor concentrations may occur just above the surface of an oil spill and, thus, may be available for inhalation by surfacing cetaceans.

Marine mammals may incidentally ingest floating or submerged oil or tar and may consume oil-contaminated prey (Geraci, 1990). Spilled oil may also foul the baleen fibers of mysticete whales, temporarily impairing food-gathering efficiency or resulting in the ingestion of oil or oil-contaminated prey (Geraci and St. Aubin, 1987). Ingested oil can remain within the gastrointestinal tract and be absorbed into the bloodstream and, thus, could irritate and/or destroy epithelial cells in the stomach and intestine. Certain constituents of oil, such as aromatic hydrocarbons and polyaromatic hydrocarbons, include some well-known carcinogens. These substances, however, do not show significant biomagnification in food chains and are readily metabolized by many organisms.

An accidental oil spill may result in the localized reduction, extirpation, or contamination of prey species. Invertebrate and vertebrate species (such as zooplankton, crustaceans, mollusks, and fishes) may become contaminated and subsequently expose marine mammals that feed on these species.

Depending on their habitat preferences and feeding styles, some species may be more vulnerable than others to exposure to a spill. For example, spills that occur in or reach coastal areas, and especially sheltered coastal habitats such as bays and estuaries, would be more likely to affect coastal delphinids and the West Indian manatee than marine mammals inhabiting more open and deep waters. Because benthic organisms (such as crustaceans and mollusks) accumulate oil compounds more readily and to higher levels than pelagic biota (Patin, 1999), the potential for ingesting oil-contaminated prey is highest for benthic feeding whales, reduced for plankton-feeding whales, and least for fish-eating whales (Würsig, 1990). Species with a dependence on or preference for offshore areas or habitats for feeding, shelter, or reproduction (e.g., surface-feeding baleen whales such as Bryde's whale) would be more likely to be affected by a deep-water spill than would other marine mammals (Würsig, 1990). In the case of the sperm whale, which tends to aggregate along deep waters off the Mississippi River mouth, a spill occurring in this area could affect a larger number of individuals than would a spill in other deep-water areas of the Gulf.

An oil spill in coastal waters may affect the West Indian manatee. Because the distribution of this species is largely limited to coastal waters along the Florida peninsula, with some individuals venturing into coastal waters of the Florida Panhandle and occasionally the central and western Gulf, the West Indian manatee would be most vulnerable to a spill occurring in or reaching the preferred river system and canals where it congregates. Under the accident scenario considered for the proposed action, there is a low likelihood that an oil spill would reach the Florida peninsula and affect the coastal habitats used by this manatee. Thus, the endangered West Indian manatee, as well as other marine mammals that utilize coastal, nearshore waters off the Florida coast, would not be expected to encounter, or be affected by, an oil spill under the proposed action.

Oil-spill response activities may affect cetaceans, either through exposure to response chemicals (e.g., dispersants or coagulants) applied to control or break down spilled surface oil, or through disturbance by or collision with spill response vehicles. The chemicals used during a spill response are toxic, but are considered much less so than the constituents of spilled oil (Wells, 1989); there is little information regarding their potential effects on marine mammals (Tucker and Associates, Inc., 1990). The presence of, and noise generated by, oil-spill response equipment and support vessels could temporarily disturb marine mammals in the vicinity of the response action, with affected individuals likely leaving the area. Oil-spill response support vessels may also increase the risk of collisions between these vessels and marine mammals in the vicinity of the spill response. Under the accident scenario evaluated for the proposed action, response actions in open water would be expected to be localized, infrequent, and of relatively short term, thus reducing the potential for affecting marine mammals. In the event of a large spill contacting the shore or moving into coastal and inland wetlands, longer-term response activities would be likely.

Conclusion

Under the proposed action, some routine operations could affect marine mammals in the northern Gulf of Mexico. Among the listed species reported from the planning areas, only the endangered sperm whale and West Indian manatee are present in sufficient numbers to potentially be affected by normal operations or spills. Effects to these species would be the same as those that could be incurred by any of the marine mammals that are present in the Gulf of Mexico planning areas. Noise generated during exploration and production activities, platform removal, and OCS-related vessels and helicopters may temporarily disturb some individuals. Collisions with OCS-related vessels may injure or kill some individuals. Many of the effects associated with noise and the presence of OCS-related vessels or structures would likely be short-term and not result in population-level effects. Existing permit requirements, regulatory stipulations, and MMS guidelines targeting many of the routine operations would greatly limit the impact of any potential effects on marine mammals.

Any of the oil-spill scenarios developed for the proposed action (section IV.B.1) may expose marine mammals to oil or its weathering products. The magnitude of effects from accidental spills would depend on the location, timing, and volume of the spills; the environmental settings of the spills (e.g., restricted coastal waterway, deepwater pelagic location), and the species (and its ecology) exposed to the spills. Spill cleanup operations could result in short-term disturbance of marine mammals in the vicinity of the cleanup activity, while a collision with a cleanup vessel could injure or kill the affected individual.

d. Marine and Coastal Birds

The Gulf of Mexico possesses a diverse bird fauna comprised of both resident and migratory marine and coastal species. Seven of these species are listed as threatened or endangered under the Endangered Species Act (ESA), while another is under consideration for such listing (Section III.A.7). In addition to the large number of marine and coastal species, the bird fauna of the Gulf also includes many inland bird species that pass through the region in large numbers during spring and fall migrations. Under the proposed action, each of these categories of birds may be affected by routine operations or by accidental oil releases.

Routine Operations

Routine activities associated with the proposed action that may affect marine, coastal, or terrestrial birds in the Gulf of Mexico include (1) offshore structure placement and pipeline trenching, (2) offshore structure removal, (3) operational discharges and wastes, (4) OCS vessel and aircraft traffic, (5) construction and operation of onshore infrastructure (including new pipeline landfalls), and (6) noise. Potential impacts associated with these activities may include injury or mortality of birds from collisions with platforms, vessels, and aircraft; exposure to operational discharges; ingestion of or entanglement with trash or debris; loss or degradation of habitat due to construction; and behavioral disturbance due to the presence of, and noise generated by, equipment and human activity. The nature and magnitude of effects on birds will depend on the specific location of an activity or completed structure (e.g., pipeline landfall construction occurs adjacent to a heron rookery, platform location), the timing of the activity (e.g., construction occurs during nesting), and the nature and magnitude of the activity (e.g., several miles of trenching through nearshore coastal habitats, the discharge of production water).

Offshore Structure Placement and Pipeline Trenching: The construction of new offshore structures is not expected to adversely affect local or migratory birds. Pipeline trenching may affect birds in nearshore coastal areas if trenching occurs in or near foraging or nesting areas. For many species, the effects would be primarily behavioral in nature, namely, the short-term avoidance or abandonment of habitats in the immediate area of trenching. Pipeline trenching near nesting colonies (such as heron rookeries) may disturb adults that are incubating eggs or feeding young, potentially affecting nesting success and resulting in a reduction of egg viability. Because trenching could result in some long-term loss of coastal habitat (see Section IV.B.2.h), habitat loss for some species may also occur. Such impacts could be avoided or minimized by locating pipeline corridors away from nesting aggregations and/or by scheduling trenching activities to avoid the nesting period.

In some coastal habitats, trenching may temporarily expose or mobilize food items and attract some species to the trenching locations. Some species may be beneficially affected following completion of offshore facilities. Local and migratory birds, including the endangered eastern brown pelican, commonly use offshore oil and gas production platforms as rest areas, as temporary shelters during inclement weather, or as resting and feeding stopovers during the spring and fall migrations (Baust et al., 1981; Russell, 2005). For example, in the fall, many migratory species (including waterfowl, shorebirds, blackbirds, sparrows, warblers, and thrushes) arrive at the Gulf Coast and then fly several hundred miles across the open waters of the Gulf of Mexico straight for Central and South America (Lincoln et al., 1998). This route appears to be preferred over the safer but more circuitous land or island routes by way of Texas or Florida. The use of offshore platforms probably increases survivability of individuals using these structures to rest or avoid bad weather conditions in the open waters of the Gulf (Russell, 2005).

Migrating birds may also collide with offshore platforms. Of the hundreds of millions of birds estimated to migrate across the Gulf of Mexico each year, annual bird mortality from collisions with major offshore platforms has been estimated at 200,000 birds in the northern Gulf of Mexico, with an average of 50 collision-deaths per platform per year (Russell, 2005). This is probably an underestimate of actual collision mortality incurred by migrating birds, as it is based only on birds recovered from the platforms; birds falling into the water are not reflected in these mortality estimates (Russell, 2005). Applying the 50 collision-deaths per platform per year estimate, new platforms constructed under the proposed action may result in up to about 25,000 bird collision mortalities per year of platform existence for the entire Gulf of Mexico OCS Region. This figure has to be adjusted to account for platform decommissions during the same time period in the Gulf. Table IV-1 indicates 700 platform removals using explosives. Typically about 70 percent of platform removals in the Gulf of Mexico have used explosives. Applying this ratio results in about 1,000 total platforms removed from the Gulf of Mexico during the life of the 2007-2012 Program. It is likely that most of the platforms removed will be from shallower areas of the Gulf of Mexico, where platforms typically are older, and that most of the new platforms will be in deeper water. This shift in the distribution of platforms in the Gulf of Mexico during the life of the proposed program could affect the ecological role of platforms for birds and the rate at which birds strike platforms.

Offshore Structure Removal: Under the proposed action, up to 1,000 existing platforms could be removed from the Gulf of Mexico planning areas. Because many marine and migratory birds are attracted to platforms, there is a potential for some individuals being affected by platform removal. Typical platform decommissioning involves dismantling many of the above-platform structures followed by the use of underwater explosives or mechanical methods to collapse or sever the platform. Birds using a platform undergoing decommissioning would likely leave the platform during dismantling activities. Any remaining birds would be startled by the underwater detonations and quickly leave the collapsing structure. Thus, impacts to birds from decommissioning activities under the proposed action would be expected to be short-term and result primarily in behavioral effects.

The explosive removal of offshore structures would not adversely affect any of the birds listed under the ESA as evidenced by a 1998 biological opinion by the NMFS that concluded structure removal would not jeopardize birds listed under the ESA (NMFS, 1988). In addition, the MMS has established guidelines for explosive platform removals (30 CFR 250) meant to protect marine life and the environment and specify procedures and mitigation measures to be taken to minimize potential impacts. The MMS conducts detailed technical and environmental reviews of proposed removal projects to ensure that listed species would not be impacted, and these reviews include consultation with the NMFS and FWS. Thus, compliance with the MMS guidelines should further reduce the likelihood that offshore structure removal would impact listed birds.

Operational Discharges and Wastes: A number of operational discharges and wastes have the potential to affect marine, coastal, and migratory birds. Operational wastes may include produced water, drilling muds, and drill cuttings discharged from offshore platforms, waste fluids produced on OCS vessels, and trash and debris generated on platforms and vessels.

The discharge of production wastes into open water is prohibited in coastal waters but permitted in marine waters under the NPDES program (see Section IV.B.2.b). Produced water, drilling muds, and drill cuttings are routinely discharged into offshore marine waters in compliance with applicable regulations and permits, and would continue to be so under the proposed action. These materials may contain a variety of constituents (e.g., trace metals, hydrocarbons) that may be toxic to birds. In marine waters, birds could be exposed to these materials by direct contact or through the ingestion of contaminated food items. Birds most likely to be exposed to discharges from offshore production locations are those that forage on fish in offshore waters and may frequent offshore facilities; these include pelicans, frigatebirds, gannets, and terns.

Among the threatened and endangered species present in the Gulf of Mexico planning areas (see Section III.A.7), with the exception of an occasional transient individual, only the endangered eastern brown pelican would be expected at offshore platforms with any regularity. This species forages for fish up to 64 km (40 miles) from shore. Because this species does not normally go further into the open Gulf, any exposure that might occur would be at platforms located within 64 km of the U.S. coastline. The threatened roseate tern, which is known to occur in oceanic waters, occurs within the Florida Keys and southeastern Florida (FWS, 1999c; Florida Fish and Wildlife Conservation Commission, 2003). These areas are located hundreds of kilometers away from areas in the Gulf of Mexico where oil and gas leasing and development might occur under the proposed action (Fig. II-2). Therefore the roseate tern would not be expected to be exposed to production wastes generated at offshore facilities.

Upon discharge in accordance with permit specifications, these materials would be rapidly diluted in the water column (i.e., to ambient levels within several thousand meters of the discharge site [see Section IV.B.2.b]) and dispersed by currents, thus greatly reducing the magnitude of exposure that a bird might incur. If constituents of the discharged materials bioaccumulate or biomagnify, There is a potential that some birds may be exposed through their food if constituents of the discharged materials bioaccumulate or biomagnify through the food chain. Field studies have shown that the concentrations of trace metals, hydrocarbons, or NORM in the tissues of fishes collected around production platforms are within background levels (Neff, 1997). Thus, food chain uptake is not a likely exposure pathway for fish-eating birds at offshore facilities.

Some bird species may also experience sublethal effects if the discharges reduce the abundance of prey species (NRC, 1983; API, 1989; Kennicutt, 1995). However, because of the rapid dilution that would occur, potential impacts to prey populations inhabiting the water column (e.g., fish, plankton) would likely be limited in extent and not be expected to affect overall prey abundance. While some production-related contaminants reach sediments and reduce macroinfaunal abundance (Rabalais et al., 1998), the potentially affected macroinvertebrate biota would be at depths beyond the diving limits of birds.

Many species of marine birds (especially gulls) often follow ships and forage in their wake on fish and other prey injured or disoriented by the passing vessel. In doing so, these birds may be affected by discharges of waste fluids (such as bilge water) generated by OCS vessels. When allowed, discharges of such wastes from OCS service and construction vessels would be regulated under applicable NPDES permits (see Section IV.B.2.b), and any discharged wastes would be quickly diluted and dispersed and, thus, would not be expected to impact marine birds.

Marine and coastal birds may become entangled in or ingest floating, submerged, and beached debris (Heneman and the Center for Environmental Education, 1988; Ryan, 1987, 1990). Entanglement may result in strangulation; injury or loss of limbs; entrapment; or prevention or hindrance of the ability to fly, swim, or feed, and all of these effects may be considered lethal. Ingestion of debris may irritate, block, or perforate the digestive tract; suppress appetite; impair digestion of food; reduce growth; or release toxic chemicals (Fry et al., 1985; Dickerman and Goelet, 1987; Ryan, 1988; Derraik, 2002). However, the discharge or disposal of solid debris into offshore waters from OCS structures and vessels is prohibited by the MMS (30 CFR 250.40) and the U.S. Coast Guard (MARPOL, Annex V, Public Law 100-220 [101 Statute 1458]) and, assuming compliance, entanglement in or ingestion of OCS-related trash and debris by marine and coastal birds would not be expected under normal operations.

OCS Vessel and Aircraft Traffic: Under the proposed action, up to 500 vessel and 5,000 helicopter trips may take place weekly within the Gulf of Mexico planning areas. Birds may be affected in following ways by this traffic: disruption of natural behaviors (such as feeding or nesting) or short- and long-term abandonment of certain areas from OCS vehicle noise, injury or mortality through collision with a vehicle, or nests may be disturbed by excessive boat wakes.

Birds disturbed by the presence of an OCS vehicle may flee an area. Displaced birds would move to other habitats and may or may not return. In most cases, such displacement would not be expected to result in any adverse effects. However, if the displaced birds were occupying active nests, incubating eggs, or feeding and protecting hatchlings, even a short-term absence of the adult birds could increase predation of eggs or unfledged young, or reduce hatching success. Such an effect may result in local, population-level effects to the affected birds.

Numerous studies have examined the responses of birds to low-flying aircraft and atypical noise (see Noise discussion below). The results of many of these studies have indicated that many species of birds will habituate to low-flying aircraft and noise and exhibit no effects on reproductive success (Black et al., 1984; Andersen et al.,1989; Delaney et al.,1999).

Federal Aviation Administration guidelines for helicopter operations in the Gulf of Mexico request that pilots maintain a minimum altitude of 213 m (600 feet) while in transit offshore, 305 m (1,000 feet) over unpopulated areas or across coastlines, and 610 m (2,000 feet) over populated areas and sensitive habitats such as wildlife refuges and park properties (Federal Aviation Administration, 2004). Compliance with these guidelines regarding service altitudes for OCS helicopters would minimize disturbance of nesting or roosting birds within coastal areas.

Because OCS vessel traffic would occur largely within designated traffic lanes and not in waterways where birds may be nesting on beaches or other shoreline habitats, OCS vessel wakes would be expected to affect relatively few birds and their nests. Furthermore, low-wake or wake-free vessel speeds are required while transiting across waterways that have sensitive shoreline resources (such as shorebird nesting colonies). Thus, compliance with such requirements would further minimize potential wake-induced impacts to birds.

Construction and Operation of Onshore Infrastructure: Loss or alteration of preferred habitat due to new OCS pipeline landfalls could result in the displacement of individual or groups of birds from the impacted area(s), including the possible decrease in nesting activities. Some pipelines in the central and western Gulf of Mexico have been brought to shore through a directional drilling process (MMS, 2002a) in which pipelines pass beneath coastal habitats to emerge inland at an onshore receiving facility, away from coastal habitats. The use of this approach under the proposed action could greatly reduce or avoid impacts to coastal habitats that are important to marine and coastal birds.

Under the proposed action, six landfalls would be expected. This small number of landfalls that could occur under the proposed action would greatly limit the amount of coastal bird habitat that might be disturbed. In addition, siting of pipeline landfalls would consider the presence of sensitive habitats and areas, and avoid such areas to the maximum extent possible, further reducing the likelihood of impacting coastal bird habitats and the magnitude and extent of impacts to such habitats.

Noise: Noise generated during facility and pipeline construction and removal activities, and by OCS ships and helicopters, may affect birds in a variety of ways. Unexpected noise can startle birds and potentially affect feeding, resting, or nesting behavior, and often causes flocks of birds to abandon the immediate area.

Much of the research on effects of noise on wildlife has shown that noise may affect territory selection, territorial defense, dispersal, foraging success, fledging success, and song learning (Anderson et al., 1986; Gladwin et al., 1988; Larkin, 1996). In many cases, the effects are temporary, with the birds often becoming habituated to the noise. For example, weapons testing noise has been reported to have no significant effect on bald eagle activity or reproductive success, suggesting habituation of the birds to the noise (Brown et al., 1999). Studies of birds exposed to frequent low-level military jet aircraft overflights and simulated (with mortars, shotguns, and propane cannons) mid- to high-altitude sonic booms have shown aircraft and detonation noise to elicit some short-term behavioral responses but have little effect on reproductive success (Ellis et al., 1991). Birds of prey have been reported to habituate to low-level helicopter flights and exhibit no effects on their reproductive success (Delaney et al., 1999; Andersen et al., 1989), and low-level (<500 feet AGL) military training flights have been shown to have no effects on the establishment, size, and reproductive success of wading bird colonies in Florida (Black et al., 1984). On the basis of these studies, noise generated during normal operations would be expected to have short-term effects to resident and migratory birds, and would not be expected to result in long-term disturbance or population-level effects.

Accidents

In the event of an accidental oil release, birds may be adversely affected through direct contact with the spilled oil, by the fouling of their habitats and contamination of their food by the oil, and as a result of oil-spill response activities. Exposure of eggs, young, and adult birds to oil may result in a variety of lethal and sublethal effects. Fouling of habitats can reduce habitat quality, while contamination of foods may lead to a variety of lethal and sublethal toxic and physiological effects. Finally, oil-spill response activities may disturb birds in the affected habitat as well as nearby habitats that are unaffected by an oil spill.

Adult and young birds may come in direct contact with oil on the water's surface or on oiled beaches, mudflats, and other shoreline features. Oil may also be physically transferred by nesting adults to eggs or young. Direct contact with oil by young and adult birds may result in the fouling or matting of feathers, which would impact flight and/or diving capabilities, affecting such activities as foraging and fleeing predators. Birds that have been fouled by oil also experience a loss in the insulating properties of their feathers, making them susceptible to hypothermia during cold weather periods. Oil making contact with skin, eyes, or other sensitive tissues may result in an irritation or inflammation of skin or sensitive tissues (Fry and Lowenstine, 1985), while oiled eggs would incur reduced gas exchange.

Birds may ingest oil incidentally while foraging and while preening oiled feathers. Ingested oil may depress egg laying activity or may result in the death or deformities of young (Fry et al., 1985; Leighton, 1990). Direct effects of oil contact may be amplified under conditions of environmental stress such as low temperatures, migration movements, and molting. Indirect effects of oil contact include toxic effects from the consumption of contaminated food or starvation from the reduction of food resources (Lee and Socci, 1989). The latter effects may hinder the recovery of impacted bird populations after a spill (Hartung, 1995; Piatt and Anderson, 1996; Piatt and Ford, 1996).

Certain species of marine and coastal birds may be more susceptible to contact with spilled oil than others, based on their life histories. For example, diving birds and underwater swimmers such as loons, cormorants, and diving ducks may be the most susceptible to spilled oil because of their relatively long exposure time in the water and at the sea surface. Shorebirds and wetland birds may also be susceptible to direct oiling if a spill were to reach the beach intertidal zone or inshore wetland habitats, respectively, where these species forage and raise young. The magnitude of the impact would depend on the size of the spill, the species and life stage when exposed, and the size of the local bird population.

Spills in deep water are not likely to affect listed birds. With the exception of an occasional transient individual, none of the seven listed species would be expected offshore of the inner continental shelf where deepwater spills could occur. However, more data are needed to assess occurrence of the procellariiforms, sulids, and other open-ocean birds in the deepwater areas of the Gulf (Steve Cardiff, Louisiana State University, and David Moran, MMS, pers. commun.). The eastern brown pelican could be exposed if the spill moved into coastal waters where this bird forages, while the other listed birds would encounter spilled oil only if it reached coastal habitats. Deepwater spills would either be transported away from coastal habitats or prevented, for the most part, from reaching coastal habitats by natural weathering processes (see Section IV.B.2.b).

In contrast, a number of non-listed seabird species (e.g., terns, gulls, shearwaters, boobies, frigatebirds) could be exposed to deepwater spills. Some of these species are found only in pelagic areas of the Gulf of Mexico, while others inhabit waters of the continental shelf (see Section III.A.7). A number of these species are attracted to offshore platforms or often follow vessels. These birds may be directly exposed while feeding or resting in spills originating from deepwater platforms or transport tankers, and could incur lethal or sublethal effects. Depending on its size, location, and timing, a deepwater spill may affect only a few individuals or, as in the case of aggregations of overwintering gannets, a relatively large number of birds.

A shallow-water spill in an offshore or nearshore area has the potential to affect a greater number of bird species than would a deepwater spill of comparable size. Among the listed species that could occur within one or more of the planning areas, the eastern brown pelican has the greatest potential to be exposed to an offshore shallow-water spill. As previously discussed, this species may forage as far as 64 km (40 miles) from shore. The roseate tern breeds in scattered colonies along the Florida Keys and would not be exposed if a spill were to occur in the Central or Western Planning Areas.

The endangered Eskimo curlew and piping plover, and also the candidate snowy plover, are shorebirds that could be exposed if an oil spill were to reach the shoreline habitats (flats and beaches) used by these species for foraging or nesting. Because shorebirds tend to be flocking species and colonial nesters, spills reaching habitats used by these species could result in the exposure of a relatively large number of individuals. The endangered wood stork is a common inhabitant of inshore wetlands along the Florida and Alabama coasts. The endangered whooping crane overwinters on salt flats and coastal wetlands in the Western Planning Area at the Aransas National Wildlife Refuge in Texas. Either of these species could be affected if a shallow-water spill were to reach the habitats used by these species within the appropriate planning areas. The threatened southern bald eagle occurs throughout the Gulf States, roosting and foraging along a variety of coastal habitats in each of the planning areas. This species could become exposed by direct contact with floating oil while foraging for fish, and through the ingestion of contaminated fish or carrion (e.g., dead, oiled waterfowl washed up on beaches).

Should any of these species be directly or indirectly exposed to a nearshore spill, they could incur any of the variety of lethal or sublethal effects previously described for birds in general. Because of the very specific and limited winter habitat that supports the entire population of whooping cranes, a spill impacting this habitat could result in the complete loss of this species.

Accidental spills in shallow water could affect a wide variety of nonlisted species. In offshore locations, shallow-water spills could expose any of a large number of ducks, cormorants, terns, grebes, and gulls. Spills reaching shoreline habitats such as beaches, mudflats, and wetlands could affect shorebirds (e.g., sandpipers, plovers), wading birds (e.g., herons, bitterns), wetland birds (e.g., rails, coots, blackbirds), and a wide variety of migratory birds. Spills occurring during the fall or spring migrations have the potential to expose large numbers of birds in both nearshore coastal waters and in coastal habitats such as beaches, mudflats, and wetlands. The magnitude of impacts that could result from an accidental spill in shallow water would depend on the timing and size of the spill, the habitats that come in contact with the spill, and the species and numbers of birds exposed to the spill.

Besides being affected by the spill itself, marine, coastal, and migratory birds may be affected during spill containment and cleanup activities. During cleanup, some oiled birds could be successfully cleaned, and cleanup of the affected habitat could be necessary to avoid chronic exposure. Nesting or roosting birds in nearby habitats unaffected by the spill could be disturbed by cleanup of contaminated habitats. Coastal cleanup and remediation activities in coastal habitats may impact local populations of coastal birds, resulting in their temporary displacement from these areas. If the abandoned area is an important nesting habitat (especially during the breeding season), local population-level impacts may be incurred. The application of dispersant chemicals to spilled surface oil could also impact birds. While dispersant chemicals contain constituents that are considered to have low levels of toxicity when compared to toxic constituents of spilled oil (Wells, 1989), the effects of these dispersants on seabirds are poorly known. Because the use of these chemicals and spill cleanup activities would be localized and infrequent, potential impacts from spill response activities would largely be short-term in nature (e.g., avoidance of the cleanup area).

Conclusion

Under the proposed action, routine operations would impact some birds. The nature and magnitude of effects on birds would depend on the specific location, the timing, and the nature and magnitude of the operation, as well as the species and life stage that would be exposed to the operation. For most routine operations, the primary effect would be disturbance of birds in the immediate vicinity of the operation. Because birds tend to habituate to human activities and noise, potential impacts for many species associated with such disturbance would be short-term and would not be expected to result in population-level effects. However, depending on the time of year, construction activities near coastal habitats could disrupt breeding and nesting activities of colonial nesting birds, potentially impacting local populations. Some collision mortality may be expected for birds colliding with offshore platforms and, to a lesser extent, OCS-related helicopters. Collisions at offshore platforms may affect several thousand birds each year as they migrate across the Gulf in spring and fall. Because the discharge of production wastes and other materials generated at offshore platforms and OCS-related vessels is regulated, and because permitted production wastes discharged into marine waters would be quickly diluted and dispersed, relatively few birds would be exposed to these waste materials.

While routine operations could affect listed bird species in the same manner as nonlisted species (primarily behavioral disturbance), compliance with ESA regulations and coordination with the NMFS and FWS would ensure that lease-specific operations would be conducted in a manner that avoids or greatly minimizes impacts to these species.

Accidental oil spills pose the greatest threat to marine, coastal, and migratory birds, and could affect both birds and their habitats. Exposed birds may experience a variety of lethal or sublethal effects, including reduced reproductive success that could result in population-level effects. The magnitude and ecological importance of any effects would depend upon the size of the spill, the species and life stages that are exposed, and the size of the local bird population. Exposure to spills in deep water would be largely limited to pelagic birds, while shallow-water spills could affect the greatest variety and number of birds, including shorebirds, waterfowl, wading birds, gulls and terns. Birds that become heavily oiled by direct contact with a spill would likely perish, while lightly oiled birds may experience a variety of lethal or sublethal affects. Oil washing ashore may contaminate eggs and nest sites as well as foul foraging areas and food resources.

Spills in deep water are not likely to affect listed marine and coastal birds because none of the seven listed species would be expected to be offshore of the inner continental shelf where deepwater spills could occur. Most of the listed species could be exposed to shallow-water spills or to large deepwater spills that had moved into coastal waters. While the roseate tern is unlikely to be exposed because of its distribution well away from potential lease-sale and spill areas, the remaining listed species could be directly exposed while foraging in oiled flats, beaches, and coastal wetlands. Because the entire wild population of whooping crane winters in a very specific and limited habitat on the Texas coast, the entire population of this species may be especially vulnerable to a spill that reaches this location.

Spill cleanup activities may affect bird populations in the vicinity of the cleanup. Dispersants used during cleanup may have toxic effects to birds that become inadvertently exposed, while human and vehicle activities may disturb nesting populations or habitats in nearby areas.

e. Terrestrial Mammals

Routine Operations

The terrestrial mammals considered in this section are those species listed as threatened or endangered under the Endangered Species Act (ESA) that may be affected by routine OCS operations or accidents under the proposed action. These species include the Alabama, Choctawhatchee, Perdido Key, and St. Andrew beach mice, and the Florida salt marsh vole (see Section III.A.8). The beach mice are limited to habitats behind coastal foredunes on the Alabama and northwest Florida coasts; the vole is known from only one location, a Gulf Coast salt marsh at Waccassa Bay in Levy County, Florida (Figure III-6). The habitats of the Alabama, Choctawhatchee, and Perdido Key beach mice are designated as critical habitat under the ESA (50 CFR 17.95), while the habitats of the St. Andrews beach mouse and Florida salt marsh vole occur on protected or restricted lands (such as State lands and Tyndall Air Force Base).

Because the habitats of these five mammal species are located within protected areas, they are buffered from contact with existing OCS industry infrastructure. Under the proposed action, new pipeline landfalls would not occur along the Florida coast, where much of the beach mice habitat in the Gulf of Mexico occurs. New pipeline landfalls and onshore OCS-related facilities could be built within the Central Gulf of Mexico Planning Area and nearby coastal areas. The habitat for the Alabama beach mouse could potentially be affected by these activities. Construction of new pipeline landfalls or onshore infrastructure could impact these species if these facilities were located within or immediately adjacent to their habitats. However, any new pipeline landfalls and onshore infrastructure would need to comply with ESA consultations so as to be sited and constructed in a manner that would avoid impacting these species or their habitats. For example, the FWS and the U.S. Army Corps of Engineers (COE) review proposed dredge-and-fill activities and construction projects in waters of the United States where projects may affect the Florida salt marsh vole or its habitats. In addition, the occurrence of many of these species within protected areas further precludes these species or their habitats from incurring adverse impacts from the construction of new onshore infrastructure.

Accidents

In the event of an accidental offshore or coastal oil spill, the four beach mice species and the vole species could be affected by oil washing up on their beach habitats, and by subsequent spill containment and cleanup activities. Individuals coming in direct contact with spilled oil may experience skin, eye, and mucous membrane irritations. Oiling of fur may affect thermoregulation. Individuals inhaling petroleum vapors may aggravate linings of the respiratory system and in extreme cases may result in asphyxiation. Oil may be ingested through contaminated food or during cleaning of oiled fur. Exposure to oil via inhalation or ingestion may lead to a variety of lethal and sublethal effects, including lung, liver, and kidney damage.

In addition to affecting individuals, an oil spill may also affect the habitats of these small mammals. Oil contacting their habitats could result in a reduced food supply (oiled vegetation), reduced physical habitat quality (oiled sands), and fouling of nests and burrows. The fouling of nests and burrows may also lead to a temporary displacement from or permanent abandonment of these habitats. Depending on the persistence of the oil in these habitats and the effectiveness of spill cleanup, long-term reductions in overall habitat quality and quantity may be possible.

An accidental spill fairly close to shore would have the potential to contact beaches adjacent to beach mouse habitat, particularly if a spill were to occur nearshore or within inshore waterways. However, beach mice are generally restricted to interior dune habitats, which would not be expected to come in contact with spilled oil unless the accident occurred during a period of high storm surge. In contrast, habitats of the Florida salt marsh vole may be more vulnerable to an oil spill because of their connected nature to coastal waters. However, the location of this species and its habitat on the western Florida coast are far removed from those portions of the Gulf of Mexico OCS where exploration and development might occur under the proposed action.

If an oil spill occurs and contacts a coastal area associated with these species, oil-spill response activities, including beach cleanup activities and vehicular and pedestrian traffic, could result in habitat degradation. However, cleanup activities would be designed and conducted in consultation with the FWS and other appropriate stakeholders so that the potential for impacts to these species and their habitats would be minimized or avoided.

Conclusion

The four federally endangered Gulf Coast beach mice species and the federally endangered Florida salt marsh vole and their habitats would not be significantly affected by normal operations under the proposed action. Impacts are expected to be minimized through appropriate mitigation and the existence of these species' habitats in protected areas. Because of their locations on inner dunes, the habitats of the beach mice are unlikely to be affected by an accidental offshore oil spill. While the habitat of the Florida salt marsh vole could be affected by an oil spill, this species and its habitat are located far from areas where oil leasing and development may occur under the proposed action. Thus, it is highly unlikely that this habitat would be contacted by an accidental oil spill from OCS oil and gas activities.

f. Fish Resources and Essential Fish Habitat

(1) Gulf Sturgeon (Threatened Species)

Routine Operations

The placement of bottom-founded structures during the exploratory drilling phase may impact adult Gulf sturgeon (*Acipenser oxyrinchus desotoi)* and its designated critical habitat (50 CFR 226.214) directly and indirectly. Installation of seafloor anchors, jack-up rigs, and other mobile offshore drilling units (MODU's) disturb the seafloor, produce turbidity, and crush benthos. The areal extent of these disturbances corresponds approximately to the dimensions of each leg and anchor, generally on the order of several hundred to several thousand square meters. In addition, it is estimated that 4,000 miles of new pipeline and six new pipeline landfalls may be installed under the proposed action, which would disturb approximately 6,000 hectares (ha) of bottom area. These disturbances could affect adult Gulf sturgeon during cooler months of the year when they move from coastal rivers into inner shelf waters of the eastern and central Gulf (Continental Shelf Associates Inc., 1995). This is the primary feeding period for Gulf sturgeon, as feeding activity decreases during the upstream spawning migration (Huff, 1975; Mason and Clugston, 1993). Adult Gulf sturgeon can be expected to move out of an area of installation activity while each phase is completed. Depending upon the amount of disturbance, displaced fish may or may not return. Placement of structures during the exploratory drilling phase may also temporarily affect benthic invertebrate assemblages, which could indirectly affect bottom-feeding Gulf sturgeon by temporarily reducing a portion of the available prey base. Under the proposed action, it is assumed that approximately 75 percent of the exploration and development activities would occur in deepwater (>1,000 feet) areas of the Gulf of Mexico. Activities in deepwater areas would not affect Gulf Sturgeon, as adults entering marine waters appear to prefer shallow coastal waters of less than 10 m in depth (67 FR 39106-39199). While there is speculation that some adult Gulf sturgeon overwinter in waters up to 100 m deep west of the Florida Middle Ground (67 FR 39106-39199), there would be no exploration or development activity in the Eastern Planning Area under the proposed action. Consequently, only a small proportion of the areas of bottom disturbance could potentially be used by Gulf sturgeon.

Under the proposed action, it is assumed that explosives would be used to remove from 140 to 250 platforms in the entire Gulf of Mexico (Table IV-1). Explosive blasts can be lethal to fishes that may be present near the structure (Gitschlag, 2000). However, the Gulf sturgeon is not known to have an affinity for offshore structures, and, thus, they are not likely to be affected.

Most operational discharges and wastes are released at or near the sea surface and are diluted and dispersed rapidly in the ocean. Because the adult Gulf sturgeon is demersal, direct exposure to these discharges is unlikely. One exception would be drilling muds and cuttings, which settle to the seafloor near drill sites, generally within a few hundred meters (Neff, 1987). Although adult Gulf sturgeon are present on the OCS during cooler months of the year when they move from coastal rivers into inner shelf waters of the eastern and central Gulf, they are not known to have an affinity for structured habitat and occur in water shallower than that typically used for drill sites. Thus, they are not likely to be exposed to drilling muds and cuttings accumulations. Studies have indicated that there is no severe change to benthic invertebrate communities at sites contaminated with drill cutting solids (Neff et al., 2005) or significant bioaccumulation of metals from drilling muds in fishes living near actively discharging platforms (Kennicutt, 1995).

Produced water discharges are unlikely to have measurable impacts on Gulf sturgeon. Although several components of produced water, such as trace metals, hydrocarbons, and NORM, are potentially toxic to fishes, field studies have shown that levels of these components in fishes collected around discharging platforms are well below background levels (Neff, 1997). Produced water discharges dilute rapidly in the open ocean. Direct exposure to produced water would only occur in the water column near the discharge point. Unlike fishes that have pelagic adults and planktonic eggs and larvae, the Gulf sturgeon is a bottom dweller, and its eggs are deposited on the bottom of rivers far removed from produced water discharges, making exposure unlikely.

As discussed in Chapter III, hypoxic conditions exist on the Louisiana-Texas shelf. While there is a potential for normal operations from oil and gas production in the Gulf of Mexico to affect the extent and severity of the hypoxic zone through discharges and accidental releases, the location of areas affected by low oxygen levels (Fig. III-5) does not greatly overlap the distribution of Gulf sturgeon (Fig. III-7). Consequently, it is believed that discharges resulting from the proposed action will not affect dissolved oxygen levels in areas utilized by Gulf sturgeon.

The sources of underwater noise from oil and gas operations include seismic surveying, drilling and production operations, support vessels, helicopter traffic, and decommissioning operations. No information is available on the hearing or acoustic biology of Gulf sturgeon from which to assess effects. Evidence from several other fish species indicates that many fish species can hear sounds within the frequency ranges produced by OCS activities. The magnitude of effects is inversely related to the distance from the source due to attenuation of sound. The only noise sources strong enough to produce impacts other than behavioral disruption are seismic surveys. Since the seismic sources (airguns) are fired in the upper water column, Gulf sturgeon are unlikely to be affected. Adult Gulf sturgeon wintering in shelf waters of the Gulf of Mexico may be affected by sounds emanating from working platforms and their attendant operations. However, the most likely effects would be short-term behavioral disruption or avoidance of certain areas.

Accidents

It is assumed that up to 9 large spills greater than or equal to 1,000 bbl could occur in Gulf of Mexico planning areas as a result of the proposed action (4 pipeline spills, 4 platform spills, and 1 tanker spill) as identified in Table IV-4. The scenario developed for the analysis of the proposed action assumes that approximately 25 percent of activities, and consequently the potential for spills, occurs in waters less than 200-m in depth. Thus, under the proposed action, it is estimated that as many as 3 relatively large spills could occur in shallow-water areas: a platform spill (1,500 bbl) and 1-2 pipeline spills (4,600 bbl). Because platforms are typically located in water deeper than that utilized by Gulf sturgeon, pipeline spills are the only accidents in the scenario likely to affect Gulf sturgeon, and only pipeline spills in the Central Gulf of Mexico Planning Areas are relevant because this is the only area in the 2007-2012 Leasing Program where Gulf sturgeon occur.

Hydrocarbons from spilled oil can affect adult sturgeon by direct contact with gills or via direct ingestion. Toxic fractions of PAH's in spilled oil can cause death or illness in adult fishes, but exposure to these fractions must be continuous. Adult and juvenile fishes would likely avoid a large oil spill; however, the demersal eggs and riverborne larvae of Gulf Sturgeon would be unable to avoid spilled oil. Eggs and larvae of fishes would die or become deformed if exposed to certain toxic fractions of spilled oil (Longwell, 1977; Carls and Rice, 1990; Collier et al., 1996; Kingsford, 1996). The Gulf sturgeon deposits demersal eggs (which hatch in about 1 week) in freshwater reaches of the major rivers from eastern Louisiana to Florida, usually in deep areas or holes with current flow (Figure 3-7). Floating oil is not likely to penetrate to the middle reaches of most rivers where eggs are deposited because it would float on the freshwater outflow and never reach or settle directly on demersal eggs (Sulak and Clugston, 1998; Fox et al., 2000). Because significant levels of spilled oil are unlikely to reach areas where eggs and larvae of Gulf sturgeon would occur, accidents related to exploration, development, or production activities should not have any impact on these life stages.

Conclusion

Impacts on Gulf sturgeon associated with routine operations and accidents under the proposed action are expected to be minimal because there is relatively little overlap among the locations that could be affected by activities and the distribution of Gulf sturgeon.

(2) Other Fish Resources

Routine Operations

Installation of seafloor anchors, jack-up rigs, other MODU's, and platforms would disturb the seafloor. The placement of these bottom-founded structures can affect fish resources in several ways. The primary impact factors are sediment disturbance, crushing of benthos (prey for bottom-feeding fishes), and increased turbidity due to suspension of sediments. Emplacement of bottom-founded systems disturbs sediments and benthic organisms beneath each jacket leg. The areal extent of the seafloor disturbance corresponds to the dimensions of each jacket leg. Floating production systems produce similar impacts due to mooring anchors, turrets, and any subsea completions.

Hard-bottom areas, and therefore hard-bottom fishes, would probably not be directly affected by facility placement because they are protected by both lease stipulations and notices to lessees. The Topographic Features Stipulation applies to specific features on the shelf and establishes "No Activity Zones" where no operations, anchoring, or structures are allowed. There is also a lease stipulation for a number of lease blocks in the Central Planning Area that requires avoidance of significant hard-bottom features termed pinnacles in that area. In deep water, hard substrates are virtually all created by chemosynthetic activity and are considered one of the primary signatures for the potential occurrence of chemosynthetic communities. Due to this co-occurrence and other engineering considerations, hard bottoms are avoided. Pelagic and soft-bottom demersal fishes may move out of an area with installation activity. Depending upon the amount of disturbance, displaced fishes may or may not return. The disruption of benthic invertebrate assemblages could indirectly affect bottom-feeding fishes by reducing the available prey base. However, as identified in Section IV.B.2.i, the overall portion of seafloor habitat that would be disturbed during the leasing period would be a very small proportion of the overall habitat available. It is anticipated that affected fish resources would recover without mitigation within a relatively short period of time.

The effects of floating structures on migratory or feeding habits of epipelagic fishes such as tunas and billfishes are not known. However, concerns have been expressed that highly migratory species could be diverted from normal migratory routes and, consequently, from normal spawning or feeding areas because of attraction to structures such as oil platforms (Carney, 1997). Because of the highly migratory nature of many epipelagic species, such effects could extend to the regional scale. Floating structures used in exploration and production and their attendant mooring lines are known to act as fish aggregation devices (FAD's). In oceanic waters, the effect of FAD's would be most pronounced for epipelagic fishes such as tunas, dolphin, billfishes, and jacks. These species are commonly attracted to fixed and drifting surface structures (e.g., Holland et al., 1990; Higashi, 1994; Relini et al., 1994). Although little is known about their habits, vertically migrating mid-water fishes may also be attracted to or repelled by surface structures. The disruption of migrations could result in short- or long-term effects on the feeding behavior of oceanic fishes. The FAD effect mentioned previously would possibly enhance feeding of epipelagic predators by attracting and concentrating smaller prey species. It is possible that persistent regional effects on populations could result. However, this issue requires further study, and the possibility of the hypothesized impacts is speculative.

Structures associated with OCS activities can also affect the food resources and feeding behavior of demersal species. Deepwater and shelf fishes that feed on benthos would be displaced from small areas by placement of seafloor structures such as anchors, manifolds, wellheads, and pipelines. Some minor loss of benthic (epifaunal and infaunal) food items would also occur. The total seafloor area impacted under the proposed action would be extremely small, representing only a small fraction of the total seafloor available. Displacement would be a recoverable impact because fishes could move to adjacent areas. Localized damage to benthic communities would also recover without mitigation.

The use of explosives to remove bottom-founded platforms can kill or stun most of the fishes associated with the structures (Gitschlag, 2000). Studies conducted at platform removal sites in the central and western Gulf of Mexico by the NMFS (Gitschlag, 2000) estimated that between 2,000 and 6,000 fishes were killed during explosive removals in water depths ranging from 14 to 32 m. Sheepshead, spadefish, red snapper, and blue runner accounted for 89 percent of the mortality estimated by these studies. Projections of population-level effects were calculated for red snapper because this is the only species of that group managed by the NMFS. The estimates indicated that the overall mortality of red snapper contributed by explosive platform removal, even if doubled, would not add significantly to the mortality estimates already determined for the fished population (Gitschlag et al., 2000). Thus, it is anticipated that the affected fish populations would recover without mitigation.

In situ abandonment of bottom-founded structures, including mooring wires, anchors, and wellheads, would likely act as an artificial reef or have fish-aggregating effects on hard-bottom fishes. There are now numerous studies documenting the increased biomass of fish populations within and near platforms in the Gulf of Mexico (McKay et al., 2002). The direct or indirect impacts of abandonment in deep water cannot be determined, given that there is extremely limited information concerning the attraction of deepwater benthic fishes to seafloor structures. By comparison, the removal of structures on the shelf or in deep water would eliminate any fish attraction or artificial reef enhancement effects.

Operational discharges that have the most potential for affecting fishes are drilling fluids and drilling muds and cuttings and produced water. Water-based drilling fluids and cuttings would increase turbidity levels in the water column but would be localized and temporary. Increased turbidity would cause fish to temporarily move from the area. Synthetic-based fluids would have no effect on fish resources since they cannot be discharged. Cuttings that may have small amounts of SBF's adhered to them are discharged and would also temporarily increase turbidity. This increase would force fishes to leave the area, but they would be expected to return. Trace metal and hydrocarbon constituents of drilling fluids can be toxic to all life stages of fishes if exposed to high enough concentrations. Planktonic eggs and larval forms appear to be at greatest risk (e.g., Kingsford, 1996), while juveniles and adults passing through a discharge would not be adversely affected. Research has indicated that SBF cuttings produce an effect related to organic enrichment, especially with respect to benthic organisms that may serve as food for demersal fish species (Neff et al., 2005). At one study site, polychaete densities were over five-fold greater along the more contaminated area, and densities of demersal fishes were higher than those observed at other locations. The fish may have been drawn to the area by the disturbed sediments or more exposed benthic food sources. The abundance of the demersal fishes did not seem to have been adversely affected by the discharge of SBF cuttings. Where the highest SBF concentrations were observed, a smaller number of benthic fauna occurred in the more heavily contaminated sediments as compared with the cleaner sediments. This may cause a reduction in some fish species in an area of SBF cuttings if their preferred prey sources were reduced.

Produced water contains several toxic elements such as trace metals, hydrocarbons, and NORM (Neff, 1997). Direct and continuous exposure to produced waters can be lethal to all life stages of fishes. Direct exposure would only occur in the water column near the discharge point, thus pelagic adults and planktonic eggs and larvae are most susceptible. Eggs and larvae of fishes are commonly found in the surface waters of the open Gulf (Richards et al., 1993; Lycozkowski-Schultz, 1999). Higher impacts would be realized if eggs and larvae were unusually concentrated. Thus, local circulation patterns greatly influence the degree of potential impact. Nevertheless, population-level effects would not be likely, given the total volumes expected and the ability of receiving waters to quickly and effectively disperse discharges (i.e., to ambient levels within several thousand meters of the discharge). Produced water discharges are rapidly diluted, and the highest concentrations occur within 10 m of the discharge pipe. Despite the volume of produced water discharged into the Gulf of Mexico, any impacts would be localized and fully recoverable. Field studies have shown that the accumulation of trace metals, hydrocarbons, or NORM in the tissues of fishes collected around production platforms was within background levels (Neff, 1997).

All fish species in the northern Gulf are presumed to be able to hear, with varying degrees of sensitivity, within the frequency range of sound produced by exploration, production, and decommissioning activities. These sounds can mask the sounds normally used by fishes. Loud sounds may cause receiving fishes to change their behavior, and their movements may temporarily affect the usual distribution of animals in relation to commercial fishing. Continuous, long-term exposure to high sound pressure levels above 180 decibels (dB) has been shown to cause damage to the hair cells of the ears of some fishes under some circumstances; however, the one well-cited study documenting this effect in open water was in a shallow bay and the sound source repeatedly passed very close to fish in traps unable to move (McCauley et al., 2003). These conditions would not exist under natural circumstances. These effects may not be permanent since damaged hair cells are repaired and/or regenerated in fishes. It seems likely that most fishes exposed to airgun shots at a distance of a few meters could receive inner ear damage as a result of source levels in the range between 210 and 240 dB. As the distance between the fish and the sources increases, the probability of hearing impairment would decrease according to the nature of distance attenuation occurring.

Accidents

Any oil spill in the proposed program areas of the Gulf of Mexico could affect one or more fish populations (Tables IV-4). Impacts of spilled oil differ among various life stages of fishes. Hydrocarbons from spilled oil can affect adult fishes through direct contact with gills or through ingestion of spilled oil. Toxic fractions (polyaromatic hydrocarbons [PAH's]) of spilled oil can cause death or illness in adult fishes, but exposure to these fractions must be continuous. Adult and juvenile fishes should actively avoid a large oil spill; however, the planktonic eggs and larvae would be unable to avoid spilled oil and would likely die if exposed to certain toxic fractions of spilled oil. Most of the fishes inhabiting shelf or oceanic waters of the Gulf of Mexico have planktonic eggs and larvae (Ditty, 1986; Ditty et al., 1988; Richards et al., 1993). Although some common groups of fish, such as damselfishes and triggerfishes, deposit demersal eggs, the newly hatched larvae take up residence in the water column. These early life history stages are not likely to be adversely affected under the proposed action. Impacts would be potentially greater in areas where local-scale currents retained planktonic larval assemblages and the floating oil slick within the same water mass. Impacts of small spills are expected to be relatively minor. Because of the wide dispersal of early life history stages of fishes in the Gulf of Mexico surface waters, it is anticipated that only a relatively small proportion of early life stages present at a given time would be impacted by a particular oil-spill event and that populations would not be significantly affected.

Conclusion

Routine operations associated with the proposed action will not affect the overall fish population numbers or viability in the Gulf of Mexico. Effects of individual spills would depend on the location, timing, and volume of the spill, in addition to other environmental factors. Small spills that may occur under the proposed action are unlikely to affect a large number of fish before dilution and weathering would reduce concentrations of toxic fractions to sublethal or nonlethal levels and would, therefore, not have substantial effects on fish populations. It is anticipated that any single large spill would affect only a small proportion of a given fish population within the Gulf of Mexico and that fish resources would not be permanently affected.

(3) Essential Fish Habitat

Appendix D describes the legal requirements regarding Essential Fish Habitat (EFH). As described in Section III.A.4 most of the coastal and marine waters of the Gulf of Mexico are considered EFH for life stages of one or more managed species. Coastal and inshore waters are important juvenile habitat for several managed fish species. Habitat relationships among species and among life stages can be complex and can present a considerable challenge to fishery managers (Lindeman et al., 2000). Any activity that degrades coastal or marine environments would impact EFH (MMS, 1999). Similarly, the benthic environment is an important EFH component for many managed fish and invertebrate species. The MMS has consulted at a programmatic level with NOAA Fisheries on EFH for the Central and Western Gulf of Mexico Planning Area lease sales and has developed mitigation measures to reduce or eliminate impacts.

Routine Operations

Impacts of routine activities on EFH could occur as a result of disturbing bottom sediments during placement of drilling units and production platforms. Sediment-disturbing activities would result in increased turbidity, which would lower the water quality of EFH in small areas for a limited amount of time, typically causing fish to leave the areas. However, the sediments would eventually settle out and would not have a lasting effect on water quality. Placement of jacket legs would smother some benthic prey of managed species. Because the majority of oil development activities are likely to occur in the Central Gulf of Mexico Planning Area, that would also be the area with the most disturbed habitat. Installation of pipelines also disturbs, suspends, and displaces bottom sediments. The estimated bottom area EFH that may be disturbed by new pipeline installation ranges from 2,100 to 5,800 ha over the entire Gulf of Mexico.

Discharges of drilling cuttings would also occur in the two planning areas (Table IV-1). These discharges are known to alter the grain size distribution and chemical characteristics of sediments immediately surrounding the drill sites. This can change the benthic habitat for EFH prey species as well as spawning sites for red snapper, which prefers bottoms with fine sand away from reefs at depths of 18-37 m.

The effects of produced water, PAH's, and NORM on waters and substrate are discussed in Section IV.B.2.b.

Hard-bottom EFH areas of named topographic features should not be affected by the deposition of drilling muds and cuttings because of the lease stipulations preventing discharges in areas containing such habitat. Habitat areas of particular concern are subsets of EFH and within the proposed action area offshore include only the Flower Garden Banks and Stetson Bank, which are also protected by the Topographic Features Stipulation. These areas have substrates of high habitat value and diversity such as coral and other hard-bottom areas.

After new platforms have been established, sessile fouling organisms would colonize the underwater portions of the structures, which would attract prey and managed fish species (Wilson et al., 2003). Over time, this could change the spawning, breeding, and feeding patterns of some fish.

During decommissioning and structure removal, both explosive and nonexplosive methods may be used to sever conductors and pilings because of their combined thickness and sturdiness. With the exception of some water quality concerns, nonexplosive removals (e.g., abrasive, mechanical or diver cutters) have little impact to the fish resources except through the loss of habitat should fish assemblages develop on the structures. With explosive removal, impacts range from disturbance and habitat loss to injury. Possible injury to biota from explosive removal of structures can extend outward approximately 900 m from the detonation source and upward to the surface. On the basis of data collected by MMS, it is assumed that approximately 70 percent of removals of conventional, fixed platforms in Gulf of Mexico waters less than 400 m deep would be performed with explosives (MMS, 1996a); the majority of platform removals would likely be located in the Central Gulf of Mexico Planning Area. Removing structures would also remove the associated fouling communities that serve as prey for managed fish species, thereby forcing these species to relocate to other foraging areas.

Accidents

The EFH for many migratory fish species includes surface water habitat for the egg and larval stages of development. Oil spills would have an impact on EFH in surface water for planktonic eggs and larvae by trapping and killing eggs and larvae in the affected area. Wave and wind action, weathering, and biological degradation would dissipate oil in the surface water, and EFH would be reestablished. The period of time needed to reestablish appropriate EFH conditions following a spill would depend upon the characteristics of the individual spill and would be related to many factors, including the location of the spill, the nature of transporting currents, the magnitude of the spill, and the chemical characteristics of the spilled oil.

Of the accident scenarios considered under the proposed action, platform and pipeline spills in shallow, nearshore waters have the greatest potential to impact the coastal environment through degradation of EFH and other important habitats and associated fish, plant, and wildlife mortality. Coastal habitat areas of particular concern include nearshore areas of intertidal and estuarine habitats with emergent and submerged vegetation, sand and mud flats, and shell and oyster reefs. These areas provide food and rearing substrate for a variety of federally managed juvenile fish and shellfish. The EFH for many managed species and their prey includes coastal, estuarine, or wetlands as habitat for at least some portion of their life history.

Oil reaching the surface from deepwater pipeline spills and deepwater tanker spills could affect EFH for the eggs and larvae of federally managed pelagic fish species, neuston prey species, and Sargassum and its associated fauna. Pelagic eggs and larvae contacting the spilled oil would be smothered, and Sargassum within affected areas would be fouled and potentially killed. However, wave and wind action, weathering, and biological degradation would dissipate oil in the surface water, and EFH would ultimately be reestablished.

Blowouts can occur during exploration drilling, development drilling, production, or workover operations. Historically, about 23 percent of all blowouts result in oil spills. Typically, subsurface blowouts suspend sediment in the water column, disturbing the bottom within a 300-m radius (MMS, 1996a). Section IV.B.2.f provides information about the effects of increased turbidity on fish and associated benthic communities.

Conclusion

Considering the small proportion of EFH area that could be affected, potential impacts on EFH due to routine operations under the proposed action would be limited. The magnitude of impacts would also be limited by specific lease stipulations and site-specific analyses conducted for particular lease sales. Accidents such as petroleum spills and subsurface blowouts could also have effects on EFH. While most accidents assumed under the proposed action would be small and would have relatively small impacts on EFH, large spills that reach coastal wetlands could have more persistent impacts and could require remediation.

g. Sea Turtles

Routine Operations

There are five species of sea turtle that may be encountered in the Gulf of Mexico OCS planning areas: green, hawksbill, Kemp's ridley, leatherback, and loggerhead. All of these species may be found in the planning areas as hatchlings, juveniles, and adults. All but the hawksbill have been reported to nest on beaches within the Gulf planning areas, and the number and distribution of nests differ dramatically among these species across the bordering States (Section III.A.10). Under the proposed action, one or more of the life stages of these sea turtles could be affected under routine operations due to (1) offshore structure placement and pipeline trenching, (2) removal of offshore structures, (3) collisions with OCS vessels, (4) operational discharges and wastes, (5) construction and operation of onshore infrastructure, and (6) airborne and underwater noise. The potential for and degree of impacts from the proposed action are dependent on species as well as developmental stage.

Offshore Structure Placement and Pipeline Trenching: The placement of offshore structures and pipeline trenching may affect hatchling, juvenile, and adult sea turtles. Individuals coming in contact with construction or trenching equipment may be injured or killed; construction and trenching activities may temporarily affect habitat use; and habitats may experience short-term and long-term changes in abundance and quality.

Once hatchlings enter offshore waters, they are transported passively within the Gulf by ocean currents into areas of current convergence or to mats of floating Sargassum algae. Hatchlings originating from nest sites located within the planning areas as well as from other areas of the Gulf (such as the Yucatan peninsula) may be carried into the open-water environment of the northern Gulf of Mexico. Because hatchlings are not strong swimmers and undergo passive transport by currents, it is unlikely that they would be able to avoid or leave areas where pipeline trenching or structure placement is occurring, and, if present during offshore construction or trenching, they could be injured or killed.

In contrast, juvenile and adult sea turtles are active swimmers and, thus, may be able to avoid areas where construction or trenching is occurring. Sea turtles have been known to be killed or injured during dredging operations (Dickerson, 1990; Dickerson et al., 1992) and, thus, may also be affected during trenching activities. Juveniles or adults may also be affected if the placement of new structures occurs in foraging or developmental habitats or offshore of nesting beaches (see Section III.A.10 for a discussion of these habitats and areas). Following several years out in open water as growing hatchlings, juvenile sea turtles move into nearshore habitats for further growth and maturation. Adults also utilize nearshore habitats for feeding and may mate in nearshore habitats directly off of nesting beaches. In addition, females may become residents in the vicinity of nesting beaches. Offshore construction and trenching may reduce the quality or availability of foraging habitat for juveniles and adults, and may affect adult nesting behavior or access to nest sites. It is assumed that habitats such as seagrass beds and live-bottom areas commonly used by turtles for feeding or resting would be avoided during facility siting and pipeline routing, and that some soft-bottom areas affected by construction or trenching would recover (see Section IV.B.2.i).

Under the proposed action, up to 1,800 exploration wells and 2,600 production wells may be constructed and up to 4,300 miles of new pipeline may be installed among the Gulf of Mexico planning areas. At any single location, construction and trenching activities would be of relatively short duration (only until the offshore structure or pipeline is in place). Thus, any impacts incurred from structure placement or trenching would be short-term and localized to the construction area and immediate surroundings and, therefore, would likely affect relatively few juveniles or adults. Because they are passively aggregated by currents, a greater number of hatchlings may be affected if present in a construction or trenching area. However, these effects are not expected to result in population-level impacts.

Removal of Offshore Structures: Sea turtles are known to be attracted to offshore platforms and, thus, may be killed or injured during explosive platform removal (Klima et al., 1988; Gitschlag and Herczeg, 1994). However, the relative importance of oil-platform removal to overall sea turtle mortality (from human activities) is considered to be low (NRC, 1990; NOAA, 2003). Under the proposed action, approximately 140 to 250 existing platforms could be removed from the planning areas using explosives.

Mitigation measures, in the form of guidelines for explosive platform removals, have been established by the MMS with the cooperation of the NMFS. These guidelines require a mitigation plan that uses qualified observers to monitor the detonation area for protected species prior to and after each detonation. The detection of sea turtles within a predetermined radius from the structure prior to detonation would, without exception, delay structure removal. As long as operators comply with these mitigating measures, it is expected that impacts other than short-term behavioral disturbance would be avoided or greatly reduced, and no population-level effects would occur.

Collisions with OCS Vessels: Data show that vessel collision is a cause of mortality in sea turtles in the Gulf of Mexico, but the number of collisions with OCS-related vessels is unknown (Lutcavage et al., 1997). While juvenile and adult sea turtles may avoid areas with heavy vessel traffic, most species generally exhibit considerable tolerance to ships. Because of their limited swimming abilities, hatchlings would likely not be able to avoid oncoming vessels and, thus, may be more susceptible to vessel collisions, especially if aggregated in areas of current convergence or in mats of floating Sargassum. To date, there is no direct evidence of OCS vessel collisions with sea turtles (of any life stage) in the Gulf of Mexico.

The likelihood of such a collision would vary depending upon species and life stage present, the location of the vessel and its speed, and visibility. Hatchling turtles, including those aggregated in convergence zones or patches of Sargassum, would be difficult to spot from a moving vessel because of their small size and generally cryptic coloration patterns, which blend in with the color and patterns of the Sargassum. While adult and juvenile turtles are generally visible at the surface during periods of daylight and clear visibility, they may also be very difficult to spot from a moving vessel when resting below the water surface, and during nighttime and periods of inclement weather.

While sea turtles are distributed within nearshore waters and waters of the continental shelf throughout the Gulf, they appear to occur in greatest abundance east of Mobile, Alabama, in the Eastern Planning Area (Davis et al., 2000). Under the proposed action, the Eastern Planning Area would receive the least amount of OCS vessel traffic (no more than 25 trips per week); thus, the potential for sea turtle-boat collisions may be very low for the Eastern Planning Area. In contrast, there may be a greater potential for turtle-vessel collisions in the Western and Central Planning Areas, due to the large number of vessel trips in these areas (125 and 350 trips per week, respectively) that could occur under the proposed action. However, the MMS has implemented measures for all oil and gas operators in the Gulf of Mexico that require actions to minimize the risk of vessel strikes to protected species, including sea turtles, and reporting observations of injured or dead animals (see Notice to Lessees [NTL] 2003-G10). In lieu of a formal observer program, this NTL also provides specific guidelines for operators to follow to avoid injury to marine mammals and sea turtles. With compliance, the MMS expects these measures to reduce the potential for negative impacts to sea turtles from vessel collisions.

Operational Discharges and Wastes: Normal operations generate a variety of wastes such as produced water, drilling muds and cuttings, sanitary and other waste fluids, and miscellaneous trash and debris. Hatchling, juvenile, and adult sea turtles may be exposed to these wastes by permitted and accidental discharges from onshore and offshore facilities and OCS service and construction vessels. Produced water and drilling muds may contain a variety of constituents, such as trace metals, hydrocarbons, and NORM (Neff, 1997), which may be toxic to fish and wildlife, including sea turtles. Exposure to these wastes may occur through direct contact with the wastes in the ocean water and through the ingestion of food contaminated by one or more of the waste constituents. Because produced water and other liquid wastes would be rapidly diluted in the open ocean (i.e., to ambient levels within several thousand meters of the discharge), sea turtles would be expected to experience only very low levels of exposure from the water column. Species such as loggerheads and Kemp's ridleys that feed at the top of the food chain have been found to have higher tissue levels of bioaccumulative compounds than species feeding at lower trophic levels (Pugh and Becker, 2001).

While there is limited information regarding the levels of some contaminants (such as polychlorinated biphenyl [PCB's] and metals) in sea turtle tissues, little is known about what concentrations are within normal ranges of a particular species or what tissue levels may result in acute or chronic effects (Pugh and Becker, 2001; NOAA, 2003). In loggerhead turtles, chlordane concentrations have been negatively correlated with blood parameters indicative of anemia, and several classes of organic contaminants have been correlated with hepatocellular damage and possible alterations of protein and ion regulation (Keller et al., 2004).

Ingestion of, or entanglement with, accidentally discarded solid debris can adversely impact sea turtles. Ingestion of plastic and other nonbiodegradable debris has been reported for almost all sea turtle species and life stages (NOAA, 2003). Ingestion of waste debris can result in gut strangulation, reduce nutrient uptake, and increase absorbance of various chemicals in plastics and other debris (NOAA, 2003). Sublethal quantities of ingested plastic debris can result in various effects including positive buoyancy, making them more susceptible to collisions with vessels, increasing predation risk, or reducing feeding efficiency (Lutcavage et al., 1997). Some species of adult sea turtles, such as loggerheads, appear to readily ingest appropriately sized plastic debris. In oceanic waters, floating or subsurface translucent plastic material and sheeting may be mistaken for gelatinous prey items such as jellyfish. Entanglement in debris (such as rope and discarded fishing line) can result in reduced mobility, drowning, and constriction of and subsequent damage to limbs (Lutcavage et al., 1997). However, the MMS has implemented measures for all oil and gas operations in the Gulf to require marine trash and debris awareness training, recordkeeping, and certification requirements (see NTL 2003-G11). With compliance, the MMS expects these requirements to reduce the potential for negative impacts to sea turtles from discarded debris.

Produced waters, drilling muds, and drill cuttings are routinely discharged into offshore marine waters and regulated by USEPA NPDES permits and USCG regulations. Compliance with these permits and regulations will greatly limit the exposure of sea turtles to produced water and other wastes generated at offshore facilities and on OCS vessels. The discharge or disposal of solid debris from OCS structures and vessels is prohibited by the MMS and the USCG. Assuming compliance with these regulations and laws and only accidental releases, very little exposure of sea turtles to solid debris generated on offshore facilities and OCS vessels may be expected under the proposed action.

Construction and Operation of Onshore Infrastructure: Nests and emerging hatchlings may be affected by the construction of new onshore infrastructure such as pipeline landfalls. If present in a construction area, nests containing eggs or emerging hatchlings could be destroyed by clearing, grading, and other construction activities. Lighting from nearby construction areas or completed infrastructure may also affect hatchings emerging from nearby nests. Disorientation by nearby lights could increase exposure to predators, cause entanglement in vegetation, or lead hatchlings away from the surf (NRC, 1990). Onshore lighting may also draw hatchlings back out of the surf.

Among the five species present in the Gulf of Mexico, only hawksbill sea turtles have not been reported to nest within any of the planning areas (Section III.A.10). Thus, it is the other four species (green, Kemp's ridley, leatherback, and loggerhead) whose nests and emerging hatchlings may be affected by the construction and operation of new onshore infrastructure. However, given the small amount of onshore construction that could occur under the proposed action, it is unlikely that this construction would impact more than a few nests.

The potential for affecting sea turtle nests and emerging hatchlings by onshore construction would be greatly reduced through compliance with applicable statutes, regulations, and stipulations. The implementation of all mitigation measures required by statutes, regulations, and/or lease stipulations that have applied in past lease sales would also greatly limit the potential for impacts to nests and emerging hatchlings. Applicable mitigation measures may include preconstruction surveys for nest sites and delay of construction activities until hatchlings have emerged and moved into open water. In addition, onshore facilities could be located such that known nesting beaches would not be affected by construction and operation of such facilities.

Noise: Potential responses to noises generated during normal operations may be expected to be behavioral and may include avoidance of the noise source, disorientation, and disturbance of normal behaviors such as feeding. However, few studies are available that have examined sea turtle hearing sensitivity or noise-induced stress (Ridgway et al., 1969; Bartol et al., 1999); thus, it is largely unknown how sea turtles may respond to and be affected by noise generating during structure placement, drilling and production, pipeline trenching, vessel traffic, and explosive structure removal (Geraci and St. Aubin, 1987). Because some sea turtles, such as the loggerhead, may be attracted to OCS structures, these may be more susceptible to sounds produced during routine operations.

Noise generated by seismic surveys may affect sea turtles. Seismic surveys generate both high-frequency and low-frequency noise at levels up to 250 dB re 1 microPascal at 1 meter [µPa-m], and can be detected at distances up to 100 km or more in deep waters (Section III.A.10). These surveys are expected to be detected by sea turtles. Offshore drilling and production structures produce a broad array of sounds at frequencies and levels that may be detected by sea turtles within the area of the installation (Geraci and St. Aubin, 1987). These sounds are generally of relatively low frequencies, typically 4.5-30 Hz, and may be generated at sound levels up to 190 dB re 1 µPa-m. Helicopters and service and construction vessels may affect sea turtles due to machinery noise and/or visual disturbances (NRC, 1990).

Underwater explosions associated with the explosive removal of offshore facilities may disturb sea turtles or result in lethal and nonlethal injuries (MMS, 2005b). These explosions generate broadband sound, with levels of 267 dB re 1 µPa-m or more (Section III.A.10). Exposure criteria developed by the U.S. Navy (as cited in Frankel and Ellison, 2005) to evaluate the potential for impacts of impulsive sounds (i.e., underwater detonations) on marine biota include a sound level of 182 dB re 1 µPa-m. Using this criterion, a sea turtle may be affected if exposed to a sound level that exceeds 182 dB re 1 µPa-m. Depending on the size of the charges used in an explosive detonation, the surrounding water depth, and the distance to the nearest sea turtle, individual turtles in the vicinity of the facility undergoing explosive removal may experience a “take” sound level.

In advance of explosive severance activities, the MMS and NOAA Fisheries have implemented protocols to detect the presence of sea turtles within a 1,000-yard radius around decommissioning sites through observer programs operated by vessels, platforms and helicopters. Since 1987, these observer programs have documented takes of four sea turtles (all loggerheads) in the Gulf of Mexico as a result of explosive severance. Of these four takes, one animal was killed, one stunned and two injured (MMS, 2005b). Today, MMS continues to require these mitigation measures (see Appendix F of MMS, 2005b) and, with compliance, expects these requirements to reduce the potential for negative impacts to sea turtles from explosive removals.

Noise related to exploration, construction vessel passage, and facility removal may be expected to be transient, while noise generated during production may be more long-term. As few studies on sea turtle hearing sensitivities or noise-induced stress exist, a full understanding of physical and behavioral impacts from sounds generated during exploration, normal operations, and explosive facility removal is not available. Experiments using air guns to try to repel turtles to avoid hopper dredges have been inconclusive (O’Hara and Wilcox, 1990; Moein et al., 1995), while sea turtles exposed to an operating seismic source of 166 dB re-1µPa-m were shown to increase their swimming speed in response to the sound (McCauley et al., 2000). In addition, MMS has implemented mitigation measures for seismic surveys in the Gulf requiring ramp-up, protected species observer training, visual monitoring, and reporting for all surveys potentially affecting marine mammals and sea turtles (see NTL 2004-G01).

These measures were developed in consultation with NOAA Fisheries, and with operator compliance, they are expected to reduce the potential for impacts to sea turtles.

Accidents

All sea turtle life stages, as well as nest sites and eggs, may be exposed to accidental oil releases in the Gulf of Mexico planning areas. Nests may be exposed by oil washing ashore and soaking through overlying soils onto buried eggs, while hatchlings may be exposed as they emerge through the overlying oiled sands or as they make their way over oiled sands to the surf. Hatchlings, juveniles, and adults may be exposed while swimming through oil on the water surface, through inhalation of petroleum vapors, and through ingestion of contaminated foods and floating tar. Nesting adults (females) may also be exposed while coming ashore on oiled beaches. In addition to direct adverse effects from such exposures, adults and juveniles may also be indirectly affected if an accidental spill reduces the quality or quantity of foraging or nesting habitats. Impacts to nesting habitats could result in population level effects.

The magnitude and severity of impacts that could result from such exposures would depend on the location of the spill, spill size, type of product spilled, weather conditions, the water quality and environmental conditions at the time of the spill, and the species and life stage of the sea turtle exposed to the spill. The magnitude and extent of any adverse effects would also depend on how quickly a spill is contained and how quickly and effectively cleanup is accomplished.

Relatively few studies have examined or documented actual adverse effects of oil exposure on sea turtles or their eggs (NOAA, 2003). However, sea turtles accidentally exposed to oil or tarballs have been reported to incur a variety of conditions, including inflammatory dermatitis, breathing disturbance, salt gland dysfunction or failure, hematological disturbances, impaired immune responses, and digestive disorders or blockages (Vargo et al., 1986; Lutz and Lutcavage, 1989).

Sea turtle nest sites and emerging hatchlings may be exposed to and subsequently affected by oil spills that wash up on nesting beaches and contaminate active nests. Oil may interfere with gas exchange within an oiled nest, may alter hydric conditions of the sand so that it is too wet or too dry for optimal nesting, or may alter nest temperatures by changing the color or thermal conductivity of the overlying sand (NOAA, 2003). Adult females may refuse to use oiled beaches (NOAA, 2003).

Eggs exposed to freshly oiled sands may incur a significant decrease in survival to hatching and an increase in developmental abnormalities in hatchlings (Fritts and McGehee, 1982). In contrast, eggs exposed to weathered oil did not produce measurable impacts on hatchling survival or development, suggesting that impacts to nest sites would be greatest if the accidental spill occurred during the nesting season. Because most sea turtles nest above the high-tide line, and oil washing ashore would be deposited at and just above the high-tide line, oiling of actual nests is unlikely except possibly in the event of exceptionally high tides or storms.

Hatchlings may become oiled while traveling from the nest to water, and a heavy oil layer or tar deposits on the beach may prevent the hatchlings from reaching water. Oiled hatchlings may have difficulty crawling and swimming, increasing the potential for predation. Open-water convergence zones where hatchlings may aggregate are also areas where oil slicks may aggregate. For example, the Sargasso Sea has been estimated to annually entrap 70,000 metric tons of tar (NOAA, 2003). Because hatchlings spend more time at the sea surface, they will be more likely to be exposed to surface oil slicks than adults or juveniles. Post-hatchling sea turtles have been collected from convergence zones off of Florida with tar in their mouths, esophagi, and stomachs, and tar caking their jaws (Loehefener et al., 1989; Lutz, 1989; Witherington, 1994)). Ingested tar may result in starvation from gut blockage and decreased food adsorption efficiency, absorption of toxins, local necrosis or ulceration associated with gut blockage, interference with fat metabolism, and buoyancy problems (NOAA, 2003).

Sea turtles surfacing and diving in an oil spill may inhale petroleum vapors and aspirate small quantities of oil. While no information is available regarding the effects of petroleum vapors or aspirated oil on sea turtles, inhalations by mammals of small amounts of oil or petroleum vapors have been shown to result in acute fatal pneumonia, absorption of hydrocarbons in organs and other tissues, and damage to the brain and central nervous system.

Ingested oil, particularly the lighter fractions, could be toxic to sea turtles. Ingested oil may remain within the gastrointestinal tract, irritate and/or destroy epithelial cells in the stomach and intestine, and subsequently be absorbed into the bloodstream (NOAA, 2003). Certain constituents of oil, such as aromatic hydrocarbons and PAHs, include some well-known carcinogens. These substances, however, do not show significant biomagnification in food chains and are readily metabolized by many organisms. Hatchling and juvenile turtles feed opportunistically at or near the surface in oceanic waters, and may be especially vulnerable and sensitive to spilled oil and oil residues such as floating tar (Lutz and Lutcavage, 1987; Lutcavage et al., 1995). Tar found in the mouths of turtles may have been selectively eaten or ingested accidentally while feeding on organisms or vegetation bound by tar (Geraci and St. Aubin, 1987; Geraci, 1990).

Certain species of sea turtles may be at greater potential risk of exposure to spilled oil based on their distributions and habitat preferences and also on the timing of a spill. For example, loggerhead and Kemp’s ridley sea turtles frequent current-restricted areas such as bays and estuaries. Because oil entering these areas may remain for longer periods of time due to reduced weathering rates and natural dispersion, sea turtles utilizing habitats in these areas may incur longer exposure periods. Spills occurring in coastal waters of the Western Planning Area may affect greater numbers of green, hawksbill, loggerhead, and leatherback sea turtles during summer months when nearshore densities are greater than offshore densities.

Oil-spill response activities that may adversely affect sea turtles include artificial lighting at night, machine and human activity and related noise, sand removal and cleaning, and the use of dispersant or coagulant chemicals. Lights used to support nighttime cleanup activities may attract sea turtles to the spill location or disorient hatchlings emerging from nearby nests. Machine and human activity may cause a temporary avoidance of nearby habitats (including nest sites) by sea turtles, produce noise that may disturb sea turtles and also increase the potential for sea turtle collisions with vessels and onshore vehicles. Onshore activities may also crush existing nests and result in beach compaction reducing the suitability of existing nest sites for future use. Sand removal may also directly impact nest site habitat quality. While oil dispersants or coagulants contain constituents that are considered to be low in toxicity when compared to many of the constituents of spilled oil (Wells, 1989), there are little available data regarding the effects of these chemicals on sea turtles (Tucker and Associates, Inc., 1990).

Conclusion

Under the proposed action, some routine operations could affect individual sea turtles, but population-level impacts are not expected. Sea turtles could be directly affected by construction of offshore and onshore facilities and pipeline trenching, and also indirectly by short-term and long-term impacts to habitats. Sea turtles may also be exposed to a variety of waste materials, such as produced water, which have the potential to cause a variety of lethal and sublethal effects. Noise generated during exploration and production activities and platform removal may result in the temporary disturbance of some individuals, while some turtles may be killed during the use of underwater explosives for platform removal. The construction and operation of new onshore facilities may impact nest sites, possibly result in eggs being crushed, and disturb hatchling movement from the nest sites to the water. Sea turtles may also be injured or killed by collisions with OCS vessels. While sea turtles may be affected by one or more of these operations-related factors, many of the factors would be of short duration and localized and would likely affect relatively few sea turtles in the immediate project area. Existing permit requirements, regulatory stipulations, and MMS guidelines and required mitigation measures targeting many of the routine operations could limit the potential effects.

Any of the oil-spill scenarios developed for the proposed action (Section IV.B.1) may result in the exposure of one or more sea turtle life stages to oil or its weathered products. Oil may reduce egg hatching and hatchling survival and may inhibit hatchling access to water. Hatchlings, juveniles, and adults may inhale or ingest oil and oil vapors and may incur any of a variety of physiological impacts. The presence of oil slicks or oiled beaches may alter habitat use and affect nest site access and use. Small spills that may occur under the proposed action are unlikely to affect a large number of sea turtles or their habitats and are not expected to have long-term effects on sea turtle populations in the Gulf of Mexico. A large spill could affect many more individuals and habitats, including nesting beaches, and potentially may incur population-level effects. The magnitude of effects from accidental spills would depend on the location, timing, and volume of the spills; the environmental settings of the spills; and the species and life stages of sea turtle exposed to the spills. Because 75 percent of the development that is expected to occur during the 2007-2012 Leasing Program is assumed to occur far from the coast in deep and ultradeep water, the likelihood of a large spill occurring close enough to the coastline to affect turtle nesting beaches is expected to be small. The rapid deployment of spill-response teams and implementation of cleanup activities could limit the magnitude of impacts incurred by sea turtles in the event of an accidental spill; however, cleanup operations themselves could also impact sea turtle habitats.

h. Coastal Habitats

(1) Coastal Barrier Beaches and Dunes

Routine Operations

The potential effects on coastal barrier beaches and dunes from routine operations would primarily be associated with direct impacts from ground-disturbing activities during pipeline construction and indirect effects from maintenance dredging and vessel traffic.

Up to six new pipeline landfalls might be constructed in the Gulf of Mexico Region, with up to four being built in the Central Planning Area. Avoiding barrier beaches and dunes might be difficult when pipeline landfalls are being located in areas with extensive coastal barrier beaches and dunes. For example, barrier islands or beach or dune communities extend for miles along the Louisiana coast in the Central Planning Area and along the Texas coast in the Western Planning Area.

Trenching and excavation activities during pipeline installation would disturb sand beaches, dunes, or other barrier island habitats. In addition to the direct habitat losses that would result from excavation, erosion of sand beaches and dunes could be induced adjacent to pipelines. Stabilization of dune margins could be difficult, and establishment of vegetation cover might be slow, possibly resulting in prolonged losses of dune habitat near pipeline routes. Direct impacts to barrier islands are frequently avoided during pipeline construction by the use of non-intrusive construction techniques, and most pipelines are installed by directional boring under barrier beaches (MMS, 2002a). These modern construction methods result in no to minimal impacts to the barrier system (Wicker et al., 1989)

Maintenance dredging of barrier inlets and bar channels could contribute to the reduction of sediment deposition along barrier islands (MMS, 2002a). Reductions in sediment supply could subsequently contribute incrementally to losses of barrier beach habitat in areas of ongoing shoreline degradation, such as along the Louisiana coastal barrier islands in the Central Gulf of Mexico Planning Area. Beneficial use of dredge material, however, would mitigate some of these impacts.

Service vessel traffic to exploration and production wells could contribute to the erosion of barrier beaches. Up to 500 vessel trips per week could occur in the Gulf under the proposed action. Increases in wave activity from vessel traffic could contribute to the removal of sediments along barrier beaches in areas of the Central Planning Area that currently experience beach losses. Vessel traffic in the Central Planning Area could amount to up to 300 trips per week. Greater erosional effects might result from the use of larger vessels required for deepwater and ultra-deepwater exploration and development. Wave activity could be minimized by maintaining reduced vessel speeds in the vicinity of barrier islands.

Accidents

The potential effects on coastal barrier beaches and dunes from accidents would primarily be associated with impacts from spills of oil and other petroleum hydrocarbons, such as fuel oil or diesel fuel, and subsequent cleanup efforts. It is unlikely that a spill in deepwater areas would contact barrier beaches, because of the length of time it would take the spill to reach a shoreline and the natural degradation and dispersion/dilution that would occur in addition to expected containment actions. Contamination of beaches would more likely result from spills in shallow water. Because 75 percent of the development in the Gulf of Mexico during the proposed program is expected to occur in deep and ultradeep areas, the likelihood of a large spill contacting coastal landforms is low. Beaches could be impacted by oil spills, and the direct mortality of biota could result. Although beach and foredune areas are often sparsely vegetated, impacts to vegetation might occur if oil was carried to higher elevations by storm waves and tides.

Spilled oil might be located only on beach surfaces, or it could penetrate into subsurface layers. Permeable substrates, generally associated with larger sand grain sizes, and holes created by infauna could increase oil penetration, especially that of light oils and petroleum products. Although any residual oil that might remain following cleanup could be largely removed in highly exposed locations through wave action, oil could remain in the shallow subsurface for extended periods of time. In some locations, oil might become buried by new sand deposition. Natural degradation and persistence of oil on beaches are influenced by the type of oil spilled, amount present, sand grain size, degree of penetration into the subsurface, exposure to the weathering action of waves, and sand movement onto and off the shore. Spilled oil might be entirely absent from affected beaches within a year or less, or it might persist for many years with continued effects to infauna (Dahlin et al., 1994; Hayes et al., 1992; Petrae, 1995). On sheltered beaches, heavy oiling left for long periods could form an asphalt pavement relatively resistant to weathering (Hayes et al., 1992).

Spill cleanup operations might adversely impact barrier beaches and dunes if the removal of contaminated substrates affected beach stability and resulted in accelerated shoreline erosion. However, sand removal is generally minimized in areas of sand deficit, such as along the Louisiana coastline in the Central Planning Area. Foot traffic during cleanup might mix surface oil into the subsurface, where it might persist for a longer time.

Conclusion

Although routine operations could have impacts on coastal barrier beaches and dunes, primarily as a result of pipeline construction, maintenance dredging of inlets and channels, and vessel traffic, modern methods of pipeline construction result in minimal beach. MMS studies have shown few effects of pipeline landfalls and navigation channels on barrier beach stability. Potential impacts from spills could occur to both surface and subsurface sands. Oiled beach sediments could weaken dune and other beach vegetation, resulting in accelerated erosion. The likelihood of a large spill resulting in heavy oiling of a barrier beach area is expected to be low, however, because 75 percent of the development associated with the 2007-2012 Program is assumed to occur far from the coast in deep and ultradeep water.

(2) Wetlands

Routine Operations

The potential effects on wetlands from routine operations would be associated with the direct impacts from ground-disturbing activities during construction of onshore facilities, pipeline yards, processing facilities, or pipeline landfalls (Table IV-1), as well as the indirect impacts from decreased water quality and air quality and altered hydrology. Avoidance of wetlands during site selection for facilities might be difficult in some areas that have a high density of wetlands, such as along the Louisiana coast in the Central Planning Area.

The construction of pipelines through coastal wetlands would result in direct losses of marsh due to excavation for pipeline emplacement. Construction of navigation canals and channels would also result in losses of coastal marsh. Additional marsh losses would likely occur along pipeline routes and navigation channels because of the widening that would result from the continued erosion of adjacent marsh substrates and the subsequent marsh breakup as marsh habitat converted to open water (LCWCRTF, 2003). Canals might alter the hydrology of coastal marsh by affecting the amount, timing, and pathways of water flow (Day et al., 2000). Hydrologic alterations can result in changes in salinity and inundation, causing a dieback of marsh vegetation and a subsequent loss of substrate (LCWCRTF, 2001; Day et al., 2000). Spoil banks along the canals cover wetland vegetation and inhibit water movement in the marsh. Banks might prevent the effective draining of some adjacent areas, resulting in higher water levels or more prolonged tidal inundation; moreover, they could restrict the movement of water, along with sediments and nutrients, into other marsh areas (Day et al., 2000). Also, canals would create a means for saltwater intrusion into brackish and freshwater wetlands further inland and could result in mortality of salt-intolerant species. Canals could increase tidal processes, which would cause greater flushing and draining of interior marsh areas. These effects could result in shifts in species composition, habitat deterioration, erosion, and wetland loss (LCWCRTF, 1998, 2003). Maintenance dredging of canals would also contribute to increased flushing and draining of interior marsh areas by tides and storms. Marsh losses could be reduced by applying dredged material onto marsh surfaces in areas of high subsidence.

The construction of a facility near the coastline could potentially result in the direct loss of wetlands from the placement of fill material during building construction, as well as the construction of pipelines, access roads, and transmission corridors. Additional impacts of construction could include habitat fragmentation and isolation of wetland areas, altered hydrology from changes in surface drainage patterns or isolation of wetland areas from water sources, conversion to upland communities or open water, sedimentation and turbidity, and introduction of contaminants in stormwater runoff. Resulting changes in affected wetlands could include a reduction in biodiversity and the establishment and predominance of invasive plant species. Impacts to wetlands from construction could be minimized by maintaining buffers around wetlands and by the use of best management practices for erosion and sedimentation control. Construction in wetlands is managed and regulated by the appropriate State agencies and the COE. This document assumes that standard mitigation measures will be applied to any construction project associated with the proposed program.

Impacts to wetlands near constructed facilities might also result from other factors, such as reduced air quality. Exhaust emissions from equipment, atmospheric releases from processing facilities, or fugitive dust generated from exposed soils could have local adverse effects on vegetation. Disposal of wastes could also introduce contaminants into wetlands. Contaminants from land storage or disposal sites might migrate into soils and groundwater or could be present in stormwater runoff that could flow into wetlands. Contaminants might also be released to surface water in service vessel discharges, and they might affect wetlands. Impacts to wetlands could be minimized by implementing practices to minimize air quality and water quality impacts. Construction in wetlands is managed and regulated by the appropriate State agencies and the COE. This document assumes that standard mitigation measures will be applied to any construction project associated with the proposed program.

Coastal seagrass communities might be damaged by vessel traffic outside established traffic routes, which could result in long-term scars on seagrass beds (MMS, 2003c) (see also Section IV.B.2.i). The recovery rate would be greater for larger scars and low-density vegetation. Seagrass communities might also be impacted by trenching for pipeline installation. Turbidity from maintenance dredging of navigation canals or vessel traffic might adversely affect seagrass communities. Areas off Florida contain approximately 98.5 percent of all coastal seagrasses in the U.S. Gulf of Mexico, and activities associated with the proposed program will be located far from Florida coastal waters. Because of these factors, the proposed program is not expected to affect the condition of seagrass communities in the Gulf of Mexico. However, localized impacts to small areas of seagrass could occur in other coastal areas west of Florida.

Accidents

The potential effects on wetlands from accidents would primarily be associated with impacts from spills of oil and other petroleum hydrocarbons, such as fuel oil or diesel fuel, and subsequent cleanup efforts. Oil or other spilled materials might be transported to coastal wetlands by currents or tides. It is unlikely that a spill in deepwater areas would contact coastal marshes because of the length of time it would take the spill to reach a marsh and the natural degradation that would occur in addition to expected containment actions. Contamination of wetlands would more likely result from spills in shallow water, including those involving pipeline or vessel traffic routes through coastal marsh areas. Because 75 percent of the development expected as part of the proposed program in the Gulf of Mexico is likely to occur in deep and ultradeep waters, the chances of a large spill occurring close enough to shore to impact wetlands is small. Coastal wetlands of Louisiana might be exposed to the majority of the large spills that do occur close to shore of the spills, because of the anticipated exploration and development in the Central Planning Area.

Impacts to coastal marsh vegetation from oil spills could range from a short-term reduction in photosynthesis to extensive mortality and subsequent loss of marsh habitat as a result of substrate erosion and conversion to open water (Hoff, 1995; Proffitt, 1998). Vegetation that dies back could recover, even following the death of all existing leaves. Long-term impacts could include reduced stem density, biomass, and growth (Proffitt, 1998). Mangroves might decrease canopy cover or die over a period of weeks to months (Hensel et al., 2002; Hayes et al., 1992). Other effects of spills could include a change in plant community composition or the displacement of sensitive species by more tolerant species. In locations where soil microbial communities were impacted, effects might be long term, and wetland recovery might be slowed. The degree of impacts to wetlands from spills are related to the oil type and degree of weathering, amount of oil, duration of exposure, season, plant species, percent of plant surface oiled, substrate type, and oil penetration (Hayes et al., 1992; Hoff, 1995; Proffitt, 1998; Hensel et al., 2002). Higher mortality and poorer recovery of vegetation generally result from spills of lighter petroleum products (such as diesel fuel), heavy deposits of oil, spills during the active growing period of a plant species, contact with sensitive plant species (especially those located in coastal fresh marsh), completely oiled plants, and deep penetration of oil and accumulation in substrates.

Spilled oil remaining after cleanup degrades naturally by weathering processes and biodegradation caused by microbial communities in the soil. Full recovery of coastal wetlands might occur in less than 1 year or might require more than 5 years, depending on site and spill characteristics (Hoff, 1995). Oil might degrade very slowly in saturated soils under mangroves; more than 30 years could be required for mangroves to recover (Hensel et al., 2002). Oil could remain in some coastal substrates for decades, even if it was cleaned from the surface. Heavy deposits of oil in sheltered areas or in the supratidal zone could form asphalt pavements resistant to degradation (Hoff, 1995).

Spill cleanup actions might damage coastal wetlands through trampling of vegetation, incorporation of oil deeper into substrates, increased erosion, and inadvertent removal of plants or sediments, all of which could have long-term effects (Hoff, 1995; Proffitt, 1998). These actions could result in plant mortality and delay or prevent recovery. In locations where spill cleanup would include the excavation and removal of contaminated soils and biota, increased erosion and lowered substrate elevation could result in marsh loss by conversion to open water, unless new sediments were applied. Effective low-impact cleanup actions could include bioremediation, low-pressure flushing, or use of chemical cleaners (Mendelssohn and Lin, 2003; Hoff, 1995; Proffitt, 1998).

Conclusion

Routine operations could have direct impacts on wetlands as a result of direct losses of habitat from construction activities, pipeline landfalls and channel dredging, and indirect impacts as a result of altered hydrology caused by channel dredging. Construction impacts, while unavoidable, would be mitigated by State and Federal regulations governing construction in wetland areas. Oil spills could have direct impacts on wetlands by weakening and killing surface vegetation. Weakened wetland vegetation could lead to long-term to permanent destruction of wetland areas, particularly in an already stressed environment such as the Mississippi River deltaic plain. Cleanup operations themselves could also impact wetlands. However, the occurrence of a large spill close enough to the shoreline to result in heavy oiling of wetland areas is unlikely because 75 percent of the oil development associated with the 2007-2012 Leasing Program in the Gulf of Mexico is assumed to occur in deep and ultradeep water areas located far from the coast.

i. Seafloor Habitats

(1) Topographic Features

Topographic features or banks (e.g., South Texas Banks, West and East Flower Garden Banks, mid-shelf banks, shelf edge banks, and the Pinnacles/Carbonate Reef structures) in the Gulf of Mexico support sensitive hard-bottom species, including corals, coralline algae, sponges, and reef fishes. Major topographic features are scattered along the 200-m shelf break off the coasts of Texas, Louisiana, Mississippi, Alabama, and Florida (Figure III-10).

Routine Operations

Biological communities associated with topographic features could be affected by routine operations from such activities as placement and removal of structures and by operational discharges that could occur as a result of exploration, delineation, development, and production activities. Because of this potential, the MMS established a Topographic Features Stipulation in 1973 for specific lease blocks near these features. The stipulation establishes a "No Activity Zone" around several underwater topographic features. The crests of these features may contain important biological communities, including corals. The No Activity Zones are designed to protect the biota of these topographic features from adverse effects of routine offshore oil and gas activities by preventing emplacement of platforms and the anchoring of service vessels or MODU's on the features. In order to prevent drilling discharges from settling on biota associated with important topographic features, all drilling muds and cuttings must be shunted to within 10 m of the seafloor in locations within 1,000 m of banks that support low reef-building, antipatharian-transitional zones. For banks that support algal-sponge communities, a shunting zone that extends out 1 nautical mile from topographic features has been established for exploratory drilling, and a 3-mile zone has been established for shunting of drilling cuttings and fluids for development operations. This stipulation has been very effective in protecting the communities associated with topographic features, as documented by Rezak et al. (1983, 1985), so detailed analyses of potential impacts from routine operations were not conducted.

Accidents

In order to harm the biological communities associated with topographic features in the Gulf of Mexico planning areas, oil from a spill would have to reach the topographic surfaces in sufficient concentrations to elicit an effect. Oil from surface spills can sometimes penetrate the water column to documented depths of 20 m; however, at these depths, the concentrations of the various chemical components of spilled oil are typically several orders of magnitude lower than those demonstrated to have an effect on marine organisms. Given the water depths of the topographic features, it is unlikely that significant amounts of oil from surface spills would reach the sensitive communities.

The use of dispersants on surface oil spills in the vicinity of the topographic features could cause these compounds to reach the deeper reef areas. However, studies indicate that the effect of chemically dispersed oil on corals is no different from the effect of oil alone (Dodge et al., 1984; Wyers et al., 1986). In addition, Knap et al. (1985) found that when *Diploria strigosa*, a common massive brain coral at the Flower Garden Banks, was dosed with oil, it rapidly exhibited sublethal effects but also recovered quickly. Consequently, it is anticipated that, while the use of dispersants to treat spills can increase the mobility of particular fractions of spilled oil, the effects would be small and temporary.

As stated in Section IV.B.1, it is assumed that up to four pipeline spills of up to 4,600 bbl could occur in the Gulf of Mexico under the proposed action scenario (Table IV-4). If such spills occurred in deeper water in the vicinity of topographic features, the potential would exist for negative effects on the associated biological communities, depending upon the location of such spills. Pipeline spills that originated outside the No Activity Zones established by the Topographic Features Stipulation could be transported to the vicinity of a topographic feature by water currents. Because rapid dilution would be likely to occur as spilled oil was transported by currents and rose toward the water surface, subsurface oil spills would have to come into contact with a topographic feature almost immediately to have detrimental effects on the associated community. Consequently, the risk to these communities is relatively small. Because the topographic features are distributed over a wide area of the shelf edge (Figure III-10), the likelihood of any one subsurface spill reaching more than one feature would be smaller. In addition, the water currents moving around the banks would tend to carry the portions of the spill components around the banks rather than directly over the features, thereby lessening the severity of the impact (Rezak et al., 1983). Analyses of the potential effects of oil spills near banks indicated that, under worst-case conditions, crude oil reaching the biota of banks would not likely be directly lethal to corals or to most of the other biota present on the bank (Continental Shelf Associates, Inc., 1992c, 1994). Any effects associated with a spill reaching sensitive biota would most likely be sublethal, with recovery of those organisms likely occurring within an estimated 2 years (MMS, 2002c).

Conclusion

Routine operations could result in impacts to biological communities associated with topographic features from physical damage (e.g., by placement of structures or anchors) and operational discharges (e.g., drilling muds and cuttings). However, such physical impacts would be avoided through compliance with the Topographic Features Stipulation and the establishment of No Activity Zones. Potential impacts on topographic features could occur due to accidental oil spills under the proposed action, but are unlikely given the depth below the water surface at which the features occur, the no activity protection zones around the features, and the tendency for ocean currents to circulate around the features rather than across them. No long-term affects on the health and viability of these communities are expected from the 2007-2012 Leasing Program.

(2) Live Bottoms and Pinnacle Trend

Live bottom areas are located primarily on the continental shelf offshore of west Florida, in the Eastern Gulf of Mexico Planning Area (Section III.A.12.b). The pinnacle trend is located along the shelf edge offshore of Mississippi and Alabama (Fig. III-10 and Section III.A.12.c).

Protective lease stipulations exist for both the live bottom and pinnacle trend areas of the Gulf of Mexico. The Live Bottom (Pinnacle Trend) Stipulation, which applies to certain blocks in the Central and Eastern Gulf Planning Areas, requires a biological interpretation of a bathymetric and geophysical survey to determine whether pinnacle features are present before any bottom disturbing activities can occur. Since the pinnacle trend area is subject to high levels of natural sedimentation and turbidity, the stipulation does not contain any specific measures to protect the pinnacles from operational discharges. However, operators may be required to relocate operations to avoid damaging associated hard-bottom communities when anchoring or placing structures. The MMS also supports investigations through its Environmental Studies Program to locate hard and live bottom features and to understand their ecologies (Continental Shelf Associates, Inc., and Texas A&M University, Geochemical and Environmental Research Group, 2001). The MMS updates regulations and mitigations based on the data from these studies and from the biological interpretations of geophysical surveys, which reduces the risk of accidental damage.

Routine Operations

Activities related to routine operations that could potentially affect these areas include placement and removal of structures and release of operational discharges and wastes.

The installation of MODU’s or production platforms on the seafloor, with associated anchoring activities, would crush any organisms under the legs supporting the structure. Placement of structures and anchors in live bottom areas could damage the benthic community. However, the Live Bottom and Pinnacle Trend Stipulations are assumed to be effective in preventing most physical disturbances from anchoring and placement of structures. Damaged areas would eventually recover over a period of years. Thus, small areas may be temporarily affected by installation of MODU’s.

Pipeline placement and removal could also affect live bottom communities by suspending sediments. Suspended sediments could bury sessile invertebrates or clog filter-feeding mechanisms of some species. The pipeline and support ship anchoring activities could also cause physical damage to the hard-bottom structure in live bottom communities. Because the Live Bottom and Pinnacle Trend Stipulations require avoidance of such areas during pipeline placement, it is assumed that direct physical disturbance of these communities and the resuspension of sediments in live bottom areas would be minimized. Although some impacts might not be avoidable, suspension of sediments would be of short duration, and live bottom communities would typically recover within several years (MMS, 2002c).

Likewise, removal of platforms by means of explosives would disturb the seafloor and could affect nearby live bottom communities by suspending sediments in the water column. Deposition of suspended sediments could smother and kill some sessile animals near the site and might temporarily affect filter-feeding organisms. Most impacts on live bottom and pinnacle trend areas would be prevented because the existing stipulations preclude placing structures on or near these communities. In the event that live bottom areas were affected during removal of existing platforms, damaged areas would typically recover within several years (MMS, 2002c).

The discharge of drilling muds and cuttings could cause increased turbidity and localized deposition of sediments on the seafloor. Discharges of muds and cuttings in the vicinity of pinnacle and medium- to higher-relief hard-bottom communities in the central and northeastern Gulf of Mexico would not be likely to significantly affect the biota. These communities are usually adapted to life in somewhat turbid conditions and are often observed coated with a sediment veneer (Continental Shelf Associates, Inc., and Texas A&M University, Geochemical and Environmental Research Group, 2001). The existing bottom currents would also prevent the accumulation of large amounts of muds and cuttings. Additional deposition and turbidity caused by a nearby well should not significantly affect the live bottom areas, since discharges would be rapidly dispersed and would have little biological effect, except very close to the discharge point. In the pinnacle region, discharges have been measured to reach background levels within 1,500 m of the discharge point (Shinn et al. 1993). Documentation of an exploratory well adjacent to hard bottom in the pinnacle trend at a depth of 103 m, 15 months after drilling, showed cuttings and other debris covering an area of approximately 0.6 ha [Shinn et al., 1993]. The hard-bottom feature was found to support a diverse community, including gorgonians, sponges, ahermatypic stony corals, and antipatharians.

The discharge of muds and cuttings in the vicinity of low-relief, hard-bottom features with associated live bottom habitat could have a more significant impact if the hard bottom and biota were covered by the sediments. Due to the lower vertical relief, there would be a higher likelihood of at least localized burial of live bottom communities. This would be limited to areas in the immediate vicinity of the discharge point and would be more severe in shallower sites, where there would be less spreading of the discharge. Most impacts of drilling muds and cuttings discharges would be avoided as a result of compliance with (1) the Live Bottom Stipulation, requiring avoidance of live bottom areas; and (2) NPDES permit restrictions that limit the amounts and types of discharges allowed near live bottom areas. Because of these requirements, it is unlikely that significant areas containing live bottom communities would be affected by the discharge of muds and cuttings from drilling operations.

Produced water discharges could also affect the biota of pinnacles and hard-bottom features due to sediment contamination by moderate amounts of petroleum hydrocarbons and metals. This impact would be minimized by limitations in the NPDES permits, as well as by the Live Bottom Stipulation, which prevent the placement of oil and gas platforms in the immediate vicinity of live bottom areas or pinnacle features. The depth of the pinnacle features and live bottom areas, prevailing current speeds, and offsets of the discharges from the live bottom areas would also cause the produced waters to be substantially diluted before they could come in contact with sensitive biological communities. As a result, the impact of these discharges would be minor.

Accidents

As stated in Section IV.B.1, it is assumed that up to four 4,600-bbl pipeline spills could occur in the Gulf of Mexico Planning Areas under the proposed action scenario (Table IV-4). The effects from a major oil spill would be dependent upon the location of the particular spill and on various environmental factors, including water depth, currents, wave action, and other factors. Spills in deepwater areas or at the surface would be unlikely to affect the benthic communities associated with live bottom and pinnacle trend areas. For the purposes of this analysis, small spills (less than 1,000 bbl) were assumed to occur at the surface and, consequently, would have no effects on benthic communities.

Because of the stipulations that restrict placement of platforms and pipelines in the immediate vicinity of live bottom and pinnacle areas, the potential for impacts from oil spills is greatly reduced. If a large oil spill from a pipeline were to occur near a pinnacle or live bottom area, there could be lethal effects on the biota in localized areas that received large quantities of oil. In such cases, the community would recover once the area had been cleared of oil, although full recovery could take many years. In most cases, effects on sensitive biota would be sublethal, with recovery occurring within months to a few years. Consequently, it is anticipated that impacts on live bottom and pinnacle trend areas would be minor.

Conclusion

Impacts could occur on live bottom and pinnacle trend communities in the Central Gulf of Mexico Planning Area from routine activities and large spill accidents under the proposed action. However, physical impacts would be avoided through compliance with the Biologic Features Stipulation and the establishment of No Activity Zones. Potential impacts on live bottom and pinnacle features could occur due to accidental oil spills under the proposed action, but are unlikely given the depth below the water surface at which the features occur, the no activity protection zones around the features, and the tendency for ocean currents to circulate around the features rather than across them. No long-term affects on the health and viability of these features are expected from the 2007-2012 Program.

(3) Submerged Seagrass Beds

Seagrass beds are extremely productive marine habitats that support a tremendously complex ecosystem. Most of the seagrass beds in the Gulf of Mexico are located off the coast of Florida (Section III.A.12.d).

Routine Operations

Factors related to routine operations that could potentially affect submerged seagrass beds include placement of structures (pipelines) and vessel traffic (and operational discharges). Impacts from these activities could be minimized or avoided through the implementation of proper mitigation.

Most areas of extensive seagrasses occur in coastal and offshore Florida, areas not included in the 2007-2012 Leasing Program. The proposed action scenario includes six new pipeline landfalls that would occur in the States that border the Western and Central Planning Areas. Pipelines passing through coastal waters would be buried, with the trenching operations temporarily disturbing and displacing bottom sediments and producing turbidity along pipeline corridors. It is assumed that scattered and localized seagrass beds in these areas would largely be avoided in the routing of pipeline corridors through coastal and estuarine waters. Turbidity generated during pipeline trenching could produce small impacts on nearby seagrass beds. Support vessel traffic in coastal waters could disturb submerged seagrass beds. However, existing measures, including use of established navigation channels and speed limits in inland waterways, would prevent most impacts.

Accidents

Submerged seagrass beds could be damaged if an oil spill were to reach coastal waters. Deepwater spills would be less likely to affect coastal seagrass habitats both because they would typically be transported away from coastal areas and because natural weathering processes would prevent most of the oil from reaching the coast. The routes used by large oil tankers are typically located in deeper-water areas, and it is assumed that tanker spills would be unlikely to have large effects on coastal seagrass habitats. Pipeline spills occurring in deep water in the Central and Western Gulf of Mexico Planning Areas would be unlikely to affect seagrass beds because of their depth.

Seagrass beds include numerous plant and animal species that are sensitive to oiling. Impacts could include death of seagrasses and associated fauna; oil saturation and trapping by vegetation and sediments (thus creating a chronic source of pollution); mechanical destruction of seagrass beds during cleanup, and impacts due to the settling of flocculate if dispersants were used to treat oil on the ocean surface. Oil reaching seagrass beds would be difficult to clean up and would be likely to persist in fine sediments and vegetation. However, because the most extensive areas of seagrasses in the Gulf of Mexico occur in coastal and offshore Florida in areas not included in the 2007-2012 Leasing Program, it is unlikely that extensive seagrass areas will be contacted by an OCS oil spill.

Small oil spills could affect smaller, localized areas of submerged seagrass beds, although it is assumed that the impacts would be relatively small and the seagrass beds would typically recover without mitigation.

Conclusion

Impacts on submerged seagrass beds due to routine operations under the proposed action could occur in coastal and estuarine areas adjacent to the Central and Western Gulf of Mexico, resulting in localized impacts in areas of scattered seagrass occurrence. More extensive seagrass areas in coastal and offshore Florida would not be affected. A large spill's contacting coastal seagrasses in the Central and Western Gulf is expected to be unlikely because 75 percent of the oil developed under the 2007-2012 Leasing Program is assumed to occur in deep and ultradeep water far from the coast. More extensive seagrass areas near Florida would not be contacted by an oil spill because of the great distance between the 2007-2012 Program areas and these seagrass beds.

(4) Chemosynthetic (Seep) Communities

With the exception of a single known site on the Florida Escarpment in the eastern Gulf, known Gulf of Mexico chemosynthetic community sites are located in the Central and Western Planning Areas in waters deeper than 200 m (Figure III-11). However, it is presumed that such communities could occur almost anywhere on the continental slope of the northern Gulf of Mexico (see Section III.A.12.e).

Routine Operations

Routine operations that could affect chemosynthetic communities include structure placement and removal and operational discharges. Most impacts would be avoided due to existing mitigation measures, and overall, impacts on chemosynthetic communities from activities related to routine operations would be small.

Existing mitigation measures include NTL 2000-G20, which requires lessees operating in water depths greater than 400 m to avoid seafloor-disturbing activities within 76 m of areas that might support chemosynthetic communities. In these areas, operators are required to submit biological interpretations of data from a geophysical survey to MMS for review. If the MMS interpretation of the surveys indicates a possible chemosynthetic community, all platform, pipeline and anchoring activities must avoid the identified areas by a minimum of 76 m (250 feet) using a differential global positioning system. Also, the MMS Environmental Studies Program funds research to locate and understand the ecology of chemosynthetic communities. An example of a recently completed study is *Stability and Change in Gulf of Mexico Chemosynthetic Communities* (MacDonald, 2002). The MMS updates regulations and mitigations based on the data from studies and from the biological interpretations of geophysical surveys, which reduces the risk of accidental damage. While these requirements and procedures are believed to be effective in identifying and avoiding areas occupied by chemosynthetic communities, it is possible that some lower-density chemosynthetic communities would not be identified.

Chemosynthetic communities could be damaged as a result of anchoring and placement of structures (rigs, platforms, subsea wellheads, and pipelines) on the seafloor. However, the existing mitigation measures are assumed to be effective in avoiding most impacts. Chemosynthetic communities are spread throughout the deep areas of the northern Gulf of Mexico, which makes it unlikely that the damage to small areas of the bottom would threaten this resource as a whole. Affected sites could be repopulated from nearby undisturbed areas, although the rate of recovery would be slow (MacDonald, 2000).

Chemosynthetic communities could be buried or stressed by drilling muds and cutting discharges. However, in water depths where these communities are found, drilling muds and cutting deposits would be spread across much wider areas of the seafloor than in shallow sites on the continental shelf. The NTL 2000-G20 prohibits drilling muds and cuttings discharges within 457 m of areas that might support chemosynthetic communities. This makes it unlikely that chemosynthetic communities would be affected by these discharges.

Accidents

The only spills assumed under the proposed action scenario that would be relevant to chemosynthetic communities would be pipeline spills in deeper waters of the Gulf; oil from spills in shallow waters or at the surface would not appreciably contact the chemosynthetic communities found at depths below 200 m. Thus, it is assumed that up to four pipeline spills of 4,600 bbl could potentially affect chemosynthetic communities under the proposed action.

It is assumed that the mitigation measures required by the NTL 2000-G20 would continue to be effective in avoiding significant impacts from spills by ensuring that pipelines were not routed through or near chemosynthetic communities. Although petroleum hydrocarbons serve as a nutrient source for symbiotic microorganisms associated with macrofaunal species comprising the chemosynthetic communities, a large spill on the seafloor could have adverse impacts on the biota. However, oil from a pipeline spill would be dispersed by currents and would rise in the water column, thereby limiting the extent of chemosynthetic community habitat that would be affected by any given spill. Consequently, the proportion of chemosynthetic communities that could be affected would be unlikely to threaten the resource as a whole. It is anticipated that chemosynthetic communities affected by spills would recover without mitigation, although such recovery would likely be slow.

Conclusion

Existing mitigation measures enforced by MMS should eliminate most impacts from physical damage and operational discharges. It is possible that some low density chemosynthetic community sites could be affected. It is unlikely that a large pipeline spill would impact these communities given their natural tolerance for oil and the dispersion and dilution of the oil away from the seafloor that would occur as soon as the spill began.

(5) Other Benthic Communities

The seafloor on the continental shelf in the Gulf of Mexico consists primarily of muddy to sandy sediments populated by deposit-feeding infauna as well as by shrimps, crabs, and finfishes (Section III.A.12.f). The slope and deep sea consist of vast areas of primarily fine sediments that support benthic communities with lower densities and biomass but higher diversity than the continental shelf (Rowe, 2000). Due to the large geographic areas of the continental shelf, slope, and deep-sea habitats, and the widespread nature of the soft-bottom communities they support, activities occurring under the proposed action would disturb only a relatively small proportion of the resource and would have minimal impact on its diversity or productivity.

Routine Operations

Factors related to routine operations that could affect benthic communities of the continental shelf and slope include placement and removal of structures and the release of operational discharges and wastes.

Placement of MODU's and platforms would disturb the seafloor and could crush or bury soft-bottom benthic organisms. Jack-up rigs could disturb bottom sediments, and benthic organisms beneath and near the "feet" of the rig could be killed or displaced. Slightly larger areas of seafloor might be disturbed by anchors and chains from semisubmersibles or other floating drilling platforms. Jack-up rigs could disturb areas as large as the areal extent of the drilling rig itself (if no anchors were used), or the area falling within the radial pattern of positioning anchors (if used). Floating drilling structures would use either an anchoring system or dynamic positioning to maintain station. Anchored structures would typically use eight anchors, with the amount of bottom affected increasing with water depth due to the use of larger anchors and longer anchor chains. The installation of production platforms would also affect the area of the seafloor beneath the platforms where the legs entered the seabed and where subsea equipment (such as reentry collars and blowout preventers) was installed. The actual area of seafloor affected by anchoring operations would depend upon water depth, currents, size of the vessels and anchors, and length of anchor chain. Anchoring would most likely kill any benthic organisms hit by the anchor or chain during anchor deployment and recovery.

Flowline or pipeline placement or removal could also affect benthic organisms along the corridor. In water depths of less than 61 m, where pipelines must be buried, benthic organisms within the trenched corridor would be killed or injured, and organisms to either side of the pipeline would be temporarily buried by sediments. It is estimated that the total bottom area that would be disturbed by pipeline construction as a result of the proposed action would range from 2,100 to 5,800 ha. Based upon the relatively rapid rate at which benthic organisms typically recolonize disturbed areas, it is anticipated that disturbed benthic communities would recover over a period of months without mitigation and that impacts would be minor.

Under the proposed action, it is estimated that 400 to 500 new platforms would be placed in the Gulf of Mexico, which would disturb a total of 600 to 750 ha of seafloor. Combining the estimated bottom area that could be disturbed by all platform and pipeline construction activities under the proposed action, a maximum of 6,750 ha of seafloor area would be affected in the entire Gulf of Mexico (including the continental shelf, slope, and deep-sea habitats); this represents less than 0.008 percent of the estimated 80,000,000 ha of such areas in the entire Gulf. It is anticipated that soft-bottom benthic communities would recover from these localized disturbances over a period of months without mitigation and that the overall impacts of bottom-disturbing activities would be minor.

Structure removal activities could result in increased turbidity, temporary suspension of bottom sediments, and explosive shock-wave impacts. Deposition of suspended sediments could bury, smother, or kill some benthic organisms in the vicinity of work sites. Benthic organisms would be relatively resistant to the direct effects of underwater explosive blasts. O'Keeffe and Young (1984) found that oysters exposed to 300-pound (lb) charges in open water showed only 5 percent mortality at distances of 8 m. Crabs exposed to 30-lb charges at 8 m exhibited 90 percent mortality, while those exposed to the same charge at 46 m showed almost no mortality. The impacts from the explosive removals of the platforms would also be attenuated by the movement of the shock wave through the seabed because the charges typically would be set at 5 m below the seafloor surface. Under the proposed action, it is assumed that a total of 700 platforms would be removed using explosives. Assuming that each of these platforms occupied an average area of 2 ha, the total area to be disturbed during platform removal could be expected to be 1,400 ha. These estimates of bottom area disturbed via platform removal are small compared with total seafloor area in the entire Gulf of Mexico Region. In addition, because soft-bottom benthic habitats are typically recolonized relatively quickly following disturbances, benthic communities in disturbed areas would be expected to recover over a period of months without mitigation. Overall, impacts associated with removal of platforms would be expected to be minor.

The discharge of drilling muds and cuttings would be highly localized (generally within a few hundred meters of a drill site) and could result in the deposition of mud and cuttings to a thickness of up to 1 m directly below and around a platform. This could cause smothering of organisms, disruption of feeding patterns, and changes in sediment grain size in the immediate area. This impact would be short in duration, with repopulation of the area occurring by larval recruitment, although a different community might initially be recruited to the area because of the change in the grain-size distributions of the sediment in the affected area. The benthic community would eventually recover over a period of months to years without mitigation. Impacts would be minor.

Produced water discharges could cause an elevation of contaminants in sediments at water depths of less than 400 m, with localized impacts on benthic organisms possible within 100 m of the discharge point at some platforms on the inner continental shelf. After discharges ceased, the benthic communities in the affected areas would recover over a period of months to years without mitigation. Impacts would be minor.

Accidents

Pipeline spills are the only accidents considered that would be likely to affect seafloor habitats and benthic communities. Relevant spills in the proposed action scenario are four pipeline spills (up to 4,600 bbl. Other large spills would be assumed to occur at the surface, with little chance of affecting benthic communities. Small spills (Table IV-4) also are assumed to occur at the surface and would have no effects on benthic communities.

Oil spills from pipeline ruptures could affect benthic communities near the spill site. Benthic organisms could be smothered by oil or killed or stressed due to the toxicity of the hydrocarbons. Hydrocarbon concentrations would typically be diluted to background levels within a few hundred meters to a few kilometers of the spill site. The seafloor habitat would recover without mitigation due to natural breakdown of the oil, sediment movement by currents, and reworking by benthic fauna. The benthic community would probably recover more quickly from a shallow-water pipeline spill than from a deepwater pipeline spill, because of the greater potential for wave-induced suspension of sediments in shallow water. Due to the widespread presence of soft-bottom communities on the continental shelf and slope, it is anticipated that impacts from oil spills would be localized in nature and would affect only a very small proportion of such communities within the Gulf, and that the communities would soon recover through larval recruitment from adjacent areas. Consequently, impacts on soft-bottom benthic communities from accidents would be minor.

Conclusion

Impacts on soft-bottom benthic communities could occur due to routine operations and accidents under the proposed action. Only localized and short-term impacts are anticipated because of the small area potentially affected compared to the total area of soft-bottom habitat in the Gulf of Mexico.

j. Areas of Special Concern

(1) National Marine Sanctuaries

Routine Operations

The Flower Garden Banks National Marine Sanctuary (FGBNMS) is located offshore Texas and Louisiana in the Western Gulf of Mexico Planning Area (Fig. III-12) and contains the most significant topographic features in the northwestern Gulf of Mexico. The sanctuary has been described in Section III.A.13. Factors potentially affecting the FGBNMS include structure placement and releases of operational discharges and wastes. However, protective measures under the Topographic Features Stipulation would make such impacts unlikely. These measures include: (1) establishment of a “No Activity Zone” based upon the 100-m isobath instead of the 85-m isobath, and (2) implementation of a 4-mile zone rather than a 1-mi zone in which shunting of drilling muds and cuttings to within 10 m of the bottom is required. Stetson Bank, which was added to the sanctuary in 1996, does not have a 4-mile shunting zone; otherwise, it has the same protections as the Flower Garden Banks.

The Flower Garden Banks are dominated (up to 75%) by communities consisting of living corals that are sensitive to physical damage from anchoring and placement of structures on the bottom. However, the Topographic Features Stipulation precludes these activities within the No Activity Zone surrounding the banks. Assuming that operators comply with the stipulation, all related impacts would be avoided. Thus, impacts within marine sanctuaries from anchoring and placement of structures under the proposed action are not expected to occur.

Coral communities are also sensitive to turbidity and sedimentation. Drilling mud and cuttings discharges can cause increased turbidity in the water column and deposition of sediments on the corals and other reef biota. Produced water discharges could cause an elevation of contaminants in sediments, with localized impacts to benthic organisms possible within 100 m of the discharge point. However, the Topographic Features Stipulation precludes discharges within the No Activity Zones of each bank and requires shunting of drilling mud and cuttings discharges to within 10 m of the seafloor within a radius of 7.4 km (or 5.6 km for Stetson Bank). Discharges near the bottom in surrounding depths adjacent to these banks have been determined not to be capable of rising to shallower depths and onto the sensitive habitats (McGrail et al., 1982). Consequently, impacts to bank biota from such discharges would be negligible.

The Florida Keys National Marine Sanctuary (FKNMS) is located offshore of southern Florida in the Eastern Gulf of Mexico Planning Area (Fig. III-12). As described in Section III.A.13, this marine sanctuary contains various sensitive habitats, including coral reefs, seagrass beds, and mangrove shorelines. Zones have been established with special restrictions to protect sensitive habitats, and the final regulations for the FKNMS prohibit operation of a tank vessel or a vessel greater than 50 m in length (except public vessels) and leasing, exploration, development, or production of minerals or hydrocarbons within the sanctuary (62 FR 32153-32176). In addition, the proposed action does not include any activities within 500 km of the sanctuary. Because of these restrictions and the distance between activity zones and the marine sanctuary, routine operations from oil and gas exploration and production would not have any impact on the biota of the FKNMS.

Accidents

Accidents of greater than 1,000 bbl could occur in Gulf of Mexico Planning Areas as a result of the proposed action (4 pipeline spills, 3 platform spills, and 1 tanker spill) as identified in Table IV-4. It is assumed that a number of small spills could also occur. Platform spills and tanker spills at the ocean surface would be unlikely to affect bank communities because of the tendency for oil components to float and because of dilution at increasing depths. Since the crests of the two banks are at least 15 m below the surface, it is considered unlikely that the associated biological communities would be affected by the subsurface oil because concentrations of oil driven to this depth would be below that capable of causing lethal effects on bank communities. It is possible that a large pipeline spill from outside the No Activity Zones established by the Topographic Features Stipulations could reach the vicinity of the FGBNMS. However, because of the tendency for oil components to rise toward the surface and to be diluted as they are transported by water currents, such subsurface oil spills would have to come into contact with a bank feature almost immediately to have a substantial detrimental impact. Furthermore, it is anticipated that water currents moving around the banks would likely carry the majority of spill components around the banks rather than directly over the features, thereby lessening the severity of the impact. Any impacts associated with a pipeline spill reaching sensitive biota would most likely be sublethal effects, with recovery occurring within 2 years or less. The potential for impacts from spills would be largely avoided through the existing mitigation measures (i.e., No Activity Zones); if oil were to reach the banks, resources would most likely recover without mitigation.

Small spills under the proposed action are assumed to occur at the surface and would be unlikely to affect bank biota. Oil from surface spills can penetrate the water column to documented depths of 20 m. At these depths, however, oil concentrations are several orders of magnitude lower than those demonstrated to have an effect on marine organisms. Because of the water depths of the FGBNMS, it is unlikely that any significant amounts of oil from surface spills would reach sensitive communities.

The proposed action does not include any leasing activities near the FKNMS, with the nearest potential lease area located more than 500 km to the northwest of the sanctuary. The distance would prevent spills from either platforms or pipelines from reaching the sensitive reef communities of the sanctuary.

Conclusion

Potential impacts on the FGBNMS due to routine operations under the proposed action would be largely prevented by provisions of the Topographic Features Stipulation. While oil spills could affect the FGBNMS, it is unlikely that a lethal concentration of oil will contact the FGBNMS because of the Topographic Features Stipulation that prohibits exploration or development activities in the immediate vicinity of the banks, the subsea location of the features, and ocean current that circulate around the banks. The magnitude of the impact depends on the location of the spill, spill size, the type of product spilled, weather conditions, effectiveness of cleanup operations, and other environmental conditions at the time of the spill.

(2) National Parks, Reserves, and Refuges

Routine Operations

Routine activities potentially affecting parks, reserves, and refuges include placement of structures, pipeline landfalls, operational discharges and wastes, accidental oil spills and vessel and aircraft traffic. It is assumed that pipeline landfalls, shore bases, and waste facilities (Figs. III-14 through III-16) would not be located in national parks, national wildlife refuges, or national estuarine research reserves because of the special status and protections afforded these areas. Consequently, there would be no impacts from these activities on these resources in any Gulf of Mexico planning area.

It is possible that shore bases and waste facilities may be located in one or more estuaries in the Western or Central Gulf of Mexico Planning Areas that are included in the National Estuary Program including Corpus Christi Bay (Coastal Bend Bays and Estuaries), Galveston Bay, Barataria-Terrebonne Estuarine Complex, and Mobile Bay. It is assumed that new shore bases and waste facilities would be constructed in existing developed or upland areas and would not be sited in coastal habitats such as barrier beaches or wetlands. Therefore, impacts on estuarine habitats and biotic communities of the national estuary program sites would not be measurable.

Trash and debris from various sources, including OCS operations, frequently wash up on beaches, including those in areas of special concern such as the Padre Island National Seashore (PINS). The discharge or disposal of solid debris from both OCS structures and vessels is prohibited by the MMS (30 CFR 250.40) and the USCG (MARPOL, Annex V, Public Law 100-220 [101 Statute 1458]). Assuming that operators comply with regulations, most potential impacts would be avoided, although some accidental loss of materials is inevitable. It is difficult to estimate the amount of such materials that would be attributable to activities from the proposed action. Locally, accumulations of trash on beaches could require remediation (cleanup).

Over time, with a large number of vessel trips, vessel wakes can erode shorelines along inlets, channels, and harbors. It is assumed there would be no routine support vessel traffic in the harbors, channels, or waterways of the Eastern Gulf of Mexico Planning Area and, therefore, no impacts on the national parks, national wildlife refuges, or national estuarine research reserves located in Florida.

Of the national parks, only the PINS is located adjacent to areas in which oil and gas activities could occur. Other potentially affected areas are the national wildlife refuges inshore of the Western and Central Planning Areas (Table III-12) and two national estuarine research reserve sites in the Central Planning Area (Grand Bay and Weeks Bay). Existing mitigation measures limit vessel speeds in inland waterways and aircraft altitudes over areas of special concern. With these measures in place, most impacts to these areas of special concern due to vessel and aircraft traffic would be avoided.

Accidents

The potential exists for impacts on national parks, national wildlife refuges, national estuarine research reserves, or national estuary program sites if a large oil spill were to reach sensitive coastal habitats within these areas. Impacts could result from both oiling of the shoreline and mechanical damage during the cleanup process.

The scenario developed for the analysis of the proposed action assumes that 75 percent of all oil and gas development will occur in deep water. Applying this percentage to the assumed total number of assumed spills results in as many as 4 shallow-water spills (Table IV-4) could affect these areas of special concern: 1 platform spill (1,500 bbl), 1 tanker spill (5,300 bbl) and 1 to 2 pipeline spills (4,600 bbl). Spills taking place in deeper water are considered unlikely to affect coastal areas because they would either be transported away from coastal habitats by currents or substantially diluted by mixing and natural weathering processes, and related containment and cleanup activities would substantially reduce the amount of oil that reaches sensitive coastal habitats.

Among the national parks, only the PINS and Gulf Islands National Seashore could be potentially affected (Fig. III-12). Potentially affected national wildlife refuges are any of those listed in Table III-12 that are located in Texas, Louisiana, Mississippi, or Alabama. The potentially affected national estuarine research reserve sites are Grand Bay, Weeks Bay, and Rookery Bay. Also, the national estuary program sites of Corpus Christi Bay, Galveston Bay, Barataria-Terrebonne Estuarine Complex, and Mobile Bay could be affected.

Impacts on estuarine wetlands within areas of special concern would depend upon the size and specific location of the oil spill and the effectiveness of cleanup procedures. Impacts could include death of wetland vegetation and associated wildlife, oil saturation and trapping by vegetation and sediments (thus becoming a chronic source of pollution), and mechanical destruction of the wetland area during cleanup. Areas where coastal wetlands front directly on the open Gulf, such as those seen in the Central Gulf of Mexico Planning Area, are more vulnerable to spilled oil under the accident scenarios assumed above. Most oil contacting wetlands are not expected to have long-lasting adverse effects. Spills that damage wetland vegetation protecting canal and waterway banks could accelerate erosion of those banks (Alexander and Webb, 1987). Some areas may recover completely if proper remedial action were taken. Others may not recover completely, but the overall viability of the resource would not be threatened by a spill of 4,600 bbl or less. Although areas of special concern might also be affected by small oil spills (Table IV-4), it is assumed that the effects would be relatively small and that such areas would recover without mitigation.

Conclusion

Overall, impacts on national parks, national wildlife refuges, national estuarine research reserves, and national estuary program sites due to routine operations are expected to be limited under the proposed action because these areas are restricted from development. Impacts from oil spills are unlikely because of the assumption that 75 percent of the hydrocarbons developed as a result of the 2007-2012 leasing program in the Gulf of Mexico area will occur in deep water (> 330 m) usually located far from the shoreline. Should oil spills reach any of these sites, the impacts would depend on the location and size of the spill, the type of product spilled, weather conditions, effectiveness of cleanup operations, and other environmental conditions at the time of the spill.

k. Population, Employment, and Regional Income

Routine Operations

In 2005, the MMS developed a new economic impact model called MAG-PLAN (MMS Alaska-GOM Model Using IMPLAN), which retains the two-stage process of the older MMS models. The first-stage estimates the expenditures required to support the activity levels in a specific exploration and development scenario, and allocates these expenditures to the various industrial sectors in the onshore geographic units of interest. The activities are meant to be comprehensive, including exploration drilling, platform fabrication and installation, pipeline construction and installation, and various other construction and maintenance functions required to support the phases of development. The exploration and development scenarios, provided by MMS Resource Evaluation Division, are estimates of the oil- and gas-related activities that could plausibly take place as the result of the proposed action. High- and low-range estimates of activity drawn from this scenario form the basis for a range of estimates of employment and personal income effects.

The second step in the process is estimating how the initial dollars spent in a geographic area reverberate through the economy. Stage II of MAG-PLAN uses multipliers taken from the widely used IMPLAN model to estimate the employment, income, and other economic effects. For each of these economic effects, the model estimates the direct, indirect, induced, and total effects. In standard usage, the direct effects would refer to the spending of the oil and gas industry as a result of the projects being analyzed, as well as the employment, income, and other such effects caused by that spending. Indirect effects are those that arise from subsequent rounds of spending by contractors, vendors, and other businesses. Induced effects arise from the spending of worker households. However, while total effects remain the same, most "direct" MAG-PLAN estimates include the first round of indirect and induced effects. MAG-PLAN direct effects can be thought of as the effects of local payroll and nonpayroll expenditures of oil and gas companies, as well as of their immediate suppliers.

Table IV-7 shows totals of the direct, indirect, and induced employment and regional income for each of the economic impact areas (see Table III-13) of the Gulf States, the rest of the Gulf of Mexico, and the rest of the United States. The projections for the economic impact area (EIA) show a range of 20,250 to 34,700 jobs in an average year attributable to the proposed action (i.e. 11 lease sales). This amounts to less than 1 percent of the overall regional employment . In Texas, the range is 8,050 to 14,000 jobs. In Louisiana, it is 10,100 to 17,150. In the other Gulf Coast States, employment impacts will be much less. An additional 8,450 to 13,850 jobs are projected to occur in other areas of the Gulf states, as well as 15,850 to 27,325 jobs in the rest of the United States.

The additional jobs will create small but noticeable increases in the population of these regions. Using an historically observed ratio of 1.9 persons per new job, we would expect population increases of 38,500 to 66,000 over the life of the proposed action.

Accidents

Variables such as total volume of oil reaching land, land area affected, and sensitivity of local environmental conditions to spilled oil can have a considerable influence on oil-spill employment impacts. Primary resource extraction (excluding oil and mining activities) and tourism are the industry categories most sensitive to landfall of spilled oil. Primary resource extraction (primarily fishing and supportive agricultural services) is directly affected by environmental conditions. Similarly, the perceived aesthetics and recreational opportunities of the coastal environment affect tourism. Oil spills reaching land can have both short- and long-term effects on coastal recreation activities.

The primary impacts of oil spills would most likely fall on such activities as beach recreation (see Section IV.B.2.p), diving, commercial fishing and recreational fishing (see Section IV.B.2.q), and sightseeing. Past studies (Sorenson, 1990) have shown that there could be a one-time seasonal decline in tourist visits of 5 to 15 percent associated with a major oil spill. Since tourist movement to other coastal areas in the region often offsets a reduction in the number of visits to one area, the associated loss of business tends to be localized. Tourism and primary resource production activities largely shift to new coastal areas in the region.

The employment and regional income impact from an oil spill would likely be greatest in Texas and Florida. The highest concentration of tourism-related employment occurs in Florida, particularly within EIA's FL-3 and FL-4 (see Table III-27). Within these impact areas, tourism-related employment is concentrated in the Miami and Tampa-St. Petersburg labor market areas (LMA's) (Table III-28). In the Central Gulf of Mexico, the Houston-Galveston and New Orleans LMA's would also be affected due to their high concentration of tourism-related employment (EIA's TX-3 and LA-4, respectively).

Conclusion

Based on proposed action scenario assumptions, the employment and regional income impact of routine operations would likely be greatest in Texas and Louisiana. Even for the areas most affected, however, added employment demands would not likely unduly burden the local labor market. In areas with a large proportion of impact sensitive industry, such as tourism, the potential incremental impacts of oil spills would likely result in a one-time seasonal decline in business activity.

l. Sociocultural Systems

Routine Operations

The impacts on Gulf of Mexico sociocultural systems from routine operations are based on the amount of activity assumed to occur during the proposed action (Table IV-1). Continuing exploration and development in shallow-water areas will account for 25 percent of the activity during the proposed 5-year program, while deepwater operations will account for 75 percent. There will also be increasing activity on ultra-deepwater areas (> 1,500 m [5,000 feet]) amounting to 10 percent of all activities that occur as a result of the leasing program.

Section III.A.15 describes the historical effects of OCS activities on sociocultual groups in the region. These effects include alterations in ethnic composition, self-identity, and cultural persistence. The shift from shallow-water to deepwater operations has been associated with a number of trends that have affected coastal cultures and populations in the Gulf of Mexico Region. The global nature of deepwater activities has contributed to cultural heterogeneity with the importation of migrant workers. A recent study reports that industry employers often hire foreign-born Mexicans and Laotians workers in upstream support sectors such as ship and fabrication yards (Donato, 2004). These workers have assimilated into local communities affecting the ethnic mix in the area. The greater distance of deepwater platforms from coastal communities has resulted in workers being drawn from a wider range of locations in the Gulf of Mexico Region, making the ties between local subcultural groups and the offshore industry less consistent. The move father offshore into deep water has also led to longer offshore work shifts and to more "on call" schedules for many workers including technical experts and mariners (Austin et al. 2002). These trends will likely continue during the life of the 2007-2012 program based on the increasing activity levels in deep and ultra-deep water.

Accidents

Accidental oil spills may result from the proposed program. According to MMS (2002f), the probability that an offshore spill will occur and impact coastal communities is low. The magnitude of impacts of such releases depends on their location, size, and timing; however, they are expected to have only temporary physical or economic effects which should not alter sociocultural systems.

Conclusion

The most notable impacts to sociocultural systems that are anticipated from the proposed action are expected to result from the ongoing expansion of deepwater activities, which will create jobs that require longer, unbroken periods of work offshore, specialized skills, and in-migration of part of the workforce. Such changes can affect workers, their families, and the communities in which they reside. These trends have already brought important changes to the OCS industry, and the contributions to them by the lease sales associated with the proposed 5-year program are expected to be limited.

m. Environmental Justice

Routine Operations

The projected impacts of routine operations on environmental justice (EJ) are based on the amounts of expected exploration and development activity and associated onshore support and infrastructure construction resulting from the proposed 5-year program. The assumed amount of these activities is shown in Table IV-1. An EJ concern from these activities is the potential risk to residents from nearby OCS-related infrastructure, including helipads, heliports, waste management facilities, pipe coating yards, petrochemical plants, shipyards, platform fabrication yards, supply bases, natural gas storage facilities, repair yards, refineries, port facilities, and terminals. Each of these is associated with varying degrees of hazards that can potentially affect the environment, subsistence, health, and physical safety. In addition to the continuing use of existing onshore support and processing facilities, 3 new pipe yards, 6 pipeline landfalls, and 2 gas processing facilities are projected to be built as a result of the proposed 5-year program (Table IV-1). New construction impacts could include noise, increased traffic, air and water pollution, impacts to residential property values, and land-use changes.

The Louis Berger Group, Inc. (2004) describes the infrastructure types of concern and their geographic distribution in the Gulf of Mexico. These facilities are identified at the county level in Section III.A.16 along with counties and parishes with higher-than-average proportions of low-income and minority populations. The distribution of minority and low-income populations compared to the locations of existing infrastructure are depicted in Figures III-17 through III-22. While not a general pattern, in some instances the infrastructure of concern is located in counties and parishes with EJ concerns.

The effect of air emissions from OCS development on coastal air quality is another EJ concern. Sources of emissions derive from offshore exploration, development, pipeline and decommissioning activities, as well as from onshore support and processing facilities and from service vessel and helicopter traffic. Coastal effects from offshore activities are expected to be small based on the established and increasing trend toward movement of oil and gas activities into deeper waters of the Gulf of Mexico. This EIS assumes that 75 percent of the activity from the proposed 5-year program will occur in deep and ultra-deep waters.

Offshore air emissions are expected to be uniformly distributed across the coastal areas adjacent to offshore areas with the greatest amounts of oil and gas activity. The coastal areas of Texas and Louisiana are expected to receive the bulk of the air emissions, with lesser amounts in occurring in Mississippi and Alabama. The coastal areas of Florida are located so far from OCS activities that no EJ issues from OCS air emissions are expected to occur there. Furthermore, a more affluent population tends to inhabit the coastal areas of Florida, thus reducing EJ issues there.

Air emissions from onshore facilities and helicopter and vessel traffic traversing coastal areas will be highest in the areas containing the greatest amounts of infrastructure, which again will be Texas and Louisiana (Figs. III-14 and III-15). Lesser amounts will occur in Mississippi and Alabama. No onshore infrastructure supporting OCS operations currently exists in Florida, and none will be built as a result of the proposed program.

The effects of the 2007-2012 OCS Program on air quality have been analyzed in Section IV.B.2.a. This analysis concluded that routine operations associated with the proposed 5-year program would result in NO_2, SO_2, PM_{10}, and CO levels that are well within the national air quality standards (NAAQS).

Accidents

According to Table IV-4, up to 13 large spills greater than 1,000 bbl could occur in the Gulf of Mexico from the proposed action. In addition, up to 70 spills less than 1,000 bbl but greater than 50 bbl could occur along with up to 700 small spills less than 50 bbl. It is reasonable to expect that most of these spills will occur in deepwater areas located away from the coast based on the established trend for oil and gas activity to move into deep waters located for the most part at a substantial distance from the coast. The magnitude of impacts from such spills cannot be predicted, should they contact the coast, and depends on their location, size, and timing. However, according to MMS (2002f), the probability that an offshore oil spill occurring and impacting coastal populations is low. While the location of possible oil spills cannot be determined and while low-income and minority populations are resident in some areas of the coast, in general the coasts are home to more affluent groups. Low-income and minority groups are not more likely to bear more negative impacts than are other groups.

Conclusion

The proposed 5-year program will result in levels of infrastructure use and construction similar to what has been occurring along the Gulf Coast during previous programs. These activities are not expected to expose residents to notably higher risks than currently occur. While the distribution of offshore-related activities and infrastructure indicates that some places and populations in the Gulf of Mexico Region will continue to be of EJ concern, the incremental contribution of the proposed 2007-2012 OCS Program is not expected to affect those places and populations.

Air emissions from the proposed program are not expected to result in air quality impacts to minority or low-income populations. An analysis of air quality impacts elsewhere in the document shows that the emissions from the proposed program will not result in exceeding the NAAQS in any affected area.

No EJ impacts from accidental oil spills are expected because of the movement of oil and gas activities further away from coastal areas and the demographic pattern of more affluent groups living in coastal areas.

n. Archaeological Resources

Archaeological resources in the Gulf of Mexico Region that may be impacted by the proposed action include historic shipwrecks and inundated prehistoric sites offshore, and historic and prehistoric sites onshore. Historic shipwrecks tend to concentrate in the shallow, nearshore waters of the Gulf of Mexico; however, numerous recent discoveries of well-preserved historic shipwrecks in deepwater areas of the Gulf of Mexico have significantly altered our understanding of shipwreck potential on the OCS. The MMS is in the process of revising its archaeological survey requirements to ensure the detection of these deepwater shipwrecks prior to approving bottom-disturbing activities. Inundated prehistoric sites may exist on the continental shelf shoreward of about the 45-m isobath.

Onshore historic properties include sites, structures, and objects such as historic buildings, forts, lighthouses, homesteads, cemeteries, and battlefields. Onshore prehistoric archaeological resources include sites, structures, and objects such as shell middens, earth middens, campsites, kill sites, tool manufacturing areas, ceremonial complexes, and earthworks. Currently unidentified onshore archaeological sites would have to be assessed after discovery to determine the uniqueness or significance of the information that they contain. Sites already listed in the National Register of Historic Places and those considered eligible for the Register have already been evaluated as having the potential for making a unique or significant contribution to science.

Routine Operations

Routine activities associated with the proposal that are likely to affect archaeological resources include drilling wells, platform installation, pipeline installation and anchoring, as well as onshore facility and pipeline construction projects. While the source of potential impact will vary with the specific location and nature of the routine operation, the goal of archaeological resource management remains the protection and/or retrieval of unique information contained in intact archaeological deposits.

Direct physical contact between a routine activity and a shipwreck site could destroy fragile ship remains, such as the hull and wooden or ceramic artifacts, and could disturb the site context. The result would be the loss of archaeological data on ship construction, cargo, and the social organization of the vessel's crew, as well as the concomitant loss of information on maritime culture for the time period from which the ship dates. Ferromagnetic debris associated with OCS oil and gas activities could mask magnetic signatures of significant historic archaeological resources, making them more difficult to detect with magnetometers. Interaction between a routine activity and a prehistoric archaeological site could destroy artifacts or site features and could disturb the stratigraphic context of the site. The result would be the loss of archaeological data on prehistoric migrations, settlement patterns, subsistence strategies, and archaeological contacts for North America, Central America, South America, and the Caribbean.

Regulations at 30 CFR 250.194 allow the MMS Regional Director to require that an archaeological report based on geophysical data be prepared, if there are indications that a significant archaeological resource may exist within a lease area. For historic resources, this decision is based on whether a lease block falls within an area assessed as having a high potential for shipwreck occurrence, such as the entrances to historic ports and harbors, or whether an historic shipwreck is reported to exist within or adjacent to a lease area. For prehistoric resources, all leases shoreward of the 45-m isobath are required to have an archaeological survey prior to initiating exploration and development activities. If the survey finds evidence of a possible archaeological resource within the lease area, the lessee must either move the proposed activity to avoid the possible resource or conduct further investigations to determine if an archaeological resource actually exists at the location. If an archaeological resource is present at the location of proposed activity and cannot be avoided, the MMS procedures require consultation with the State Historic Preservation Office to develop mitigating measures prior to any exploration or development.

Federal, State, and local laws and ordinances, including the National Historic Preservation Act and the Archaeological Resources Protection Act, protect known sites and also as-yet-unidentified archaeological resources. Existing regulations require archaeological surveys to be conducted prior to permitting any activity that might disturb a significant archaeological site. Therefore, most archaeological resources will be located, evaluated, and mitigated prior to any onshore construction. New data related to the human history and prehistory of the Gulf coastal region likely will be produced from compliance-related archaeological projects associated with the proposal.

It is assumed for this analysis that the level of protection provided by existing laws and regulations is in place. However, a routine activity could contact a shipwreck if the MMS failed to require a survey because of incomplete knowledge of the location of all historic shipwrecks in the Gulf of Mexico. Such an event could result in the disturbance or destruction of unique or significant historic archaeological information. It is less likely that an inundated prehistoric site would be contacted by a routine activity because archaeological surveys are required on all leases that have any potential for prehistoric site occurrence.

Accidents

An accidental oil spill resulting from the proposed action could impact shipwrecks in shallow waters and coastal historic and prehistoric archeological sites. Archaeological resource protection during an oil spill requires specific knowledge of the resource's location, condition, nature, and extent prior to impact; however, the Gulf of Mexico coastline has not been systematically surveyed for archaeological sites. Existing information indicates that, in coastal areas of the Gulf, prehistoric sites occur frequently along the barrier islands and mainland coast and the margins of bays and bayous. Thus, any spill that contacted the land would involve a potential impact to a prehistoric site.

Should an oil spill contact a coastal historic site, such as a fort or a lighthouse, the major impact would be visual due to oil contamination of the site and its environment. This impact would most likely be temporary, lasting up to several weeks depending on the time required for cleanup. Gross crude oil contamination of shorelines is a potential direct impact that may affect archaeological site recognition. Heavy oiling conditions (Whitney, 1994) could conceal intertidal sites that may not be recognized until they are inadvertently damaged during cleanup. Crude oil may also contaminate organic material used in 14C dating, and, although there are methods for cleaning contaminated ^{14}C samples, greater expense is incurred (Dekin et al., 1993). An Alaskan study examining the effects of the 1989 *Exxon Valdez* oil spill on archaeological deposits revealed that oil in the intertidal zone had not penetrated the subsoil, apparently due to hydrostatic pressure (Dekin et al., 1993); however, due to the different environments, these results should not be translated into the Gulf coastal environment without further study.

The major source of potential impact from oil spills is the harm that could result from unmonitored shoreline cleanup activities. Unmonitored booming, cleanup activities involving vehicle and foot traffic, mechanized cleanup involving heavy equipment, and high pressure washing on or near archaeological sites pose risks to the resource. Unauthorized collecting of artifacts by cleanup crew members is also a concern, albeit one that can be mitigated with effective training and supervision. As Bittner (1996) described in her summary of the *Exxon Valdez* oil spill: “Damage assessment revealed no contamination of the sites by oil, but considerable damage resulted from vandalism associated with cleanup activities and lesser amounts were caused by the cleanup process itself.”

The National Response Team’s *Programmatic Agreement on Protection of Historic Properties During Emergency Response Under the National Oil and Hazardous Substances Pollution Contingency Plan* clarifies interagency and regulatory aspects of archaeological site protection during oil-spill response. This 1997 agreement outlines the Federal On-Scene Coordinator’s responsibility for ensuring that historic properties are appropriately considered in planning and during emergency response.

Conclusion

Assuming compliance with existing Federal, State, and local archaeological regulations and policies, most impacts to archaeological resources resulting from routine activities under the proposal will be avoided. Based on the scenario for the proposal, some impact could occur to coastal historic and prehistoric archaeological resources from accidental oil spills. Although it is not possible to predict the precise numbers or types of sites that would be affected, contact with archaeological sites would probably be unavoidable, and the resulting loss of information would be irretrievable. The magnitude of the impact would depend on the significance and uniqueness of the information lost, but based on experience gained from the *Exxon Valdez* oil spill, we expect no to limited impacts from direct contact with oil, but some impacts during cleanup operations

o. Land Use and Existing Infrastructure

Routine Operations

The pace of oil and gas development in the Gulf of Mexico is expected to remain largely consistent with past levels. As a result, the nature and extent of impacts to land use and the existing infrastructure over the proposed 5-year period are not expected to change appreciably from past experience. The oil and gas industry has been an integral part of the Gulf of Mexico economy for decades, and the continuation of industry activities is not expected to result in any major land use or infrastructure impacts for the region.

Over the proposed 5-year period, increases are expected in the construction of new underwater pipelines and the creation of new gas-processing facilities. All new development would be in the central and western portions of the Gulf. Potential impacts resulting from this development include the conversion of land from other uses, increased demands on roads and utilities, and increased demand for housing and public services (e.g., schools and hospitals) due to the in-migration of workers and their families. The nature and extent of these impacts, especially those associated with the construction of gas-processing facilities, would depend on the specific locations chosen for construction.

Under the proposed action, more exploration and development would be taking place in deepwater areas, which could stress existing infrastructure in the nearest coastal areas supporting those developments. Because remote deepwater exploration requires deeper ports for construction and servicing of deepwater facilities than nearshore facilities, only a few locations can accommodate these types of activities. Impacts associated with remote deepwater exploration would be similar to those itemized above and would be concentrated in this limited area.

Accidents

The potential oil spills estimated to occur under the proposed action would be responded to according to spill response protocols, the responses occurring primarily from existing response facilities along the coast. Supplies for assisting with the response may also be stored at existing shore bases. No new shore bases are projected. Potential impacts to land use and existing infrastructure resulting from an oil spill would likely include immediate (temporary) stresses of the spill response on existing infrastructure, direct land-use impacts (such as impacts of oil contamination to a recreational area or to agricultural land), and restrictions of access to a particular area while the cleanup is conducted. These impacts are expected to be temporary. The magnitude of the impacts would depend upon the location and size of the spill; the greatest potential impacts would occur from large spills in shallow water. The potential for impacts to land use likely would decrease with decreasing size of the spill and increasing water depth.

Conclusion

Impacts to land use and infrastructure from routine operations under the proposed action would occur in each of the two Gulf of Mexico planning areas. Oil spills that reach the coast or are in close proximity to the shoreline could also impact land use and existing infrastructure. New impacts from the proposal will be similar to past ones, and are expected to be limited but noticeable. The nature and magnitude of these impacts would depend upon the level of new construction, the degree to which the area is already developed, and, in the case of accidental spills, the size and location of the spill.

p. Tourism and Recreation

The Gulf of Mexico provides many recreational opportunities through its natural landscapes (e.g., coastal beaches, barrier islands, estuaries, river deltas, tidal marshes), public and protected areas (e.g., national seashores, wildlife sanctuaries, wilderness areas), and commercial facilities (e.g., resorts, marinas). These diverse resources support a strong recreation and tourism industry that serves as a major source of employment in the region (Section III.A.19). The industry is projected to continue to grow, while the pace of the oil and gas development is expected to remain consistent with past levels. Therefore, the continuation of oil and gas development activities is not expected to result in adverse impacts to recreation and tourism in this region.

Routine Operations

The main recreation and tourism activities that could be impacted by routine oil and gas operations would be beach recreation, sightseeing, diving, and recreational fishing (see also Section IV.B.2.q). Impacts on beach recreation and sightseeing might be viewed as being negative, with adverse aesthetic impacts from additional offshore platforms and possible increases in construction projects for gas-processing facilities and new pipelines. Impacts on these recreational activities would depend on the proximity of the new construction to the recreational use areas. Another impact could be increased amounts of trash and debris washing to shore on beaches, which is both an aesthetic issue and a potential health and safety issue. Certain areas could also be closed temporarily to accommodate new construction. Although onshore facilities would likely be placed near other commercial areas zoned for such development, underground pipeline construction could occur near important recreational areas.

Since the presence of oil and gas structures is often associated with diving and fishing activities, these structures can serve as artificial reefs and attract a variety of marine life. In this regard, oil and gas operations appear to have a positive impact on diving and recreational fishing. Continued oil and gas industry operations in the future would not alter these impacts and could enhance them.

Accidents

The oil spills that could occur under the proposed action would be responded to primarily by existing response facilities along the coast and existing shore bases according to spill-response protocols. Potential impacts to recreation and tourism resulting from an oil spill would likely include direct land-use impacts (e.g., from oil contamination at a beach area), access restrictions to a particular area (e.g., no diving or fishing while cleanup is conducted), and aesthetic impacts (e.g., view of spill and cleanup activities). These impacts are expected to be temporary. The magnitude of the impacts would depend on the location and size of the spill and the effectiveness of cleanup operations. The greatest potential impacts would occur from large spills in shallow water. The potential for land-use impacts would likely decrease with decreasing spill size and increasing water depth.

Conclusion

Routine operations would have limited effects on recreation and tourism, with potential adverse aesthetic impacts to beach recreation and sightseeing and potential positive impacts to diving and recreational fishing. Temporary impacts would occur if an oil spill reached a beach or other recreational-use area. The magnitude of these impacts would depend on factors such as the size and location of the spill, and would likely be greatest if the spill occurred during the peak recreational season.

q. Fisheries

(1) Commercial Fisheries

Routine Operations

Factors potentially affecting commercial fisheries in the Gulf of Mexico include structure placement, presence, and removal, and related vessel traffic, with the largest impact resulting from the restriction of fishing from areas containing structures. This would preclude fishers from accessing viable fishing grounds over time.

Exploration activities, such as placement of mobile drilling units and deposition of cuttings, cause turbidity than can drive fishes away from the immediate area. Noise from drilling activities and pipeline installation may also cause fishes to leave the area. Because of potential conflicts between exploration activities and the use of fishing gear, bottom trawlers, longliners, and purse netters would be temporarily precluded from using areas surrounding exploration activities. For example, floating production systems in deeper water require as much as 5 ha of space, and exploratory drilling rigs spend approximately 30 to 150 days on site. These periods of exclusion would be temporary, and the overall area affected at any time would be relatively small.

Once platforms are installed and production activities begin, fishes are likely to return to the disturbed area. Offshore structures are known to act as FAD's for both pelagic and reef-associated species that are desirable to commercial fisheries (Continental Shelf Associates, 1982). However, in some limited cases to avoid potential conflicts and to maintain safety at large deepwater structures, a safety zone for vessels longer than 100 feet may be established up to 500 m around each production platform, which would encompass up to approximately 80 ha of surface area per platform. It is assumed that 400-500 new platforms would be established under the proposed action, which could place as much as 32,000-40,000 ha of seafloor off-limits to some commercial fishing activities (Table IV-1). Ultimately, the total area precluded would vary depending upon the nature of a particular structure, the phase of operation, fishing method or gear, and target species group. Conflicts for use of space would be higher for drifting gears such as purse nets, bottom longlines, and pelagic longlines than for trawls and handlines (Centaur Associates, Inc., 1981; MMS, 2000). Nevertheless, areas in which commercial fishing would be affected are small relative to the entire fishing area available to surface longliners or purse seiners.

Seafloor area that would be affected by placement of pipelines ranges from 2,100 to 5,800 ha over the entire Gulf of Mexico. Together, the fishable area potentially affected by platforms and pipelines would represent only a small proportion of the total area available to fishers in the northern Gulf of Mexico.

The area placed off-limits to commercial fishing during decommissioning of a platform depends on several factors, including when each step is completed relative to the remaining steps. From a bottom-oriented commercial fishing perspective, decommissioning and removal of facilities is better than on-site abandonment, which results in the presence of potential seafloor obstacles such as flowlines, anchors, and mooring lines that could present obstacles to trawling. Federal regulations (30 CFR 250.702(I)) require all wellheads, casings, pilings, and other obstructions be removed to a depth of at least 15 ft below the mud line or to a depth approved by the MMS District Supervisor. Thus, areas left untrawlable due to abandoned components would represent only a fraction of the area excluded by oil and gas operations. Longlining would not be precluded following decommissioning and removal because surface waters would not be affected by the presence of the remaining underwater components.

Accidents

Commercial fisheries would be affected by oil spills in several ways. The possibility of oil-soaked fishing gear and potentially contaminated fish may reduce commercial fishing efforts or may affect the value of catches, resulting in economic loss. Individuals of target fish species could be affected directly by exposure to spilled oil. Hydrocarbons from spilled oil can affect adult fishes by direct contact with gills or deposition in the gut after swallowing spilled oil. Toxic fractions of PAH’s in spilled oil can cause death or illness in adult fishes, but only with continuous exposure. Adult and juvenile fishes typically are capable of avoiding large spills by moving to other areas or deeper water. However, planktonic eggs, larvae, and neustonic communities would be unable to avoid spilled oil. Eggs and larvae of fishes would die if exposed to certain toxic fractions of spilled oil. Most of the fish species inhabiting shelf or oceanic waters of the Gulf of Mexico have planktonic eggs and larvae (Ditty 1986; Ditty et al. 1988, Richards and Potthoff 1980; Richards et al. 1993). Certain species, such as triggerfishes, deposit demersal eggs but have larvae that take up residence in the water column, so these species would also be affected. Effects would be potentially greater if local water currents retained planktonic larvae and floating oil within the same water mass for extended periods of time. However, this would depend on the location and timing of particular spills.

Spills would also indirectly affect commercial fisheries by degrading habitats critical for the survival of target species. These impacts would only be serious to commercial fisheries if they lead to significant declines in target populations of fish or invertebrates. This would likely require large areas of coastal habitat, including wetlands and seagrass beds, to be negatively impacted by a spill. Coastal habitats could be affected by oil spills in shallow water, but they are not likely to be affected by spills in deepwater areas.

Oil spills reaching coastal and wetland areas could lead to the death of wetland vegetation, seagrass beds, and associated fauna. Saturation of sediments with oil and trapping of oil by vegetation could lead to chronic sources of pollution, resulting in long-term effects on important fishery resources. Mechanical destruction of wetland areas during cleanup could also result in long-term loss of nursery and foraging areas for some commercially important species of fish and invertebrates. On a large scale, this could result in significant impacts to local fish or invertebrate populations. Areas where coastal wetlands front directly on the open Gulf are most vulnerable to nearshore oil spills.

Many wetlands would eventually recover; even though some wetland areas may not recover completely, it is anticipated that spills of the sizes considered possible as a result of the proposed action are unlikely to substantially threaten the overall viability of wetland habitats used by commercially important species. On the basis of the potential level of impacts to coastal habitats including wetlands and submerged seagrass beds under the proposed action, major population declines are not likely to occur.

Adults of highly migratory fish species, including pelagic species such as tunas, sharks, and billfish, would move away from surface oil spills in deepwater areas. Pelagic larvae and neuston would not be able to move away from the spilled oil on the surface and would most likely be killed or injured. However, these impacts are not expected to cause major population declines.

Accidental spills could also result in interference with fishing operations, loss of use of traditional fishing areas, tainting of catches, and fouling of gear (Bolger et al. 1996; Hom et al. 1996). The resulting effect to individual fishers could be short-term loss of income and, at worst, loss of livelihood in a particular region.

Conclusion

The level of impacts on commercial fisheries due to routine operations under the proposed action would be similar to impacts during the previous lease period. Biological resources that serve as the basis for commercial fisheries in the Gulf of Mexico are expected to be affected by activities associated with routine operations under the proposed action. The level of effects from accidental spills would depend on the location, timing, and volume of spills in addition to other environmental factors. Small spills would unlikely affect a large number of fish or commercial fishing before dilution and weathering reduced concentrations; therefore, they would not have long-term effects on commercial fisheries in the Gulf of Mexico. It is anticipated that any single large spill would affect only a small proportion of a given fish population within the Gulf of Mexico, and that fish resources would not be permanently affected. However, localized effects on commercial fishing could result as a consequence of reduced catch, loss of gear, or loss of fishing opportunities during cleanup and recovery periods.

(2) Recreational Fisheries

Routine Operations

The most significant impact of routine operations on recreational fisheries would be the conflict for use of space. Placement of MODU's disturbs the seafloor, causes turbidity, and may temporarily drive fishes away from the general area. These activities would primarily affect soft-bottom species such as red drum, sand sea trout, and spotted sea trout that are sought by anglers in private or charter/party vessels. Such conflicts would be temporary, however, as fishes would eventually return to disturbed areas.

The presence of offshore platforms may have a positive effect on availability of recreational fishing opportunities. During 1999, approximately 20 percent of private boat fishing trips, 32 percent of charter boat fishing trips, and 51 percent of party boat fishing trips in the Western and Central Gulf (Alabama, Mississippi, Louisiana, and Texas) took recreational fishers within 300 feet of oil or gas structures (Hiett and Milon, 2002) as the presence of structures are known to aggregate pelagic (e.g., king mackerels, tunas, and cobia) and reef-associated fish species (e.g., red snapper, gray triggerfish, and amberjack) that are targeted by many recreational fishers.

Accidents

Accidental oil spills can affect recreational fisheries by contaminating target species through ingestion of spilled oil, increasing egg and larvae mortality, and degrading habitats critical for the survival of target species. In addition, impacts affecting recreational species or the ability to fish for these species can have broad effects on local economies. Motels, restaurants, bait and tackle shops, charter boats, guides, and other supporting industries would be affected by economic losses if fishing activity declines. A major oil spill that degrades the esthetic value of a particular shoreline could deter fishers from using an area even if the impact to fish stocks was negligible or after short-term impacts have abated. However, on the basis of the number and size of spills assumed for the proposed action, persistent degradation of shorelines and waters are not likely to occur; therefore, impacts to recreational fishing are not expect to be significant.

Conclusion

The level of impacts on recreational fisheries in the Gulf of Mexico due to routine operations under the proposed action would be similar to impacts during the previous lease period. Biological resources that serve as the basis for recreational fisheries in the Gulf of Mexico are expected to be affected by activities associated with routine operations. The magnitude of effects from accidental spills would depend on the location, timing, and volume of spills, in addition to other environmental factors. Small spills that may occur under the proposed action are unlikely to affect a large number of fish or have a substantial effect on recreational fishing before dilution and weathering reduced concentrations of oil in the water. Consequently, it is anticipated that small spills would not have substantial or long-term effects on recreational fishing in the Gulf of Mexico. Any single large spill would likely affect only a small proportion of a given fish population within the Gulf of Mexico, and it is unlikely that fish resources would be permanently affected. However, spills could have localized effects on recreational fishing as a consequence of contamination of fish tissues, degradation of esthetic values that attract fishers, or temporary closure of fishing areas.

3. Alaska Region

a. Air Quality

Air Emissions: The OCS facilities located off Alaska would be under the jurisdiction of the U.S. Environmental Protection Agency (USEPA), which regulates air emissions as prescribed in 40 CFR Part 55. For facilities located within 25 miles of a State's seaward boundary, the regulations are the same as would be applicable if the emission source were located in the corresponding onshore area, and would include State and local requirements for emission controls, emission limitations, offsets, permitting, monitoring, testing, and monitoring. For facilities located beyond 25 miles of a State's seaward boundary, the basic Federal air quality regulations apply, which include the USEPA emission standards for new sources and the prevention of significant deterioration (PSD) regulations. The USEPA has established national ambient air quality standards (NAAQS) for nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter less than 10 microns in diameter (PM_{10}), fine particulates less than 2.5 microns in diameter ($PM_{2.5}$), carbon monoxide (CO), lead, and ozone (O_3) because of their potential adverse effects on human health and welfare. The health and environmental effects of air pollutants have been summarized by the USEPA (USEPA, 1979, 1998, 1999a). Ambient levels of NO_2, SO_2, PM_{10}, and O_3 can contribute to respiratory illnesses, especially in persons with asthma and the elderly, and can also aggravate heart disease.

Air emissions from OCS oil and gas development arise from production platforms, drilling activities, construction, support vessels, and helicopters. A comprehensive inventory of air emissions from OCS activities was constructed by Wilson et al. (2004), but it was specific only to operations in the Gulf of Mexico.

Accidental Oil Spills: Small accidental oil spills would cause small, localized increases in concentrations of volatile organic compounds (VOC) due to evaporation of the spill. Most of the emissions would occur within a few hours of the spill and would decrease drastically after that period. Large spills would result in emissions over a large area and a longer period of time. Hanna and Drivas (1993) modeled the emissions of various hydrocarbon compounds from a large spill. A number of these compounds, including benzene, ethylbenzene, toluene, and o-xylenes, are classified by the USEPA as hazardous air pollutants. The results showed that these compounds evaporate almost completely within a few hours after the spill occurs. Ambient concentrations peak within the first several hours after the spills starts and are reduced by two orders of magnitude after about 12 hours. The heavier compounds take longer to evaporate and may not peak until about 24 hours after spill occurrence. Total ambient VOC concentrations are significant in the immediate vicinity of an oil spill, but concentrations are much reduced after the first day.

In situ burning of a spill results in emissions of NO_2, SO_2, CO, and PM_{10} and would generate a plume of black smoke. Fingas et al. (1995) describes the results of a monitoring program of a burn experiment at sea. The program involved extensive ambient measurements during two experiments in which approximately 300 bbl of crude oil were burned. It found that during the burn, CO, SO_2, and NO_2 were measured only at background levels and were frequently below detection levels. Ambient levels of VOC were high within about 100 m of the fire, but were significantly lower than those associated with a nonburning spill. Measured concentrations of polyaromatic hydrocarbons (PAH) were low. It appeared that a major portion of these compounds was consumed in the burn.

McGrattan et al. (1995) modeled smoke plumes associated with in situ burning. The results showed that the surface concentrations of particulate matter did not exceed the health criterion of

150 micrograms per cubic meter (ug/m^3) beyond about 5 km downwind of an in situ burn. This is quite conservative as this health standard is based on a 24-hour average concentration rather than a 1-hour average concentration. This appears to be supported by field experiments conducted off of Newfoundland and in Alaska.

Visibility: Gaseous and fine particulate matter in the atmosphere can potentially degrade atmospheric visibility. The most important source of visibility degradation is from particulate matter in the 1- to 2-micron size range. These particles are directly emitted into the atmosphere through fuel burning. However, other sources arise through chemical transformation of NO_2, SO_2, and VOC into nitrates, sulfates, and carbonaceous particles. Existing visibility in Alaska is generally good because of the absence of large emission sources. The phenomenon of arctic haze, which occurs in northern Alaska during the winter, is attributed primarily to long-range transport of pollution sources from the Eurasian continent. A screening model for visibility was applied to a planned OCS facility in the Beaufort Sea. It found a noticeable effect during only a very limited number of days, ones that had the most restrictive meteorological conditions. No effects were simulated during average conditions (MMS, 2002b). The screening method overestimates impacts so it is unknown if the modeled impacts are real. It is not known to what extent aggregate OCS sources contribute to visibility reductions. However, the individual emission sources from the proposed 5-Year Program are relatively small and scattered over a large area, and it is not expected that, as a whole, they would have a measurable impact on visibility. The impacts on visibility from the proposed 5-Year Program would be negligible.

Ozone Formation: Ozone is formed in the atmosphere through photochemical reactions involving primarily NO_x and VOC. Ozone formation is most favorable when there are relatively large sources of NO_x and VOC in the area, the atmosphere is stable, there is a considerable amount of solar radiation, and temperatures are high. Conditions in Alaska are seldom favorable for significant O_3 formation. Emissions from the proposed 5-Year Program would be relatively small and dispersed and located far from major population centers. Ambient O_3 levels are within the Federal standard in all areas of Alaska. The impacts from the proposed 5-Year Program activities would be negligible.

(1) Arctic Subregion

Routine Operations

The OCS operations in the Arctic Subregion are unique in a number of ways due to the sea ice that is present much of the year. In very shallow waters (5-10 m depth), exploratory wells may be drilled from an ice or gravel island (MMS, 2003a). Construction of an ice island would need to take place in winter, and material and personnel would be carried to the site by vehicles operating on an ice road. In water 10-20 m deep, movable platforms resting on the seafloor may be used for exploration. Drilling operations from these platforms could take place all year. In deeper waters, drillships or floating platforms would need to be used, and drilling would be limited to a short time period during the summer months. Material and supplies would be ferried using barges or supply boats. In addition, icebreakers would operate in the vicinity of the drilling rig and vessels to control sea ice. Because of the arctic conditions, the pace of development is slower as activities are limited to certain, rather narrow, timeframes. Air emission rates tend to be higher because activities are more concentrated and additional vessels such as icebreakers may be needed. In shallow waters, production may take place from gravel islands or bottom-founded structures, while in deeper waters floating structures anchored to the seafloor would be used. As in the case of exploration, the gravel island would be constructed during the winter. The modules for the production facilities would be installed during the ice-free period using barges, tugboats, and supply vessels.

Air emissions resulting from the proposed 5-Year Program were estimated by using the exploration and development scenario for the Alaska Region presented in Table IV-2 and applying air emission factors derived from emission projections for the Kuvlum exploration project (USEPA, 1993) and the Northstar and Liberty development projects (BP Exploration, 1998a, b). Table IV-8 shows estimated emissions for the various types of activities. A range of values is given reflecting the low and the high end of the exploration and development scenario. The emissions from platform production, support vessels, helicopters, and tankers are averaged over the projected 30-year duration of activities. It was assumed that exploratory drilling would take place over a 5-year period, while platform and pipeline installation would be spread over 3 years. If one excludes tanker transport, which would all take place outside the Arctic Subregion, the highest emissions for all pollutants, except VOC, would be associated with exploration activities. This is because the need for ice-breaker activity was factored into the emissions calculations as sea ice may be present in and around the exploration activity. However, if climate change continues to reduce the sea ice in summer, exploration activities would require fewer vessels, and emissions would be lower. Platform construction is projected to be the second highest source of NO_x and PM_{10}. The relatively high emissions would be associated with gravel island construction. Platform construction in deeper waters may result in relatively lower emissions.

Air quality modeling using the Offshore and Coastal Dispersion (OCD) model has been performed in past studies to assess impacts from planned lease sales in the Beaufort Sea (MMS, 1996c) and additional discussions of air quality impacts may be found in MMS (1998b) and MMS (2003a). The highest predicted onshore annual average NO_2 concentrations were in the range of 0.5 to 1.5 $\mu g/m^3$, which is well within the PSD Class II maximum allowable increase of 25 $\mu g/m^3$. Concentrations of SO_2 and PM_{10} were not modeled; however, when one scales the results according to the respective emission rates, the levels would be well within the PSD Class II increments. Modeling for the Northstar and Liberty projects on gravel islands in the Beaufort Sea (MMS, 2002b; COE, 1999) resulted in higher concentrations because they considered points just outside the facility boundary, but the levels predicted for NO_2, SO_2, and PM_{10} were still within the PSD Class II limits.

Results of OCD modeling for development from a proposed lease sale in the Chukchi Sea were presented in MMS (1991d). The highest annual average NO_2 concentration was 1.29 $\mu g/m^3$, which is well within the PSD Class II maximum allowable increase of 25 μg/m3. No modeling was performed for NO_2, SO_2, and PM_{10}, but concentrations should be well within the PSD Class II increments.

The proposed 5-Year Program would result in a rather slow rate of development involving a small number of facilities that would be spread over a wide area. Each project would apply the best available control technology according to USEPA and State regulations, and pollutant concentrations would have to meet the PSD incremental limits. Existing pollutant concentrations in coastal Alaska are well within the NAAQS. The small additional concentrations from the proposed 5-Year Program activities would result in levels that are still well within the ambient standards.

Accidents

Air quality impacts from accidental oil spills during the proposed action would be similar to those described above. However, a spill in the Arctic Ocean during broken ice or melting ice conditions could result in more concentrated emissions over a smaller area than would be the case under open-water conditions. In a large spill occurring under the ice, the oil would remain trapped and be dispersed under the ice until melting or breakup occurs. Emissions would then occur at a slower rate and would already be dispersed over a wider area before breakup starts.

Conclusion

The concentrations of NO_2, SO_2, and PM_{10} from any routine activities associated with the proposed 5-Year Program activities in the Beaufort and Chukchi Seas would be within the applicable maximum allowable increases. The concentrations of NO_2, SO_2, PM_{10}, and CO would remain well within the NAAQS. The impacts from the proposed 5-Year Program on the pollutant levels would be minor.

Any air quality impacts from oil spills in the Arctic Subregion would be localized and of short duration. Emissions do not appear to be hazardous to human health. Impacts from in situ burning would also be very temporary. Pollutant concentrations would not be expected to be within the NAAQS. The air quality impacts from oil spills and in situ burning would, therefore, be minor.

(2) Bering Sea Subregion

Routine Operations

Most of the North Aleutian Basin experiences ice conditions during a portion of the year. Exploration drilling and construction activities would be carried out in the ice-free period of the year (late spring through fall). Projected emissions for the proposed 2007-2012 Leasing Program were made using emission factors derived from an emissions inventory constructed by Wilson et al. (2004). The results are shown in Table IV-9. The emissions from platform production, support vessels, and helicopters are averaged over the projected 40-year duration of activities. Emissions from exploratory drilling, platform construction, and pipeline installation were averaged over a period of 4-6 years.

No air quality modeling has been performed for any potential oil/gas development in the North Aleutian Basin Planning Area. Dispersion of air emissions would generally be favorable because of the prevailing wind speeds and the unstable atmosphere. Any OCS facilities located within 25 miles from the State seaward boundary would be subject to the State of Alaska's air pollution control requirements. All OCS facilities would need to obtain a USEPA air permit. Proposed facilities with projected emissions greater than 250 tons per year would be subject to an air quality modeling analysis to determine compliance with the NAAQS and the PSD increments. Facilities would have to apply best available control technology.

In addition to the activities on the OCS, there is the possibility that a plant would be constructed onshore for converting OCS natural gas to liquefied natural gas (LNG) as well as a tanker terminal for transporting LNG to market. No estimates were made of the air emissions that may result. However, such facilities would be subject to an air permit, and emissions would need to be controlled to prevent adverse impacts on air quality.

Exploration drilling, construction activities, and production platforms would result in a small increase in levels of NO_2, SO_2, and PM_{10} in the nearest onshore areas. However, based on modeling performed for similar facilities in the Arctic, concentrations would be small and localized and well within the NAAQS and PSD increments.

Accidents

Air quality impacts from accidental oil spills in the Bering Sea Subregion during the proposed action would be similar to the general impacts described above.

Conclusion

Concentrations of NO_2, SO_2, and PM_{10} from any routine activities associated with the proposed 2007-2012 Program activities in the Bering Sea Subregion would be within the applicable maximum allowable increases. The concentrations of NO_2, SO_2, and PM_{10}, and CO would remain well within the NAAQS, and the impacts from the proposed action on the pollutant levels would be minor.

Any air quality impacts from oil spills would be localized and of short duration. Emissions do not appear to be hazardous to human health. The impacts from in situ burning are also very temporary. Pollutant concentrations would not be expected to be within the NAAQS. The air quality impacts from oil spills and in situ burning would, therefore, be minor.

(2) South Alaska Subregion

Routine Operations

The Gulf of Alaska, including the Cook Inlet, experiences open-water conditions throughout the year. In these areas, OCS operations would be more similar to those in the Pacific and Gulf of Mexico OCS areas. Projected emissions for the proposed 5-Year Program were made using emission factors derived from an emissions inventory constructed by Wilson et al. (2004). The results are shown in Table IV-10. The emissions from platform production, support vessels, and helicopters are averaged over the projected 30-year duration of activities. Emissions from exploratory drilling, platform construction, and pipeline installation were averaged over a period of 1-3 years.

The results of the most recent air quality modeling conducted for a lease sale in the Cook Inlet Planning Area are found in Herkhof (2002). The highest predicted onshore NO_2 concentration was 0.27 $\mu g/m^3$. For SO_2 the highest predicted annual average, maximum 24-hour, and maximum 3-hour average concentrations were 0.02, 0.55, and 2.7 $\mu g/m^3$, respectively. These values are well within the PSD Class II incremental limits. Potential sources were placed so as to maximize potential air quality impacts to the Tuxedni National Wilderness Area, which is a PSD Class I area in the Cook Inlet. The maximum allowable PSD incremental limit for a Class I area is 2.5 $\mu g/m^3$. Projected concentrations were, therefore, well within the Class I incremental limits.

Accidents

Air quality impacts from accidental oil spills in the South Alaska Subregion during the proposed action would be similar to the general impacts described above.

Conclusion

Concentrations of NO_2, SO_2, and PM_{10} from any routine activities associated with the proposed 5-Year Program activities in the South Alaska Subregion would be within the applicable maximum allowable increases. The concentrations of NO_2, SO_2, PM_{10}, and CO would remain well within the NAAQS, and the impacts from the proposed 5-Year Program on the pollutant levels would be minor.

Any air quality impacts from oil spills would be localized and of short duration. Emissions do not appear to be hazardous to human health. The impacts from in situ burning are also very temporary. Pollutant concentrations would not be expected to be within the NAAQS. The air quality impacts from oil spills and in situ burning would, therefore, be minor.

b. Water Quality

Coastal waters are waters that are located landward of the inner boundary of the territorial seas (i.e., State and Federal offshore waters) (40 CFR Part 435, Subpart D), while marine waters are waters that are located seaward of the inner boundary. Impacts to coastal and marine waters could occur as a result of the routine operations (Table IV-2) and accidents (Table IV-4) assumed for Cook Inlet under the proposed action.

(1) Arctic Subregion

Routine Operations

Coastal Waters: Construction and installation of exploratory and development wells, platforms, offshore pipelines, and process facilities would impact water quality. Such activities would disturb bottom sediments and increase the turbidity of the water in the area of the construction. Because pipelines in shallow waters are buried using a trenching method, installation would initially release sediment to the water column. Moderate impacts to water quality (i.e., turbidity) from such construction and installation activities would occur in the immediate area of the activity. These impacts would be local and short term as settling and mixing occurred.

Because of climatic conditions in the Arctic Subregion, there would be a number of additional operations that are specific to the Arctic (e.g., constructing and maintaining ice roads [MMS, 2002b] and ice islands). In addition to impacting the turbidity of coastal waters in the Arctic Subregion, construction activities would also produce waste materials. Contaminants would also be released to the coastal waters during every ice breakup from fluids entrained in ice roads and ice islands (Skolnik and Holleyman, 2005). Entrained contaminants from vehicle exhaust, grease, antifreeze, oil, and other vehicle-related fluids would pass directly into the sea at each breakup (MMS, 2002b). These discharges are not expected to be major; however, they would occur throughout the life of a development area.

The construction of new support facilities on land and pipeline landfalls would also impact coastal water quality in the Arctic Subregion. Proper siting of facilities and requirements associated with construction permits would largely mitigate these impacts. The impacts on water quality would range from negligible to minor, depending on site location and construction and mitigation activities.

Marine Waters: Routine operations that could affect marine water quality in the Arctic Subregion include anchoring, mooring, drilling and well completion activities, well testing and cleanup operations, flaring/burning, facility installation and operations, support service activities, decommissioning, and site clearance. Activities such as dredging trenches for pipelines and constructing artificial islands would disturb the seafloor and increase the suspended sediment load in the water column. These suspended sediments have toxicity ranges that are generally described as nontoxic to slightly toxic (National Academy of Sciences, 1983). Turbidity and plumes containing sediments would depend on the season, sediment grain size, the rate and duration of discharge within the disturbed areas, and the currents present. This additional suspended sediment load would be temporary, and impacts to water quality would be localized.

The majority of wastes generated during construction and development would consist of drill cuttings and spent muds (MMS, 2002b). Some waste also would be generated during operations from well-workover rigs. Drilling fluids would be disposed of through onsite injection into permitted disposal wells or would be transported offsite to permitted disposal locations. Domestic wastewater and produced waters generated by these activities would also be injected into the disposal well. Solid wastes, including scrap metal, would be hauled offsite for disposal at an approved facility. Impacts to water quality from these activities would be negligible.

Turbidity on a smaller scale would also result from retrieving anchors used to control the movement of vessels while dredging and setting pipes or placing platforms. These types of disturbances would not occur if drillships, which use dynamic positioning rather than anchors, were used, a standard procedure in Chukchi Sea exploration.

Accidents

Coastal Waters: Accidental releases could affect the quality of coastal water in the Arctic Subregion. The magnitude and severity of impacts would depend on the location of the spill, spill size, type of product spilled, weather conditions, and the water quality and environmental conditions at the time of the spill.

If a large spill (> 1000 bbl) were to occur in enclosed coastal waters or were driven by winds, tides, and currents into an enclosed coastal area, water quality would be adversely affected. With limited wave and current activity in coastal waters, the oil would not be easily dispersed, and weathering could be slower than in the open sea (see discussion in Section III.B.3.a). Under arctic conditions (i.e., cold water and cold air temperatures), weathering processes, such as volatilization, would also be much slower than in warmer climates (Australian Maritime Safety Authority, 2005); under calm conditions and cold temperatures in restricted waters, vertical mixing and dissolution would be reduced (MMS, 2003a). If the spill were to occur on ice or under ice, oil would be trapped and essentially remain unchanged until breakup occurred and the ice began to melt. The volatile compounds from such a spill would be more likely to freeze into the ice within hours to days rather than dissolve or disperse into the water below the ice. A hydrocarbon plume in the water column underneath the ice could persist with concentrations that exceed ambient standards and background levels for a distance greater than that in the open sea (MMS, 2003a). Impacts from a large spill to coastal waters would depend on the season, type and composition of the spill, weather conditions, and size of the spill.

Effects on water quality could persist even longer if oil were to reach coastal wetlands and be deposited in fine sediments, becoming a long-term source of pollution because of remobilization. In such locations, spill cleanup could be necessary for recovery of the affected areas. Shoreline cleanup operations could involve crews working with sorbents, hand tools, and heavy equipment. The magnitude and severity of impacts from such spills would depend on the nature of the coastal area associated with the spill, the spill size and composition, and the water quality and condition of resources affected by the spill.

Cleanup of large spills in the open sea could be hindered by several factors. There could be limited access to oil slicks contained between ice floes during a large part of the year. There could also be reduced oil flow into recovery devices because of increased viscosity and precipitation of wax crystals, as well as decreased oil adhesion to the recovery unit material and a high percentage of free water in the recovered product due to mixing of the oil slick with slash ice and snow (Broje, 2005). Impacts from the spill would again depend on the spill size and composition, weather conditions, and the location of the spill.

Small oil spills (< 1,000 bbl) or very small oil spills (< 50 bbl) would produce measurable impacts on water quality. Assuming that all small and very small spills do not occur at the same time and place, water quality would rapidly recover without mitigation, due to mixing, dilution, and weathering.

Marine Waters: Under arctic conditions (i.e., cold water and air temperatures), weathering processes would be much slower than in warmer climates (Australian Maritime Safety Authority, 2005). Seasonality and the specific spill location would cause variability in effects (e.g., summer vs. winter in the Beaufort and Chukchi Seas). If a spill were to occur, oil would be trapped and essentially remain unchanged until breakup occurred and the ice began to melt. The volatile compounds from such a spill would be more likely to freeze into the ice within hours to days rather than dissolve or disperse into the water below the ice. A hydrocarbon plume in the water column underneath the ice could persist with concentrations that are above ambient standards and background levels for a distance that would be five times greater than that in the open sea (MMS, 2003a).

Small oil spills (< 1,000 bbl) or very small oil spills (< 50 bbl) would have measurable impacts on water quality. If it is assumed that all small and very small spills would not occur at the same time and place, water quality would rapidly recover without mitigation because of mixing, dilution, and weathering.

Conclusion

Overall coastal and marine water quality impacts due to routine operations and operational discharges under the proposed action would be unavoidable. Oil spills in coastal waters of the Arctic Subregion could reduce water quality, and these impacts would be unavoidable. In the presence of cold temperatures and ice, cleanup activities could be more difficult than in more temperate environments. The magnitude of the impacts would depend on the specific location affected and the nature and magnitude of the activity/accident. Small spills would be expected to result in short term, temporary impacts to coastal and marine water quality. A large spill in coastal waters could result in longer term impacts to water quality, but clean up efforts would reduce the likelihood of permanent impairment. A large spill in marine waters would be expected to have temporary impacts to water quality, however, cleanup efforts and evaporation, dilution, and dispersion would minimize the long-term impacts.

(2) Bering Sea Subregion

As discussed in Chapter 3, the North Aleutian Basin Planning Area incorporates all of Bristol Bay and adjacent waters out to Unimak Pass at the southern end of Unimak Island. This planning area encompasses approximately 32.5 million acres (about 50,800 mi^2) (MMS, 1985b). Impacts to water quality resulting from OCS activities could occur to both coastal and marine waters in the North Aleutian Basin Planning Area.

Coastal waters are waters that are located landward of the inner boundary of the territorial seas (i.e., State and Federal offshore waters) (40 CFR Part 435, Subpart D). Within the North Aleutian Basin Planning Area, the coastal environment is characterized by extensive tidal flats, some of which are several miles wide. Marine waters are waters that are located seaward of the inner boundary of the territorial seas. Impacts to both coastal and marine waters could occur as a result of routine operations (e.g., placing and removing structures and operational discharges and wastes) and accidents.

Routine Operations

Coastal Waters: Routine operations that could affect coastal water quality in the North Aleutian Basin Planning Area include the same activities as those identified above for the Arctic Subregion. These activities include constructing and installing offshore pipelines and constructing and maintaining docks and causeways (Table IV-2).

Trenching for offshore pipeline placement (up to 150 mi) would disturb bottom sediments and increase the turbidity of the water in the area of the construction. Degradation of water quality (i.e., turbidity) from the construction and installation activities would occur in the immediate area of the activity. Contaminants introduced into waters of the North Aleutian Basin Planning Area by these activities are expected to be quickly diluted and dispersed by the currents associated with the tides, estuarine circulation, wind-driven waves and currents, and Coriolis forces (MMS, 2003b).

Construction of new onshore support facilities (up to 2 pipeline landfalls, up to 50 miles of onshore pipelines, one waste facility, one processing facility, and one shore base) could affect the quality of nearshore and fresh waters in the planning area. During land site preparation, vegetation is typically cleared from the area, compacting the topsoil due to the constant movement of heavy machinery. This compaction would reduce the water retention properties of the soil and would increase erosion and surface runoff from the site. Water quality would be degraded near the construction sites by runoff of particulate matter, heavy metals, petroleum products, and chemicals into local streams, estuaries, and bays. Proper siting of facilities and implementation of erosion and surface runoff mitigation measures should largely mitigate the likelihood, extent, and magnitude of such impacts.

Marine Waters: Routine operations that could impact marine water quality in the North Aleutian Basin Planning Area for the proposed action are the same as those discussed above for the Arctic Subregion and include dredging for pipeline placement and placement of platforms. These activities would disturb the seafloor and increase the suspended sediment load in the water column. Offshore pipelines in Alaska in waters less than about 60 m deep are normally placed in a dredged trench. Plumes of suspended sediment generated during pipeline placement could extend a few hundred meters to a few kilometers down current, but the length of the plume would depend on rate and duration of discharge, sediment grain size, current regime, source type, water column turbulence, and season. Suspended sediments in the plumes are expected to have toxicity ranges that are generally described as nontoxic to slightly toxic (National Research Council [NRC], 1983). As with coastal water impacts, the relatively quick dilution and settling of the suspended sediments would minimize any long lasting impacts to the quality of marine waters.

For marine waters, drilling muds and cuttings can be disposed in the sea if the facility is located at least 3 miles offshore, and produced water can be discharged into all offshore waters (40 CFR Part 435). The principal discharges of concern during drilling would be drilling muds and cuttings. Drilling muds, cuttings, and produced water generated during well development and production would be disposed downhole and, thus, would not be expected to impact water quality. Drilling muds, cuttings, and produced water generated during exploratory drilling would be discharged directly at the drill sites and, thus, would adversely affect nearby water quality. Materials entering overlying waters would be quickly diluted and dispersed and, thus, would not be expected to result in long-term impacts on the local water quality.

Adverse water quality impacts would also be produced by routine discharges of domestic waste (e.g., wash water, sewage, and galley wastes) and deck drainage (platform and deck washings, and gutters and drains, including drip pans and work areas). Domestic waste would increase suspended solids in the receiving water, thereby increasing turbidity and biological oxygen demand. Established effluent limitations and guidelines published in the Code of Federal Regulations (40 CFR Part 435) and operator compliance with these guidelines/regulations should minimize impacts to ambient water quality. Such impacts would be local and temporary.

Accidents

Coastal Waters: The following potential spills have been postulated for waters in the North Aleutian Planning Area under the proposed action: up to one large condensate spill (i.e., ≥ 1,000 bbl); up to 2 spills with volumes between 50 and 999 bbl; and up to 10 spills with volumes less than 10 bbl (Table IV-4). For conservative analysis (i.e., one in which impacts would be greater than those that would actually occur), all of the spills are assumed to occur in coastal waters within the planning area. Such spills would adversely impact water quality. A spill in isolated coastal waters, or shallow waters under ice, or in rapidly freezing water could cause sustained degradation of water quality to levels that are above State or Federal criteria for hydrocarbon contamination. Concentrations could exceed the chronic criterion of 0.015 parts per million (ppm) total hydrocarbons, but this would probably occur over a relatively small area. Persistent small spills in such areas could result in local, chronic contamination. The degree of adverse impact would depend on the type, size, location, and season of the spill.

Marine Waters: Potential spills estimated to occur in marine waters in the North Aleutian Basin Planning Area are conservatively assumed to be the same as those discussed above for coastal waters (i.e., all spills are assumed to occur in marine waters). In open marine waters, mixing, evaporation, advection, and dispersion would generally reduce the effects of toxic oil fractions and their degradation products to below State and Federal criteria for hydrocarbon contamination. Because of the small number and size of spills that might occur under the proposed action, sustained degradation of water quality to levels exceeding the chronic criterion of 0.015 ppm total hydrocarbon contamination is unlikely. However, in the event of a large spill, levels could exceed this standard over several thousand square kilometers for a short period of time (about 30 days), depending upon the type, size, location, and season of the spill. The persistence of oil slicks would generally be less than 1 year.

Oil spills occurring in the southern portions of the North Aleutian Basin Planning Area (an area of known and postulated oil and gas systems) would be expected to move northeastward along the Alaska Peninsula at all times of the year (Armstrong et al., 1984; Thorsteinson, 1984). Winds and tides drive the circulation of the shallow continental shelf waters of the North Aleutian Shelf area. Oil spill trajectories indicate that oil spilled on the North Aleutian Shelf would respond directly to and be controlled by ambient wind velocities. In summer, prevailing southerly winds (5 meters per second [m/s]) would move spilled oil to the northeast into Bristol Bay at 6 km/day. In winter, prevailing northerly winds (10 to 15 m/s) would move spilled oil west southwest into the Bering Sea (MMS, 1985b).

The presence of ice in Bristol Bay could also affect the trajectory of spilled oil. The northern part of the North Aleutian Basin Planning Area is an active area of sea-ice formation. Ice begins to form along the shoreline in late October and November. As winter progresses, the ice edge advances further to the south from the coastlines, and to the west from the Alaska Peninsula. Ice may extend as far south as Unimak Island during a heavy ice year. Ice coverage in Bristol Bay generally is on the order of 60-70 percent. Under heavy icing conditions, the coverage can be up to 90 percent (MMS, 1985b).

Spilled oil in the North Aleutian Basin Planning Area would be driven by the combined processes of tides and wind. Impacts of spills would be adverse; however, the impact would depend on the type, size, location, season of the spill, and any cleanup activities implemented.

Conclusion

Normal operations in the North Aleutian Basin Planning Area could adversely impact coastal water quality. However, these impacts are expected to be local and temporary. Accidental spills to coastal waters could adversely impact water quality. Although impacts would generally be localized, the extent and magnitude of the impacts would depend on the type, size, location, and season of the spill.

Normal operations in the North Aleutian Basin Planning Area could adversely impact marine water quality. However because of dilution, settling, mixing, and evaporation, these impacts are expected to be local and temporary. Similarly, spills to marine waters would adversely impact water quality. The extent and magnitude of the impact would depend on the type, size, location, and season of the spill. Recovery times could be decreased by oil-spill cleanup activities.

(3) South Alaska Subregion

The Cook Inlet Planning Area lies between the Kenai Peninsula and the Kodiak Islands to the south and east and the Alaska Peninsula to the north and west (MMS, 2005b) and includes Cook Inlet and Shelikof Strait (See Fig. II-5). Impacts to water quality resulting from OCS activities could occur to both coastal and marine waters in the Cook Inlet Planning Area. These impacts are discussed below.

Routine Operations

Coastal Waters: Routine operations that could affect coastal water quality in the Cook Inlet include the same activities as those identified above for the Arctic Subregion (Section IV.B.3.b(1)). These activities include the following: constructing and installing exploratory and development wells, platforms, offshore pipelines; constructing and maintaining ice roads (MMS, 2002c), ice pads, and ice islands (Skolnik and Holleyman, 2005); and traveling by vessel to and from operational sites.

Construction and installation of exploratory and development wells (up to 10 and 100, respectively), platforms (up to 2), and offshore pipelines (up to 125 miles [230 km]) would impact water quality and disturb habitats (see Table IV-2). Such activities would disturb bottom sediments and increase the turbidity of the water in the area of the construction. Because pipelines in shallow waters are buried using a trenching method, installation would initially release sediment to the water column. If construction took place during the winter (a practice commonly followed in the Arctic), excess fill would be placed on the ice parallel to the pipeline. This fill would fall into the sea as breakup of the ice commenced (MMS, 2002c). Suspended sediments associated with trenching operations have very low levels of direct toxicities for sensitive species (MMS, 2003b).

Degradation of water quality (i.e., turbidity) from construction and installation activities would occur in the immediate area of the activity. Contaminants introduced into Cook Inlet waters by these activities would be diluted and dispersed by complex currents associated with the tides (diurnal tidal variations at the upper end of the Cook Inlet at Anchorage can be 9 m), estuarine circulation, wind-driven waves, and Coriolis forces (MMS, 2003b; Royal Society of Canada, 2004). Seawater enters thelLower Cook Inlet from the Gulf of Alaska at the Kennedy Entrance south of the Kenai Peninsula, and freshwater enters the Inlet from numerous streams along the east, north, and west shorelines; major freshwater inputs include the Susitna and Kenai Rivers. Seawater circulates northward in Cook Inlet along its eastern boundary, mixes with freshwater in the northern end, and flows southward along the western boundary. Water exits the lower Cook Inlet through Shelikof Strait and discharges into the Gulf of Alaska (MMS, 2002c). Surface currents in Cook Inlet can exceed 5 knots, and bottom currents can reach 1.5 knots (Royal Society of Canada, 2004). Approximately 90 percent of waterborne contaminants would be flushed from the lower Cook Inlet within about 10 months (Kinney et al., 1969, 1970c). Contaminants flushed from Cook Inlet would pass through Shelikov Strait and enter the Gulf of Alaska. Because of dilution, settling, and flushing, impacts from these activities would be local and temporary.

In addition to impacting the turbidity of coastal waters in the Cook Inlet, construction activities would produce waste materials. The majority of wastes generated during construction and developmental drilling would consist of drill cuttings and spent muds (MMS, 2002c). Because all muds, cuttings, and produced water would be discharged down hole, there would be no impacts to water quality from these activities. Domestic wastewater and produced waters would also be generated by these activities. This material would be injected into a disposal well. Solid wastes, including scrap metal, would be hauled offsite for disposal at an approved facility.

Construction of new onshore support facilities (up to 2 pipeline landfalls, up to 120 km (75 miles) of onshore pipelines, up to one waste facility, and up to one processing facility) could affect the quality of nearshore and fresh waters in the Cook Inlet Planning Area. During land site preparation, vegetation is typically cleared from the area, compacting the topsoil due to the constant movement of heavy machinery. This compaction would reduce the water retention properties of the soil and would increase erosion and surface runoff from the site. Water quality would be degraded by increases in site runoff of particulate matter, heavy metals, petroleum products, and chemicals to local streams, estuaries, and bays. Proper siting of facilities and requirements associated with construction permits should largely mitigate these impacts.

The OCS service and construction vessel traffic to and from platform sites within the planning area (up to 3 vessel trips/week/platform) would also impact water quality through the permitted release of operational wastes (such as bilge water). Because of the relatively small volumes that would be discharged, these waste materials would be quickly diluted and dispersed, and any impacts to water quality would be highly localized and temporary.

Marine Waters: Routine operations that could impact marine water quality in the Cook Inlet Planning Area are the same as those discussed above for the Arctic Subregion and include dredging for pipelines, possible construction of artificial islands, placement of platforms, and subsequent structure removal. These activities would disturb the seafloor and increase the suspended sediment load in the water column. Offshore pipelines in Alaska are normally placed in a dredged trench in waters less than about 60 m deep. Dredged material from the trenches can be used to cover the pipeline. Fill deposited during artificial island construction also increases turbidity. As these operations are reversed and structures removed, increased turbidity would reoccur. Generally, plumes from these activities extend a few hundred meters to a few kilometers down current, but the length of the plume would depend on rate and duration of discharge, sediment grain size, current regime, source type, water column turbulence, and season. The direction of plume movement would be influenced by the general circulation pattern in the planning area and local ambient conditions. Suspended sediments in the plumes are expected to have toxicity ranges that are generally described as nontoxic to slightly toxic (National Academy of Sciences, 1983). Overall, it is anticipated that the impacts to water quality from routine operations would be localized and temporary. As with coastal water impacts, dilution, settling, and rapid flushing would minimize any long lasting impacts to water quality.

Adverse water-quality impacts would also be produced by routine discharges of domestic waste (e.g., wash water, sewage, and galley wastes) and deck drainage (platform and deck washings, and gutters and drains, including drip pans and work areas). Domestic waste would increase suspended solids in the receiving water, thereby increasing turbidity and biological oxygen demand. Established effluent limitations and guidelines published in 40 CFR Part 435, and operator compliance should minimize impacts to ambient water quality. Such impacts would be local and temporary.

For marine waters, drilling muds and cuttings can be disposed to the sea if the facility is located at least 5.5 km (3 miles) offshore, and produced water can be discharged to all offshore waters (40 CFR 435.43 [Effluent Limitations Guidelines for the Coastal Subcategory of the Oil and Gas Extraction Point Source Category]). The principal discharges of concern during drilling would be drilling muds and cuttings. However, because all drilling muds, cuttings, and produced water would be disposed downhole in the Cook Inlet Planning Area, there would be no impacts to water quality.

As with coastal waters, OCS vessels traveling to and from platform sites within the planning area (up to 3 vessel trips/week/platform) could impact local water quality as a result of operational discharge of waste fluids. Because of dilution, settling, and flushing, water quality impacts from such discharges would be localized and temporary.

Accidents

Coastal Waters: Under the proposed action, the number and types of spills assumed to occur in the Cook Inlet Planning Area include up to one large spill (i.e., >1,000 bbl) from either a platform or pipeline, up to 2 spills with volumes between 50 and 999 bbl, and up to 50 small spills with volumes less than 10 bbl (Table IV-4). For conservative analysis (i.e., one in which impacts would be greater than those that would actually occur), all of the spills are assumed to occur in Cook Inlet coastal waters. Such spills would adversely impact water quality. A spill in isolated coastal waters, or shallow waters under thick ice, or in rapidly freezing ice, could cause sustained degradation of water quality to levels that are above State or Federal criteria for hydrocarbon contamination. Concentrations could exceed the chronic criterion of 0.015 ppm total hydrocarbons, but this exceedance would probably occur over a relatively small area. Persistent small spills in such areas could result in local chronic contamination. In most cases, spills would be rapidly diluted. In some cases, however, water quality could be degraded to a greater extent. The degree of adverse impact would depend on the size, location, and season of the spill. Spills would tend to move in directions consistent with established circulation patterns for the planning area, i.e., northward along the Kenai Peninsula and southward along the Alaska Peninsula. Actual flow paths would be affected by winds, tides, ice cover, temperature, and cleanup activities.

Marine Waters: The number of potential spills estimated for Cook Inlet marine waters are conservatively assumed to be the same as those discussed above for coastal waters. In open marine waters, evaporation, advection, and dispersion generally reduce the effects of toxic oil fractions and their degradation products to below State and Federal criteria for hydrocarbon contamination. Sustained degradation of water quality to levels exceeding the chronic criterion of 0.015 ppm total hydrocarbon contamination is unlikely. However, levels could exceed this standard over several thousand square kilometers for a short period of time (about 30 days), depending on the size, location, and season of the spill. Marine spills would tend to move in directions consistent with established circulation patterns for the planning area, i.e., northward along the Kenai Peninsula and southward along the Alaska Peninsula. Actual flow paths would be affected by winds, tides, ice cover, temperature, and cleanup activities. The persistence of oil slicks would generally last less than 1 year. Large oil spills assumed under this alternative would be unavoidable. Water quality would eventually recover, but recovery time could be decreased by oil-spill cleanup activities.

Conclusion

Normal operations in the Cook Inlet Planning Area could adversely impact coastal water quality. However because of dilution, settling, and flushing, these impacts are expected to be localized and temporary. Similarly, spills to coastal waters could adversely impact water quality. The impacts of these spills will be localized and short term, unless chronic spills occurred in a localized area. The extent and magnitude of the impact would depend on the size, location, and season of the spill.

Normal operations in the Cook Inlet Planning Area could also adversely impact marine water quality. However because of dilution, settling, and flushing, these impacts are expected to be localized and temporary. Similarly, spills in marine waters would adversely impact water quality. The extent and magnitude of the impact would depend on the size, location, and season of the spill. Recovery times could be decreased by oil-spill cleanup activities.

c. Marine Mammals

(1) Arctic Subregion

There are 11 resident or seasonal species of nonendangered and nonthreatened marine mammals in Arctic Subregion, including 5 species of cetaceans (the gray, minke, killer, and beluga whales and the harbor porpoise), 5 species of pinnipeds (the Pacific walrus and the ringed, bearded, ribbon, and spotted seals), and 1 fissiped species (the polar bear) (Table III-33). All of these species occur in the Chukchi Sea, while the Pacific walrus and the bearded and ribbon seals may also be found in western portions of the Beaufort Sea, and the ringed and spotted seals, beluga whale, and polar bear may be found in both seas (see Section III.B.6).

In addition to the above species, there are three seasonal species of endangered marine mammals that occur in Arctic Subregion (the bowhead, fin, and humpback whales). All three species occur in the Chukchi Sea; however, the bowhead whale also occurs in the Beaufort Sea. The fin and humpback whales only occur as occasional transients in the southern portion of the Chukchi Sea during summer. The bowhead whale migrates through the Chukchi and Beaufort Seas between its wintering grounds in the Bering Sea and its summering grounds primarily in the Canadian portion of the Beaufort Sea. However, some individuals remain in the Alaska portion of the Beaufort Sea and in the Chukchi Sea during summer (see Section III.B.6). Thus, the bowhead whale has the greatest potential of the three endangered mammal species to occur in areas where OCS-related activities are occurring and be affected by normal operations or oil spills. The potential for this would be most probable during the bowhead whale's spring and fall migrations that generally occur from March through June and September through November, respectively (Hill and DeMaster, 1998).

The few fin and humpback whales that occur in the Chukchi Sea would generally be there from June through October (MMS, 2002c). This is the period when these species would be most sensitive to oil and gas development and related oil spills (MMS, 2002c). However, it is unlikely that the fin or humpback whale would encounter or be affected by OCS operations within Arctic Subregion.

For more information on potential effects to marine mammals from seismic exploration, see the MMS Programmatic Environmental Assessment for Arctic Ocean Outer Continental Shelf Seismic Surveys (MMS, 2006b) and the MMS Environmental Assessment on Geological and Geophysical Exploration for Mineral Resources on the Gulf of Mexico Outer Continental Shelf (MMS, 2004).

Routine Operations

Under the proposed action, a number of facilities could be constructed and operated in offshore and onshore portions of the Beaufort Sea and Chukchi Sea Planning Areas. Routine operations associated with these facilities that could affect marine mammals include: offshore exploration, construction of offshore platforms and pipelines, construction of onshore processing facilities and pipelines, operations of offshore and onshore facilities, operational discharges and wastes, and vessel and aircraft traffic. Onshore construction activities would be expected to have minimal affect on the three endangered whale species in the Arctic Subregion because they normally occur in offshore open-water habitats. However, as for the non-listed species, any individuals that might be present in nearshore waters adjacent to a construction area would be expected to leave the area.

Offshore Exploration: During offshore exploration, seismic surveys conducted from boats in offshore areas and in lagoon systems could affect marine mammals in the area. Seismic surveys in the Beaufort Sea occur during the ice-free periods, normally from July to October (NMFS, 2001b). Noise generated by seismic surveys may have physical and/or behavioral effects on marine mammals, such as: hearing loss, discomfort, and injury; masking of important natural sound signals, including communications among individual whales; and behavioral responses such as fright, avoidance, displacement of migration route, and changes in physical or vocal behavior (Richardson et al., 1995; Davis et al., 1998; Gordon et al., 1998; MMS, 2003a). It has not been possible to predict the type or magnitude of responses to such surveys (and other oil and gas activities) nor to evaluate the potential effects on populations (NRC, 2003b). However, there is no evidence to suggest that routine surveys may result in population-level effects for any of the affected marine mammal species. There have been no documented instances of deaths, physical injuries, or physiological effects on marine mammals from seismic surveys (MMS, 2004a).

Noise from airguns and survey vessels could disturb nearby marine mammals that may be foraging in open waters or using floe ice for resting, birthing, and the rearing of young. These disturbances would be largely limited to the immediate area of the survey vessel, although animals within a few kilometers of the seismic operations may be affected (Richardson et al., 1986). Because cetaceans and pinnipeds are highly mobile species, they may leave an area when a seismic survey is initiated, thereby greatly reducing their exposure to maximal sound levels and, to a lesser extent, masking frequencies. For example, ringed seals have been reported to exhibit a higher abandonment rate of seal breathing holes close to seismic survey lines (Kelly et al., 1988). Upon relocation, the animal likely would resume normal behavior patterns. In addition, displaced or disturbed individuals may return to the area and/or resume normal behavioral patterns after the survey activities have ceased.

Among cetaceans, the odontocetes generally demonstrate relatively poor low-frequency hearing sensitivity, and thus might not be expected to experience hearing loss from seismic surveys (unless they are in close proximity to airgun arrays) (MMS, 2004b). The odontocetes in the Arctic Subregion (beluga and killer whales) may respond behaviorally to seismic surveys by leaving the areas where seismic surveys are being conducted. Unless the surveyed area is further developed, such displacement would be temporary and not expected to result in long-term impacts to either individual animals or populations of these species.

The mysticetes, which include the endangered bowhead, fin, and humpback whales, are considered to possess good hearing sensitivity at low frequencies down to approximately 10 Hz, and many of their vocalizations occur in the low tens to a few hundred Hertz (Richardson et al., 1995; Crane and Lashkari, 1996; Ketten 1998; Stafford et al., 1998). Seismic survey airgun arrays are configured to output maximal energy in the region of a few tens of Hertz, which overlaps with the expected hearing sensitivity of mysticetes. Thus, mysticetes that occur regularly in the Chukchi and Beaufort Seas (the minke, gray, and bowhead whales) may be affected during routine seismic surveys. Exposure of these whales to maximal airgun output during a seismic survey may result in behavioral changes such as area avoidance or short-term or long-term hearing loss, while less than maximal exposure could result in masking effects (Ljungblad et al., 1988b; Malme et al., 1989). Given their mobility and avoidance reactions to approaching seismic vessels, it is unlikely that whales would occur close to injurious noise levels (MMS, 2003a).

Sounds produced by seismic pulses can be detected by bowhead whales from 10-100 km away from the source (MMS, 2002c). Bowheads have been rarely observed within 20 km of where airguns are operating. However, occurrences of bowheads within 20 km are similar to those outside this radius about 12-24 hours after seismic operations cease (MMS, 2002c).

As discussed for the Gulf of Mexico (Section IV.B.2.c), the MMS requires a ramp-up of seismic activities coupled with visual monitoring and clearance within an exclusion zone around a seismic array. Additional mitigation and monitoring measures may also be imposed on a case-by-case basis. These actions would reduce the potential for cetaceans to be exposed to sound levels that could affect hearing or behavior. The avoidance reactions of whales to approaching seismic vessels would normally prevent exposure to potentially injurious noise pulses (NMFS, 2001b). The geographic scale of any potential noise effect is probably relatively small compared to the total habitat used by whales in the Chukchi and Beaufort Seas (MMS, 2004a). For example, in the Chukchi Sea, fall migrating bowhead whales are commonly seen from the coast to about 150 km offshore (MMS, 2004a), while the fall migration of this endangered whale in the Beaufort Sea occurs over a 100-km corridor (Malme et al., 1989).

Polar bears may not be very sensitive to noise (Richardson et al., 1995). Bears in the vicinity of a seismic survey may leave the area, and because they swim largely with their heads above water, it is unlikely that they would incur any hearing damage from a seismic survey. Female bears excavate dens in snow on drifting pack ice and on land. Pregnant females and females with newborn cubs in maternity dens are sensitive to noise and may be disturbed by seismic exploration, and have been reported to abandon den sites when seismic crews are operating nearby (Trasky, 1976; Amstrup, 1993). Such abandonment of a maternity den, even if short-term, could reduce cub survival. In addition, polar bears encountered along seismic survey lines may be killed in defense of life and property, although regulatory agencies and the oil and gas industry have made serious efforts to minimize interactions with polar bears (NRC, 2003b).

Drilling of exploratory wells could result in the discharge of approximately 610 tons of drilling muds and cuttings (Table IV-2). While heavier materials would settle to the bottom, lighter materials could increase turbidity of waters immediately surrounding the well site. These suspended solids would be quickly diluted and dispersed, and would not be expected to affect marine mammals.

For more information on potential effects to marine mammals from seismic exploration, see the MMS Programmatic Environmental Assessment for Arctic Ocean Outer Continental Shelf Seismic Surveys (MMS, 2006b) and the MMS Environmental Assessment on Geological and Geophysical Exploration for Mineral Resources on the Gulf of Mexico Outer Continental Shelf (MMS, 2004).

Construction of Offshore Platforms and Pipelines: Under the proposed action, 3-10 offshore platforms, 1-3 new offshore pipelines totaling 50-160 miles in length, and 1-3 new pipeline landfalls could be constructed in the Arctic Subregion (Table IV-2). Noise and human activity associated with construction of offshore facilities and pipelines could disturb marine mammals that may be present in the vicinity of the construction site. Construction activities could disturb normal behaviors (e.g., feeding, social interactions), mask calls from conspecifics, disrupt echolocation capabilities, and mask sounds generated by predators. The immediate response of disturbed individuals or groups would be to leave or avoid the construction area. For example, bowhead whales were found to stop feeding and move from within 0.8 km of experimental dredge sounds to more than 2 km away (MMS, 2002c). Such effects would likely be limited to individuals or small groups, be limited in duration to the construction period, and be sublethal. In addition, some individuals may habituate to dredging and other construction activities (MMS, 2002c). Because some marine mammal species exhibit seasonal changes in distribution and are absent or infrequent in the Arctic Subregion in winter, winter construction of offshore platforms would be expected to affect relatively few animals. Construction in spring and summer would be expected to disturb individuals present in the vicinity of the construction, although affected individuals would be expected to leave the area to other habitats. Displacement could be of short- or long-term duration and could affect survival of young if adults abandon young or are displaced from important foraging areas.

Pipeline trenching may also locally disrupt benthic invertebrate communities that serve as food sources for some marine mammal species (e.g., Pacific walrus, gray whale). The extent to which benthic food sources could be affected and the subsequent impact to marine mammals will depend on the type and amount of benthic habitat that would be permanently disturbed by trenching, the importance of the specific habitats in providing food resources to marine mammals, and the mammal species and numbers of individuals that could be affected. Because no more than 3 new pipelines would be built within the entire Arctic Subregion under the proposed action, relatively little benthic habitat would be disturbed (no more than 120 ha within the entire region) compared to that present. Natural recovery of the disturbed benthic habitats would occur within 3 to 10 years of initial disturbance (see Section IV.B.3.h). Thus, pipeline trenching is expected to have a limited effect on the overall availability of food sources for marine mammals. Any impacts to food sources would be localized and relatively short-term, and not expected to result in population-level impacts to marine mammal populations.

Construction of Onshore Processing Facilities and Pipelines: Under the proposed action, up to 3 new onshore facilities, 200 miles of new pipeline, and 3 new pipeline landfalls could be constructed in onshore areas adjacent to the Arctic Subregion (Table IV-2). Depending on the proximity of the new facilities to existing roads (such as those associated with North Slope infrastructure), one or more new access roads may be needed for each new facility to bring in construction equipment and supplies, and additional land would be needed for other infrastructure such as airstrips and power stations.

Onshore construction activities would not be expected to affect most of the marine mammals in the Arctic Subregion because these species typically occur in offshore open-water habitats and ice floes, and along pack ice away from coastal areas where construction might occur. Individuals that might be present in nearshore waters adjacent to a construction area would be expected to leave the area.

Two species of marine mammals that occur in the Arctic Subregion may be found in coastal habitats, and thus could be affected by onshore construction. The spotted seal uses coastal habitats such as beaches and river delta sandbars for sunning and resting. The polar bear forages along shore ice locations, and may have onshore maternity dens located as much as 8-10 km inland of the coast (Section III.B.6). Foraging bears and resting seals would be expected to leave or avoid areas where onshore construction is occurring, and because probably only a small number of individuals of either species might be disturbed, no population-level effects would be expected. If an active maternity den is present at or near the construction site, construction may cause the female to abandon the den and her cubs, potentially decreasing cub survival.

Operations of Offshore and Onshore Facilities: Noise associated with OCS drilling and production is of relatively low frequency, typically between 4.5 and 30 Hz. (Richardson et al., 1995). Potential effects on marine mammals may include disturbance (e.g., changes in behavior, short- or long-term displacement) and masking of calls from conspecifics or other natural sounds (e.g., surf, predators).

Because odontocetes use sounds at frequencies that are generally higher than the dominant sounds generated by offshore drilling and production activities, they may not be sensitive to or affected by these sounds. In contrast, mysticetes (such as the minke, gray, and bowhead whales) are considered to have good low-frequency hearing and exhibit vocalizations at low frequencies, and thus may be affected by drilling and production noise. Effects would be similar to those identified for exploration and construction activities, namely, behavioral disruption and avoidance of or displacement from the immediate vicinity of the operating facility. For example, bowhead whales have been observed to deflect from their migratory path by 20 km or more in response to drilling noises (MMS, 2002c). However, bowhead whales have also been reported to tolerate high levels of continuous drilling noise when necessary to continue with migration (MMS, 2002c).

Avoidance or displacement could be of short- or long-term duration, depending on whether or not affected individuals may become acclimated to the operational activities. Because affected individual would most likely leave the area to other appropriate habitats, neither behavioral disturbance nor the displacement of individuals by normal operations would be expected to result in long-term effects to either individuals or populations. However, the presence of an operating onshore facility could reduce the suitability of some areas for use by denning female polar bears, while normal operations of offshore facilities could decrease the suitability of offshore areas as pinniped foraging or pup-rearing habitats.

Operational Discharges and Wastes: Under the proposed action, normal operational wastes (produced water, drilling muds, and drill cuttings) would be disposed of through onsite injection into NPDES-permitted disposal wells (see Section IV.B.3.b). Thus, no impacts from operational wastes to marine mammals would be expected under normal operations.

Some marine mammals may be exposed to waste fluids (such as bilge water) generated by and discharged from OCS vessels. Discharges of such wastes from OCS service and construction vessels, if allowed, would be regulated under applicable NPDES permits and rapidly diluted and dispersed. Sanitary and domestic wastes would be processed through shipboard waste treatment facilities before being discharged overboard, and deck drainage would also be processed shipboard to remove oil before being discharged. Thus, permitted waste discharges from OCS service and construction vessels would not be expected to directly affect marine mammals.

Ingestion or entanglement with solid debris can adversely impact marine mammals (Marine Mammal Commission, 2004). Mammals that have ingested debris, such as plastic, may experience intestinal blockage which, in turn, may lead to starvation, while toxic substances present in the ingested materials (especially in plastics) could lead to a variety of lethal and sublethal toxic effects. Entanglement in plastic debris can result in reduced mobility, starvation, exhaustion, drowning, and constriction of, and subsequent damage to, limbs caused by tightening of the entangling material. The discharge or disposal of solid debris into offshore waters from OCS structures and vessels is prohibited by the MMS (30 CFR 250.40) and the USCG (MARPOL, Annex V, Public Law 100-220 [101 Statute 1458]). Thus, entanglement in or ingestion of OCS-related trash and debris by marine mammals would not be expected under the proposed action during normal operations.

Vessel and Aircraft Traffic: The majority of vessel traffic in the Beaufort and Chukchi Seas primarily occurs during summer, at which time it could contribute to ambient noise and potential disturbance to marine mammals (MMS, 2002c). Under the proposed action, there could be up to 3 weekly vessel trips and 3 daily helicopter trips to each offshore platform (Table IV-2). Additional helicopter or fixed-wing aircraft overflights may also occur as part of routine visual inspections and maintenance of onshore pipelines and for the transport of supplies and personnel to onshore facilities. Marine mammals may be affected by this traffic either by disturbance from passing vessels or aircraft or by direct collisions with vessels. Among the cetaceans, the beluga, gray, and endangered bowhead whales are the most abundant in the Arctic Subregion (Section III.B.6). Thus, these species have the potential to encounter OCS-related vessels that are in transit. The other cetaceans are present in relatively small numbers (less than 2,000 throughout the entire subregion), and thus are less likely to encounter OCS-related vessels. During their spring migration (April through June), bowhead whales would likely encounter few, if any, vessels along their migration route, as the ice at this time of the year typically would be too thick for seismic-survey ships, drillships, and supply vessels to operate (MMS, 2003a).

Stationary sources of sound appear less disruptive to bowhead whales than moving sources (MMS, 2001a). For example, the predicted zone of responsiveness for bowhead whales for drilling from an artificial island is 0.2 km, compared to 3 to 4 km for drilling from a vessel (MMS, 2001a). Bowhead whales move quickly away from approaching vessels that are closer than 2 km. Fleeing would usually stop within minutes after the vessel passes (MMS, 2001s). Bowheads typically avoid vessels at distances ranging from 1 to 4 km, and may show an avoidance response to icebreakers at 4.6-20 km (MMS, 2002c). Bowheads do not seem to respond adversely to aircraft overflights at altitudes greater than 300 m and do not react to occasional single passes of helicopters at heights above 150 m (MMS, 2001a). In general, they do not deflect more than a few kilometers in response to a single noise disturbance, and behavioral responses last only a few minutes (MMS, 2002c).

Worldwide, at least 11 species of cetaceans have been documented as being hit by ships (Laist et al., 2001; Jensen and Silber, 2003). In most cases, the whales are not seen beforehand or are seen too late to avoid collision. Most lethal or severe injuries involve ships traveling 14 knots or faster, and collisions with vessels greater than 80 m in length are usually either lethal or result in severe injuries (Laist et al., 2001). In addition to possible collision-related injuries, cetaceans in the vicinity of an OCS-related vessel may be disturbed by the vessel itself and the noise it generates. Disturbed individuals would be expected to cease their normal behaviors and likely move away from the vessel. Following passage of the vessel, affected individuals may return and resume normal behaviors. However, if vessel traffic occurs along a consistent route, some species may permanently leave the area. If the abandoned areas represent important feeding or calving areas, condition and reproductive success may be adversely affected. Of the 236 bowhead whales examined between 1976 and 1992, only 3 ship-strike injuries were documented, indicating that they do not often encounter vessels, avoid interactions with vessels, or that interactions usually result in the death of the animals (Shelden and Rugh, 1995).

Pinnipeds and the polar bear may also be expected to exhibit behavioral changes in response to OCS-related vessel and aircraft traffic. Disturbed individuals may temporarily cease normal behaviors (such as feeding) and leave an area, but may return after the vessel or aircraft has left the area. However, Pacific walruses in water have been reported to show little response to vessels (Fay et al., 1984), and thus may be more susceptible to vessel collisions. While temporary disturbance may not be expected to result in population-level effects, cub or pup survival may be affected if adults temporarily abandon their young or den sites.

The amount of vessel and aircraft traffic that could occur under the proposed action would be relatively limited. Which species could be affected, the nature of their response, and the potential consequences to the disturbance, will be a function of a variety of factors, including the specific routes, the number of trips per day, the altitude of the aircraft overflights, the seasonal habitats along the routes, the species using the habitats and the level of their use, and the sensitivity of the mammals to vessel and aircraft traffic. Traffic over heavily utilized feeding or calving habitats (such as coastal estuaries, bays, and river mouths used for molting and calving by beluga whales) could result in population-level effects for some species, while impacts from traffic over other areas with less sensitive species would likely be limited to a few individuals and not result in population-level effects.

Accidents

Oil spills could affect marine mammals in a number of ways, and the magnitude and severity of potential impacts would depend on the location and size of the spill, the type of product spilled, weather conditions, the water quality and environmental conditions at the time of the spill, and the species and habitats exposed to the spill. Marine mammals may be exposed to spilled oil by direct contact, inhalation, and ingestion (directly, or indirectly through the consumption of contaminated prey species). Such exposures may result in a variety of lethal and sublethal effects (Geraci, 1990).

Direct contact of oil may irritate, inflame, or damage skin and sensitive tissues (such as eyes and other mucous membranes) (Geraci and St. Aubin, 1982). Prolonged contact to petroleum products may reduce food intake; elicit agitated behavior; alter blood parameters, respiration rates, and gas exchange; and depress nervous functions (Lukina et al., 1996). Under less extreme exposures (lower concentrations or shorter durations), oil does not appear to readily adhere to or be absorbed through cetacean skin, which, due to a thick fat layer, may provide a barrier to the uptake of oil-related aromatic hydrocarbons through the body surface (Geraci and St. Aubin, 1982, 1985; Harvey and Dahlheim, 1994).

Effects of oil spills would depend on how many whales contacted oil, the duration of contact, and the age/degree of weathering of the spilled oil. The number of whales contacting spilled oil would depend on the size, timing, and duration of the spill; how many whales were near the spill; the whales' inclination or ability to avoid contact; and the effectiveness of cleanup activities (MMS, 2001a, 2004a). Some displacement of bowhead whales may occur in the event of a large oil spill, and avoidance of the contaminated area may last for several years (MMS, 2001a; NMFS, 2001b). This indicates that bowhead whales may have some ability to detect an oil spill and would avoid surfacing in the oil by detouring away from the spill area (NMFS, 2001b). Modeling efforts have indicated that only up to 2 percent of the Beaufort Sea bowhead whale population would be affected by a large oil spill (NMFS, 2001b).

While adult ice seals depend on a thick fat layer for insulation, seal pups rely on a dense layer of underfur until they are several weeks old. The fouling of this underfur in young pups could reduce its insulating properties, increasing the potential for hypothermia and increasing pup mortality. Polar bears may be affected in a similar manner, with fouling of fur resulting in hypothermia and reduced survival.

Fresh crude oil releases toxic vapors that when inhaled may irritate or damage respiratory membranes, congest lungs, and cause pneumonia. Following inhalation, volatile hydrocarbons may be absorbed into the bloodstream and accumulate in the brain and liver, leading to neurological disorders and liver damage (Geraci and St. Aubin, 1982; Geraci, 1990). Toxic vapor concentrations may occur just above the surface of a fresh oil spill, and thus be available for inhalation by surfacing cetaceans. Inhalation would only be a threat during the first few hours after a spill (Hayes et al., 1992; ADNR, 1999c). Prolonged exposure to freshly spilled oil could kill some whales (including bowheads), but the numbers would be small due to a low chance of such contact. This would most likely occur if oil spilled into a lead that bowhead whales could not escape (MMS, 2001a).

Marine mammals may incidentally ingest floating or submerged oil or tar, and may consume oil-contaminated prey (Geraci, 1990). Spilled oil may also foul the baleen fibers of mysticete whales, temporarily impairing food-gathering efficiency or resulting in the ingestion of oil or oil-contaminated prey (Geraci and St. Aubin, 1987). Ingested oil can remain within the gastrointestinal tract and be absorbed into the bloodstream, thus irritating and/or destroying epithelial cells in the stomach and intestine. Oil ingested during grooming of fouled fur has been reported to result in liver and kidney damage in polar bears and ringed seals (NRC, 2003b).

An accidental oil spill may result in the localized reduction, extirpation, or contamination or prey species. Invertebrate and vertebrate species (such as zooplankton, crustaceans, mollusks, and fishes) may become contaminated and subsequently expose marine mammals that feed on these species.

Depending on their habitat preferences, feeding styles, and migration patterns, some species may be more vulnerable to exposure than other species. Spills occurring in spring may affect a greater number of individuals due to animals congregating during migration. Spills occurring in or reaching coastal areas, especially sheltered coastal habitats such as bays and estuaries, would be more likely to affect species such as the beluga whale and spotted seal that utilize coastal habitats for calving and resting. Bowheads are most sensitive to oil contamination during the spring migration when calves are present and their movements are restricted to open leads in the ice (MMS, 2002c). Since fin and humpback whales remain relatively far offshore from OCS activities, there is a low probability that these endangered species would be affected by an oil spill (MMS, 2002c).

Spills associated with onshore facilities (and especially any onshore pipelines) would be expected to potentially affect only the polar bear. While it is unlikely that a bear would be directly exposed to an accidental pipeline release, bears could be affected by feeding on contaminated prey. However, because of the relatively low density of bears in the Arctic Subregion, no more than a few individuals would be expected to be affected by an onshore release. Onshore spills that enter a stream system may be carried to coastal areas, where other marine mammals may be exposed.

Because benthic organisms (such as crustaceans and mollusks) accumulate oil compounds more readily and to higher levels than pelagic biota (Patin, 1999), the potential for ingesting oil-contaminated prey is highest for benthic feeding species, such as the gray whale, less so for plankton-feeding cetaceans, and least for fish-eating cetaceans (Würsig, 1990). Similar differences in exposure via food ingestion may be expected among benthic and fish-eating pinnipeds (i.e., Pacific walrus, spotted seals). Species with a dependence on or preference for offshore areas or habitats for feeding, shelter, or reproduction would be more likely to be affected by a deepwater spill than would other marine mammals (Würsig, 1990).

Spills occurring in winter may accumulate and freeze under ice and move with the ice pack. In spring, this oil may be released into ice leads that are used by migrating whales (such as beluga and bowhead whales) and by pinnipeds that utilize these areas (Section III.B.6), resulting in the exposure of relatively large numbers of individuals. Spills under ice or associated with leads may affect haulout sites, causing either abandonment or repeated exposure through use of the contaminated haulout. Because some species (ringed seals) are relatively restricted to open-water areas associated with ice, individuals may not be able to disperse from spills in these areas and, thus, may incur increased exposures. Because poplar bears are closely associated with ice edges, spills accumulating along these areas may expose the greatest number of bears to an offshore spill.

An approved oil-spill response plan would be required for all exploration and production activities. Oil-containment and cleanup activities would be initiated a short time following the detection of an oil spill (MMS, 2003a). Oil-spill response activities may affect marine mammals through exposure to spill response chemicals (e.g., dispersants or coagulants) or through behavioral disturbance by cleanup operations, or habitat disturbance. The chemicals used during a spill response are toxic, but are considered much less so than the constituents of spilled oil (Wells, 1989), although there is little information regarding their potential effects on marine mammals. The presence of, and noise generated by, oil-spill response equipment and support vessels could temporarily disturb marine mammals in the vicinity of the response action, with affected individuals likely leaving the area. While such displacement may affect only a small number of animals and not result in population-level effects, cleanup operations disturbing adults in pup-rearing areas may decrease pup survival. Oil-spill-response support vessels may also increase the risk of collisions between these vessels and marine mammals in the vicinity of the spill response.

Bowhead whales may be displaced temporarily from an oil-spill area due to the large numbers of personnel, equipment, vessels, and aircraft that could be involved in oil-spill cleanup activities. However, fewer bowhead whales would be expected to be exposed to oil as a result of cleanup operations (MMS, 2001a). The Industry Site-Specific Bowhead Whale-Monitoring Program should be effective in detecting a delay or blockage of the migration (MMS, 2004a). The optional Stipulation on Pre-Booming Requirements for Fuel Transfers should ensure rapid spill responses, decreasing the likelihood that large fuel spills would affect bowhead whales during their migration (MMS, 2004a).

Conclusion

Under the proposed action, some routine operations could affect marine mammals in the Arctic Subregion. Noise generated during exploration and operation activities and by OCS-related vessels and helicopters may temporarily disturb some individuals, causing them to leave or avoid the area. When properly mitigated, such effects would likely be short-term and not result in population-level effects. If the disturbance results in the temporary abandonment of young by adults, such as polar bears in maternity dens on drifting pack ice, survival of young may be reduced. Collisions with OCS-related vessels may injure or kill some individuals. Existing permit requirements, regulatory stipulations, and MMS guidelines targeting many of the routine operations would generally limit the likelihood of marine mammals being affected by these operations. No population level impacts from these activities are expected to occur.

Compliance with the Endangered Species Act (ESA) and Marine Mammal Protection Act (MMPA) would limit the likelihood of impacts to both listed and non-listed marine mammals. Similarly, careful siting of onshore and offshore facilities and OCS-support vessels and aircraft routes to avoid impacts to habitats, particularly during migration, would generally reduce the likelihood and/or magnitude of adverse impacts to all marine mammals in the Arctic Subregion. Mitigation measures are in place that may subject areas to seasonal drilling restrictions to prevent the endangered bowhead whale from being disrupted during its migration and when it is most likely to be hunted (ADNR, 1999c). Other marine mammal species would also indirectly be provided with protection by the same mitigation measures developed to minimize disturbance to bowhead whales (ADNR, 1999c).

Bowhead whales do not seem to travel more than a few to 20 km in response to a single disturbance, and behavioral changes are temporary, lasting from a few minutes for vessels and aircraft to up to an hour for seismic activities (MMS, 2001a). While some individuals may move to avoid a particular activity, a significant change in seasonal distribution of the bowhead whale is unlikely (NMFS, 2001b). The OCS activities conducted in the Beaufort Sea as a result of Federal lease sales since 1979 have not apparently had adverse effects on the bowhead whale population. No bowhead whale mortality has been reported over this time, while the bowhead whale population has continued to increase over this period even in the face of energy-related activities and subsistence hunting (MMS, 2001a, 2004a).

Oil spills may expose marine mammals to oil or its weathering products. Animals could be exposed by the inhalation or ingestion of oil or contaminated foods, which may result in a variety of lethal and sublethal effects. Fouling of fur of some species (e.g., ringed seal pups, polar bear cubs) could affect thermoregulation and reduce survival of affected young. With only two large oil spills assumed to occur in the Arctic Subregion during the 40-year life of the 2007-2012 Leasing Program, it is unlikely that population-level impacts would occur.

(2) Bering Sea Subregion

A total of 23 marine mammal species occur regularly or sporadically in the North Aleutian Basin Planning Area (Table III-33) and may be affected by the proposed action. These include 14 cetacean species, eight species of pinnipeds, and one fissiped species. The following sections discuss the potential impacts to these groups that could result from routine operations or from accidental oil spills.

Routine Operations

Routine OCS operations in the North Aleutian Basin Planning Area that could affect marine mammals include offshore exploration, the construction and operation of offshore platforms and pipelines, the construction and operation of onshore processing facilities and pipelines, operational discharges and wastes, and OCS vessel and aircraft traffic. Marine mammals may be affected by the noise, contaminants, human activities, and physical structures and equipment associated with these undertakings.

Of the four federally listed cetacean species occurring in North Aleutian Basin waters, all but fin and humpback whales are considered relatively rare. However, recent sightings of North Pacific right whales in the area are of interest, as any perturbation to this small remnant group is likely to affect much of the North Pacific right whale population (and species).

Routine operations occurring near important habitats, such as the Steller sea lion rookery at Amak Island or the Steller sea lion and Pacific walrus haulouts at Walrus Islands, could affect a greater number of individuals and potentially result in long-term and population-level effects for affected species. Because of the low level of OCS-related activities that could occur in the planning area and the restricted and protected nature of many of the important habitats (such as the 20 nautical mile aquatic avoidance zone around the sea lion rookery, haulouts, and select foraging sites), few such habitats may be affected as a result of normal operations under the proposed action.

Offshore Exploration: Noise generated during offshore seismic surveys may physically and/or behaviorally affect marine mammals in the vicinity of seismic surveys. Associated effects may include hearing loss, discomfort, and injury; asking of important sound signals; and behavioral responses such as fright, avoidance, and changes in physical or vocal behavior (Richardson et al., 1995; R.A. Davis et al., 1998; Gordon et al., 1998; Thomson and Davis, 2001). There have been no documented instances of deaths, physical injuries, or physiological effects on marine mammals from seismic surveys (MMS, 2004a). There is currently no evidence to suggest that routine surveys may result in population-level effects in marine mammals. However, it is not possible to predict the type or magnitude of responses to such surveys (and other oil and gas activities) or to evaluate the potential effects on populations (NRC, 2003b).

Noise from seismic surveys could disturb marine mammals, primarily affecting animals in the vicinity of the survey vessel, although animals within a few kilometers of the seismic operations may be affected (Richardson et al., 1985; Thomson and Davis, 2001; MMS, 2003a). The mysticetes have demonstrated a range of responses to seismic noises, including short-term avoidance and deflection of travel (Malme and Miles, 1985; Richardson and Malme, 1993).

Exposure to maximal sound levels could result in damage to hearing organs and short-term or long-term hearing loss in exposed individuals. Seismic survey airgun arrays are configured to output maximal energy in the region of a few tens of Hertz (MMS, 2004a). Among cetaceans, the odontocetes (such as the beluga, killer, and beaked whales) generally demonstrate relatively poor low-frequency hearing sensitivity and, thus, might not experience hearing loss from seismic surveys and may not exhibit behavioral responses to seismic surveys (Richardson et al., 1994). However, sperm whales (an odontocete unlikely to be encountered in the planning area) may have displayed some vertical avoidance to sound sources during the Acoustic Thermometry of Ocean Climate Project by remaining at the surface for longer intervals (Bowles et al., 1994). Sperm whales are deep divers that use mid-frequency sound for communication and echolocation, and it is possible that low-frequency sounds produced during seismic exploration could mask communication among sperm whales or affect them in some other manner. It is possible that individuals of the three species of beaked whales that occur sporadically in the deeper western waters of the planning area could be similarly affected during seismic surveys.

In contrast, the mysticetes are considered to possess good hearing sensitivity at low frequencies (Richardson et al., 1995; Crane and Lashkari, 1996; Ketten, 1998; Stafford et al., 1998) and, thus, may be affected more than odontocetes during routine seismic surveys. Affected individuals may be expected to leave the area and, if exposed to maximal sound levels, may incur short-term or long-term hearing loss. Exposure to less than maximal sound levels could result in temporary masking effects to the affected individuals (Ljungblad et al., 1988; Malme et al., 1989).

In general, seals have been reported to move away from seismic vessels, although some have been observed swimming in the bubbles generated by large seismic airgun arrays (67 FR 35793; Thomson and Davis 2001; MMS 2003b). Small groups or individual pinnipeds may be locally displaced by seismic activities. Seismic airgun blasts greater than 190 dB re 1 μPa can damage seal hearing (dB-decibel; μPa-microPascal). Because seismic surveys would occur away from coastal habitats, routine seismic surveys are not expected to adversely affect pinnipeds (including the endangered Steller sea lion) or sea otters in coastal habitats (such as rookeries, haulouts, and foraging areas).

Riedman (1983) subjected sea otters in California to simulated industrial noises associated with oil and gas exploration and development. Although one group, or raft, of sea otters displayed slightly alarmed behavior at the close approach of a seismic airgun vessel and the loud airborne sounds generated by that vessel, none of the otters exposed to simulated noise exhibited movements out of the vicinity of the sound projection, indicating no habitat abandonment. In addition, mating activities and mother-pup interactions were considered unaffected during all phases of the airgun experiments. Riedman (1983) concluded that the behavior, density, and distribution of sea otters in the study area were not affected by the playback of industrial noises and the sounds generated by the airguns. Sea otters in the

North Aleutian Basin Planning Area may be expected to exhibit a similar, limited response to exploration activities that could occur under the proposed action.

Offshore exploration activities could include the placement of up to 20 exploration and delineation wells in the North Aleutian Basin Planning Area that could each generate and discharge up to 522 tons of drilling muds and cuttings (Table IV-2). Heavier components of these cuttings and muds (such as rock) would settle to the bottom, while lighter components could increase turbidity around the drill site. While this increased turbidity could cause marine mammals to avoid the area, any increase in suspended solids associated with the discharge of drilling wastes would be rapidly diluted and dispersed and, thus, not be expected to adversely affect marine mammals in the area.

For more information on potential effects to marine mammals from seismic exploration, see the MMS Programmatic Environmental Assessment for Arctic Ocean Outer Continental Shelf Seismic Surveys (MMS, 2006) and the MMS Environmental Assessment on Geological and Geophysical Exploration for Mineral Resources on the Gulf of Mexico Outer Continental Shelf (MMS, 2004).

Construction and Operation of Offshore Platforms and Pipelines: Under the proposed action, 4-6 offshore platforms and up to 150 miles of offshore pipeline and 1-2 pipeline landfalls could be constructed in the North Aleutian Basin Planning Area (Table IV-2). Noise and human activity associated with construction and operations could disturb marine mammals that may be present in the immediate vicinity of these facilities. Because any platforms and most pipelines would be located away from coastal waters, construction of these facilities would not be expected to affect marine mammals (such as the sea otter, Pacific walrus, and Steller sea lion) in coastal habitats such as rookeries and haulouts. Construction activities in the noncoastal areas of the planning area could disturb normal behaviors (e.g., feeding, social interactions), masking calls from conspecifics or sounds generated by predators and disrupting echolocation capabilities.

Among the mysticetes, reactions to pipeline dredging and other industry-related activities have been best studied in bowhead whales, and their responses may be expected to be representative of the baleen whale species that could occur in the North Aleutian Planning Area (North Pacific right, gray, humpback, fin, and sei) (Richardson et al., 1994). Bowhead whales exposed to experimental dredge sounds of 122-133 dB have been reported to exhibit avoidance behavior, and individuals have been reported to stop feeding and move from within 0.8 km (0.5 miles) of the sound source to locations greater than about 2 km (1 mile) away. However, whales farther away exhibited only weak and inconspicuous avoidance. A gradual onset of dredge noise produced less abrupt reactions. There is some indication that some individuals may habituate to dredging and other construction activities.

The odontocetes appear to be relatively tolerant of drilling and production noise (Richardson et al., 1994). Belugas are probably most sensitive to drilling activities in the spring, when migrating in or near ice leads. Belugas in leads have been observed to change course within 1 km (0.6 miles) of a stationary drillship, and to actively avoid support vessels moving near the drillship. Killer whales are also expected to be relatively tolerant, as other species of odontocetes have been observed close to drilling operations. Harbor and Dall's porpoise reactions are expected to be similar to killer and beluga whales, including avoidance of the immediate construction locations and surrounding areas.

With the exception of pipeline landfalls, most construction and operations activities would occur well away from coastal areas utilized by the sea otter. Therefore, routine construction and operation activities are not expected to adversely affect sea otter populations within the planning area. Nearshore pipeline and landfall construction could result in the temporary disturbance of nearby animals and their avoidance of the area during the construction period. Operational impacts of these coastal facilities are discussed later.

The immediate response of affected individuals or groups would be to leave or avoid the construction areas. This displacement or avoidance could be short- or long-term in duration, depending on the duration of the construction activity and the degree to which disturbed individuals may habituate to the noise and human activity. Because of the small number of platforms and relatively small amount of pipeline that would be constructed and operated under the proposed action, only a few individuals or small groups of marine mammals may be expected to be affected during routine construction and operation of these facilities, and disturbance of these individuals would not be expected to result in population-level effects to affected marine mammals.

Benthic invertebrate communities that may provide food for some marine mammal species may be impacted by platform and pipeline construction. Because of the relatively small amount of benthic habitat that could be disturbed (no more than 190 ha) compared to the total habitat present in the planning area, construction is expected to have a limited effect on the overall availability of food resources in the planning area. Any impacts to food resources would be very localized and largely short-term, and not expected to result in population-level impacts to marine mammal populations.

Construction and Operation of Onshore Facilities, Dock, Causeways, and Pipelines: Under the proposed action, up to 3 onshore facilities, 50 miles (80 km) of onshore pipeline, 2 pipeline landfalls, and 1 dock/causeway facility could be constructed in onshore areas adjacent to the North Aleutian Basin Planning Area (Table IV-2). Depending on the proximity of these facilities to existing roads, one or more new access roads may be needed for each new facility and for pipeline maintenance activities. Marine mammals that could be affected by the construction and operation of onshore facilities are those that utilize coastal habitats, especially beaches and other shoreline locations, such as the sea otter, harbor seal, Pacific walrus, and the endangered Steller sea lion. Affected individuals would be expected to leave (at the onset of construction) or avoid (during construction and operation) areas where onshore activities are occurring. In addition, the presence of an operating onshore facility could reduce the suitability of surrounding offshore and onshore areas as pinniped rookery or haulout sites or foraging areas, and could displace individuals from these areas. Some species, such as the sea otter, may become habituated to operational activities and experience little or no disturbance from onshore operations. In areas that are lightly used, only a small number of individuals might be disturbed. and no population-level effects would be expected.

Construction in the planning area near Steller sea lion rookeries or haulouts would be restricted by the critical habitat designations and the associated onshore exclusion buffer zones specified for rookery and haulout sites for this species (50 CFR 226.202; 50 CFR 223.202). The siting of pipeline landfalls, a dock/causeway facility, and onshore pipelines and processing facilities to avoid rookeries and haulouts of other pinnipeds species would greatly reduce the potential impacts to these species.

Operational Discharges and Wastes: Under the proposed action, normal operational wastes (produced water, drilling muds, and drill cuttings) would be disposed of through down-hole injection into NPDES-permitted disposal wells (see Section IV.B.3.b). Thus, no impacts from operational wastes to marine mammals would be expected under normal operations.

The OCS-related vessels supporting exploration activities and the construction and operation of offshore platforms and pipelines will generate waste fluids (such as bilge water), which may be discharged to the surface water. Such discharges, if allowed, would be regulated under applicable NPDES permits. Sanitary and domestic wastes would be processed through shipboard waste treatment facilities before being discharged overboard, and deck drainage would also be processed shipboard to remove oil before being discharged. Because of the low level of vessel traffic, only relatively small volumes of operational wastes would be discharged (if allowed), and these would be rapidly diluted and dispersed. Thus, permitted waste discharges from OCS service and construction vessels would not be expected to affect marine mammals.

Ingestion of, or entanglement in, solid debris can adversely impact marine mammals (Marine Mammal Commission, 2005). The discharge or disposal of solid debris into offshore waters from OCS structures and vessels is prohibited by the MMS (30 CFR 250.40) and the USCG (MARPOL, Annex V, Public Law 100-220 [101 Statute 1458]). Thus, entanglement in, or ingestion of, OCS-related trash and debris by marine mammals would not be expected under the proposed action during routine operations.

Vessel and Aircraft Traffic: Under the proposed action, there could be up to 3 vessel trips per week and 3 helicopter trips per day to each offshore platform (for a maximum of 6 platforms). Additional helicopter or fixed-wing aircraft overflights may occur as part of routine visual inspections and maintenance of onshore pipelines. Marine mammals may be affected by this traffic either by disturbance from passing vessels or aircraft or by direct collisions with vessels. Species most likely to be present in the southern portion of the planning area, where platforms could be located (MMS, 1998b), include a number of nonlisted cetaceans (e.g., beluga) and pinnipeds (e.g., harbor seal, Pacific walrus), as well as the listed humpback and fin whales and the Steller sea lion. Thus, these species have the potential to encounter OCS-related vessels that are in transit. Because of the low level of vessel traffic that could occur under the proposed action, potential impacts to marine mammals from this traffic would likely be limited to a few individuals, largely short-term in nature, and not result in population-level effects.

Fast-swimming, agile pinnipeds and smaller odontocetes, such as Dall's porpoise and the Pacific white-sided dolphin, may be expected to readily avoid collisions with OCS-related vessels. In contrast, worldwide at least 11 species of cetaceans have been documented as incurring ship collisions (Laist et al., 2001; Jensen and Silber, 2003). Northern right whales appear particularly susceptible to vessel collisions. In addition to possible collision-related injuries, cetaceans and pinnipeds in the vicinity of an OCS-related vessel may be disturbed by the vessel itself and the noise it generates. Disturbed individuals would be expected to cease their normal behaviors and likely move away from the vessel. Following passage of the vessel, affected individuals may return and resume normal behaviors. For example, during spring, noise from ships and icebreakers in deep channels of the Canadian high Arctic caused belugas to flee when a ship approached within about 20 to 30 miles (35-50 km), traveling up to about 80 km (50 miles) from the ship's path and remaining away from the area for 1-2 days (Richardson et al., 1994). However, in areas such as Bristol Bay, belugas seem to have become relatively habituated to fishing vessel traffic during the salmon fishing season and do not appear to flee from feeding areas.

Marine mammals may be disturbed as a result of overflights of helicopters supporting offshore construction and production activities. Individuals beneath or near the flight paths may be startled by the presence or noise of the passing helicopter, ceasing normal behaviors and diving or fleeing the immediate area to avoid the oncoming helicopter. For example, aircraft overflights have been reported to cause temporary, localized behavioral reactions in Dall's porpoises. Dall's porpoises dove, moved erratically, or rolled to look upward at an helicopter flying over at altitudes of 215-365 m (700-1,300 feet) altitude (Withrow et al., 1985). In contrast, belugas have shown variable reactions to fixed-wing aircraft and helicopter overflights. Some show no overt response, whereas others look upward, dive abruptly, or turn sharply away when aircraft fly over at altitudes up to 460 m

(1,500 feet). Fixed-wing aircraft traveling at altitudes of 245 m (800 feet) are typically used to conduct aerial surveys for beluga without obvious impacts to surveyed individuals (for example, see Rugh et al., 2002).

Because of the transient nature of OCS-related overflights, disturbed animals may be expected to return to the area and/or resume normal behaviors shortly after the overflight. Aircraft overflight restrictions associated with Steller sea lion critical habitat protection (50 CFR 223.202, 50 CFR 226.202) would further reduce the likelihood of helicopter flights impacting designated rookery sites for this species. The planning of flight paths to avoid rookeries and haulouts of other pinnipeds would further reduce or eliminate the potential for disturbing animals in these habitats.

There have been no systematic studies on the effects of aircraft overflights on humpbacks or fin whales. However, observations indicate that large groups of humpbacks showed little to no response to small aircraft, while groups containing only adults showed some avoidance (Richardson et al., 1994). Fin whales reacted slightly to small aircraft circling at altitudes of about 50-300 m (160-980 feet) above the surface. Helicopter traffic is probably more disruptive, but there are few data available on the effects of helicopter overflights on either species. Fin whales reduced the durations of surfacing and dives, and had fewer blows per surfacing when whale-watching vessels were nearby. Overall, humpbacks attempted to avoid vessels, and small pods containing calves were more affected than larger non-calf pods.

Accidents

A small number of accidental oil spills could occur under the proposed action (Table IV-4). Marine mammals may be affected in a number of ways, and the magnitude and severity of potential impacts would depend in large part on the location and size of the spill, the species and habitats exposed to the spill, and the nature and duration of the exposure. Marine mammals may be exposed to spilled oil by direct contact, inhalation, and ingestion, which may result in a variety of lethal and sublethal effects (see Sections IV.B.2.c and IV.B.3.c(1)) for descriptions of potential effects).

Direct contact could result in sensitive tissues such as eyes and lungs becoming temporarily irritated and/or permanently damaged, while inhalation may damage or irritate lung tissue. Direct and indirect ingestion could result in a variety of lethal or sublethal effects. Some species, such as the sea otter and fur seal, rely on thick fur and the constant aeration of their fur for effective thermoregulation, and fouling of fur could reduce thermoregulation and reduce survival in such species. Oil may also foul baleen and affect feeding in the baleen whales.

Accidental oil spills may also result in the localized reduction or contamination of invertebrate and vertebrate prey (such as zooplankton, crustaceans, mollusks, and fishes). While there is no conclusive evidence of oil spills causing a decline in prey species sufficient to result in a decline in any marine mammal population, such an effect is possible. However, given the small size and number of spills that might occur under the proposed action, it is unlikely that an accidental spill would result in a reduction in prey of sufficient duration and magnitude to result in population-level effects on marine mammals occurring in the North Aleutian Basin Planning Area.

Because of the small number and size of potential spills that could occur under the proposed action (most spills less than 50 bbl), exposure to spilled oil would be temporary and likely affect only a few individuals (NMFS, as cited in MMS, 2003b). However, the number of whales affected by an accidental oil spill would depend on the time of year and duration of the spill, the quantity of the spill, the density of the whale population in the vicinity of the spill, and the ability of individual whales to avoid the spill (Geraci and St. Aubin, 1990). Spills occurring in marine waters of the planning area are not expected to affect the humpback, sei, fin, and North Pacific right whales; the beaked whales; or the northern fur, ringed, and bearded seals. Individuals of these species occur in the planning area relatively infrequently and/or in deep offshore waters away from areas of the basin where oil and gas development may occur (see MMS, 1998b). Accidental spills could expose the more common and widely distributed cetaceans and pinnipeds (such as the minke whale and the harbor seal, respectively) feeding in marine waters of the basin. Among the odontocetes, killer whale pods and bottlenose dolphins (*Tursiops truncatus*) (which does not occur in the basin) have been reported to not avoid oil-contaminated areas (Loughlin, 1994; Smultea and Würsig, 1995). These reports suggest that the killer whale and possibly other toothed whales in the planning area may be especially susceptible to exposure to an accidental oil spill.

Spills occurring in or reaching coastal areas and islands pose the greatest risk to marine mammals of the basin. Spills in these areas could affect species such as the sea otter, Steller sea lion, and Pacific walrus that utilize coastal and island habitats for pupping, foraging, and resting. Spills in nearshore areas could result in the direct oiling of large numbers of pinnipeds and sea otter, and adversely affect local populations of some of these species (such as the sea otter and fur seals) via direct lethal and sublethal effects. A large spill contacting an active rookery or haulout site could result in population-level effects for some species (such as the walrus and sea lion). Spills contacting Amak Island in late spring, summer, and early fall could have a serious impact on Steller sea lions, when adults and pups are concentrated at the rookery. Similar potential for impacting large numbers of sea lions exists for spills contacting either of the two major haulout sites in Bristol Bay.

Spills associated with onshore facilities (and especially any onshore pipelines) would not be expected to affect marine mammals unless the spilled oil is then transported to a coastal habitat. For example, an onshore spill may enter a stream system and subsequently be carried to a coastal area where it could expose and affect marine mammals such as the sea otter.

Oil-spill response activities may affect marine mammals through exposure to spill response chemicals (e.g., dispersants or coagulants) and behavioral disturbance during cleanup and restoration operations. The chemicals typically used during a spill response are toxic, but are considered much less so than the constituents of spilled oil (Wells, 1989), although there is little information regarding their potential effects on marine mammals. The presence of, and noise generated by, spill response equipment and support vessels could temporarily disturb marine mammals in the vicinity of the response action, with affected individuals likely leaving the area.

While such displacement may affect only a small number of animals, cleanup operations disturbing adults in pup-rearing areas may decrease pup survival and result in population-level effects. Direct oiling of pups could lead to a variety of lethal and sublethal effects. In addition, adults of easily disturbed species (such as the Steller sea lion) may stampede into the water upon arrival of containment and cleanup equipment, trampling pups, which could impact the population as a whole. Cleanup activities near rookeries or haulout locations (such as Amak and the Walrus Islands) could displace large numbers of individuals for many months, with unknown population-level effects.

Conclusion

Marine mammals in the North Aleutian Basin Planning Area could be affected by noise, contaminants, human activity, and ship and helicopter traffic associated with routine OCS operations. Noise generated during exploration, construction, and operations may temporarily disturb some individuals, causing them to leave or avoid the area. While collisions with OCS-related vessels may injure or kill some individuals (especially large cetaceans), such collisions would be relatively unlikely because of the low level of such traffic that could occur under the proposed action. The degree and length of impact to marine mammals are dependent on such factors as tolerance, level of repeated disturbance, activities being disturbed and even the age or sex of the individual. Short-term or periodic disturbances would likely only result in short-term impacts and would not be expected to result in population-level effects. However, repeated exposure at critical life stages or in important areas may lead to more long-term and potential population-level effects. The implementation of appropriate mitigation and monitoring measures would likely reduce the potential for both short and long-term disturbances.

Many listed cetacean species occur very infrequently within the planning area and, thus, would not be expected to be affected by normal operations. Others use these areas regularly and even on a year-round basis or primarily use the habitat to fulfill important behaviors, such as feeding. In these cases, impacts could potentially result in long-term and population level effects if appropriate mitigation measures are not implemented. Compliance with the ESA and MMPA would further limit the likelihood of routine operations impacting marine mammals. Activity restrictions related to protecting important haulout, feeding, breeding or molting areas would assist in limiting the potential for impacts to occur. Similarly, careful siting of offshore and onshore facilities and OCS-support vessel and helicopter routes to avoid important habitats for this and other species (such as major haulouts for the Pacific walrus and the harbor seal) would greatly reduce the likelihood and magnitude of adverse impacts to marine mammals in the planning area.

Accidental oil spills may result in the direct and indirect exposures of marine mammals and their habitats to the oil and subsequent weathering products. Animals could be exposed by the inhalation or ingestion of oil or contaminated foods, which may result in a variety of lethal and sublethal effects. Fouling of fur of some species (e.g., sea otter and fur seal) could affect thermoregulation and reduce survival. The magnitude of effects from accidental spills would depend on the location, timing, and volume of the spills; the habitats affected by the spills (e.g., coastal habitats); and the species exposed. For ESA-listed species, a major oil spill could result in detrimental effects to the population depending on the location of the spill, the number of animals affected, and the life history stage of the affected animals. The degree of impacts from spills in open waters may result in detrimental effects to some marine mammal species, including those not listed under the ESA, depending again on the location and extent of the spill (i.e., sea otters that occur far offshore in the Bering Sea or right whales feeding at the surface). The greatest risk to marine mammals would be associated with large spills reaching rookeries, haulout, feeding, breeding, or molting areas. Spills in these locations have the potential for affecting the greatest number of individuals and could result in population-level impacts to some species, especially those listed under the ESA. Spill cleanup operations could result in short-term disturbance of marine mammals in the vicinity of the cleanup activity, while a collision with a cleanup vessel could injure or kill the affected individual. Disturbance of adults with young during cleanup activities could reduce survival of the young animals.

(3) South Alaska Subregion

There are 21 species of marine mammals that occur in south Alaskan waters and that may occur in some portions of the Cook Inlet Planning Area (Section III.B.6). Eight of these species are listed as threatened or endangered under the ESA, as shown in Table III-33. These species include the northern right, sei, blue, fin, humpback and sperm whales; the northern sea otter, and the Steller sea lion. The Cook Inlet stock of beluga whales is also listed as a Species of Concern under the ESA. Of the remaining 13 nonlisted species, 8 commonly occur in portions of or throughout the Cook Inlet Planning Area (MMS, 2003b). These species include the Pacific harbor and the northern fur seals; the minke, killer, and gray whales; and Dall's and harbor porpoises. These marine mammals may be exposed to OCS-related oil and gas exploration, development, and operations that could occur under the proposed action.

Routine Operations

Routine OCS operations in the Cook Inlet Planning Area that could affect marine mammals include offshore exploration, the construction and operation of offshore platforms and pipelines, the construction and operation of onshore processing facilities and pipelines, operational discharges and wastes, and OCS vessel and aircraft traffic. Marine mammals may be affected by the noise, contaminants, human activity, and physical structures and equipment associated with these activities.

Because of the relatively small amount of OCS-related oil and gas exploration and development that could occur in the planning area under the proposed action, routine operations are not expected to result in widespread or long-term effects on marine mammals. In most cases, routine operations may be expected to have short-term and temporary effects and affect relatively few individuals. For example, among the threatened and endangered species reported from the Cook Inlet Planning Area and adjacent waters, the blue, sei, northern right, humpback, and sperm whales do not typically breed, calve, feed, or migrate through the Cook Inlet Planning Area. These species occur seasonally in open waters of the Gulf of Alaska adjacent to the planning area, but are found very infrequently, if at all, within the planning area itself (MMS, 2003b). Thus, it is unlikely that these species would encounter or be affected by routine OCS operations in the Cook Inlet Planning Area.

Routine operations occurring near important habitats, such as Steller sea lion rookeries or haulouts, could affect a greater number of individuals and potentially result in long-term and population-level effects for affected species. Because of the low level of OCS-related activities that could occur in the inlet, few important habitats may be affected. While the highest use areas for the beluga whale are located at the extreme northern end of the inlet (above Tyonek and Nikiski; see Fig. III.B-2 in MMS, 2003b), routine operations under the proposed action would occur mostly south of Anchor Point, more than 60 miles (97 km) south of these high-use habitats and, thus, not be expected to affect these areas. However, belugas do travel further south in the Inlet at certain times of the year and may become more susceptible to potential impacts under the proposed action during these times. Critical habitat designation for the Steller sea lion (50 CFR 226.202) includes a 3,000 feet (0.9 km) radius no-entry zone around designated rookeries within the Cook Inlet Planning Area, as well as a 20 nautical mile (37 km) aquatic avoidance zone around all major rookeries and haulouts. Additional restrictions (50 CFR 223.202) associated with Steller sea lion critical habitat include a 3 nautical mile (5.5 km) radius vessel approach zone around listed rookeries, and a 1 nautical mile (1.9 km) minimum distance for vessel passing near rookery sites (50 CFR 223.202). Compliance with these critical habitat designations, restrictions, and buffer zones would greatly reduce the likelihood of exposure of Steller sea lion rookeries and haulouts to OCS activities that could occur in the Cook Inlet Planning Area.

Offshore Exploration: Noise generated during offshore seismic surveys may physically and/or behaviorally affect marine mammals in the vicinity of the surveys. Associated effects may include hearing loss, discomfort, and injury; masking of important sound signals; and behavioral responses such as fright, avoidance, and changes in physical or vocal behavior (Richardson et al., 1995; Davis et al., 1998; Gordon et al., 1998; Thomson and Davis, 2001). There have been no documented instances of deaths, physical injuries, or physiological effects on marine mammals from seismic surveys (MMS, 2004b). However, MMS recognizes the potential for injury or harm may still exist. There is currently no evidence to suggest that routine surveys may result in population-level effects in marine mammals.

However, it is not possible to predict the type or magnitude of responses to such surveys (and other oil and gas activities) or to evaluate the potential effects on populations (NRC, 2003b).

Noise from seismic surveys could disturb marine mammals, primarily affecting animals in the vicinity of the survey vessel, although animals within a few kilometers of the seismic operations may be affected (Richardson et al., 1986; Thomson and Davis, 2001; MMS, 2003b). Exposure to maximal sound levels could result in damage to hearing organs and short-term or long-term hearing loss in exposed individuals. Seismic survey airgun arrays are configured to output maximal energy in the region of a few tens of Hertz (MMS, 2004b). Among cetaceans, the odontocetes generally demonstrate relatively poor low-frequency hearing sensitivity and thus might experience hearing loss from seismic surveys, as well as respond behaviorally by leaving the areas where seismic surveys are being conducted. In contrast, the mysticetes are considered to possess good hearing sensitivity at low frequencies (Richardson et al., 1995; Crane and Lashkari, 1996; Ketten 1998; Stafford et al., 1998), and thus may be affected more than odontocetes during routine seismic surveys. Affected individuals may be expected to leave the area and, if exposed to maximal sound levels, may incur short-term or long-term hearing loss. Exposure to less than maximal sound levels could result in temporary masking effects to the affected individuals (Ljungblad et al., 1988b; Malme et al., 1989).

Seals and sea lions are considered to be less likely to be harmed by underwater noise than cetaceans. In general, seals have been reported to move away from seismic vessels, although some have been observed swimming in the bubbles generated by large seismic airgun arrays (67 CFR 35793; Thomson and Davis, 2001; MMS, 2003b).

Because seismic surveys would occur away from coastal habitats, routine seismic surveys are not expected to adversely affect pinnipeds (including the endangered Steller sea lion) or the sea otter in coastal habitats (such as rookeries, haulouts, and foraging areas).

Offshore exploration activities could include the placement of up to 10 exploration and delineation wells. Up to 522 tons of drilling muds and cuttings could be produced and discharged at each well location (Table IV-2). Heavier components of these muds and cuttings (such as rock) would settle to the bottom, while lighter components could increase turbidity around the drill site. While this increased turbidity could cause marine mammals to avoid the area, any increase in suspended solids associated with the discharge of drilling wastes would be rapidly diluted and dispersed and, thus, not be expected to adversely affect marine mammals in the area.

For more information on potential effects to marine mammals from seismic exploration, see the MMS Programmatic Environmental Assessment for Arctic Ocean Outer Continental Shelf Seismic Surveys (MMS, 2006b) and the MMS Environmental Assessment on Geological and Geophysical Exploration for Mineral Resources on the Gulf of Mexico Outer Continental Shelf (MMS, 2004).

Construction and Operation of Offshore Platforms and Pipelines: Under the proposed action, up to 2 offshore platforms, 125 miles of offshore pipeline, and 2 new pipeline landfalls could be constructed in the Cook Inlet Planning Area (Table IV-2). Noise and human activity associated with construction and operations could disturb marine mammals that may be present in the immediate vicinity of these facilities. Because any new platforms and most new pipelines would be located away from coastal waters, construction of these facilities would not be expected to affect marine mammals (such as the sea otter or Steller sea lion rookeries) in coastal habitats. Construction activities in the noncoastal areas of the planning area could affect cetaceans and pinnipeds, potentially disturbing normal behaviors (e.g., feeding, social interactions), masking calls from conspecifics or sounds generated by predators, and disrupting echolocation capabilities.

Because of the small number of new platforms and relatively small amount of new pipeline that would be constructed and operated under the proposed action, relatively few individuals or small groups of marine mammals may be expected to be disturbed by routine construction and operation activities. The immediate response of disturbed individuals or groups would be to leave or avoid the construction areas. This displacement or avoidance could be short- or long-term in duration, depending on the duration of the construction activity and the degree to which disturbed individuals may habituate to the noise and human activity. Because relatively few individuals would be expected to be affected by the limited amount of construction and few new facilities that would be operating, the construction and operation of new offshore facilities would not be expected to result in population-level effects to affected marine mammals.

Benthic invertebrate communities that may provide food for some marine mammal species may be impacted by platform and pipeline construction. Because of the relatively small amount of benthic habitat that could be disturbed (no more than 89 ha) compared to that available in the planning area, construction is expected to have a limited effect on the overall availability of food resources in the planning area. Any impacts to food resources would be very localized and largely short-term, and not expected to result in population-level impacts to marine mammal populations.

Construction and Operation of Onshore Processing Facilities and Pipelines: Under the proposed action, up to 2 new onshore facilities, 75 miles of new onshore pipeline, and 2 new pipeline landfalls could be constructed in onshore areas adjacent to the Cook Inlet Planning Area (Table IV-2). Depending on the proximity of the new facilities to existing roads, one or more new access roads may be needed for each new facility.

Species most likely to be affected by onshore construction and operations activities are those that utilize coastal habitats, especially beaches and other shoreline locations. The marine mammals that may be found in such habitats include the sea otter and the endangered Steller sea lion. Affected individuals would expected to leave or avoid areas where onshore construction is occurring, while the presence of an operating onshore facility could reduce the suitability of surrounding offshore and onshore areas as pinniped rookery or haulout sites or as foraging sites for pinnipeds and the sea otter, and could displace individuals from these areas. In areas that are lightly used, only a small number of individuals might be disturbed and no population-level effects would be expected. Construction near Steller sea lion rookeries or haulouts would be restricted by the critical habitat designations for this species and the associated onshore exclusion buffer zones specified for rookery and haulout sites (50 CFR 226.202; 50 CFR 223.202). Siting pipeline landfalls and onshore pipelines and processing facilities in such ways as to avoid rookeries and haulouts of other pinnipeds species would greatly reduce the potential for impacts to these species.

Operational Discharges and Wastes: Under the proposed action, normal operational wastes (produced water, drilling muds, and drill cuttings) would be disposed of through downhole injection into NPDES-permitted disposal wells (see Section IV.B.3.b). Thus, no impacts from normal operational wastes to marine mammals would be expected under normal operations.

The OCS-related vessels supporting exploration activities and the construction and operation of offshore platforms and pipelines will generate waste fluids (such as bilge water) which may be discharged to the surface water. Such discharges, if allowed, would be regulated under applicable NPDES permits. Sanitary and domestic wastes would be processed through shipboard waste treatment facilities before being discharged overboard, and deck drainage would also be processed aboard ship to remove oil before being discharged. Because of the low level of vessel traffic, relatively small volumes of operational wastes would be discharged, and these would be rapidly diluted and dispersed. Thus, permitted waste discharges from OCS service and construction vessels would not be expected to directly affect marine mammals.

Ingestion of, or entanglement in, solid debris can adversely impact marine mammals (Marine Mammal Commission, 2004). The discharge or disposal of solid debris into offshore waters from OCS structures and vessels is prohibited by the MMS (30 CFR 250.40) and the USCG (MARPOL, Annex V, Public Law 100-220 [101 Statute 1458]). Thus, entanglement in, or ingestion of, OCS-related trash and debris by marine mammals would not be expected under the proposed action during routine operations.

Vessel and Aircraft Traffic: Under the proposed action, there could be up to 3 vessel trips per week and 3 helicopter trips per day to each offshore platform (Table IV-2). Additional helicopter or fixed-wing aircraft overflights may also occur as part of routine visual inspections and maintenance of onshore pipelines. Marine mammals may be affected by this traffic either by disturbance from passing vessels or aircraft or by direct collisions with vessels. Species most likely to be present in areas where new platforms could be located (i.e., the Cook Inlet Planning Area below Anchor Point) include a number of the nonlisted cetaceans and pinnipeds as well as the listed humpback and fin whales and the Steller sea lion. These species have the potential to encounter OCS-related vessels that are in transit. The other cetaceans are present in relatively small numbers (MMS, 2003b) and, thus, are much less likely to encounter OCS-related vessels. Because of the low level of vessel and aircraft traffic that could occur under the proposed action, potential impacts to marine mammals from this traffic would likely be limited to a few individuals, be largely short-term in nature, and not result in population-level effects.

Fast-swimming and agile pinnipeds and the smaller odontocete (such as Dall's porpoise and the Pacific white-sided dolphin) may be expected to readily avoid collisions with OCS-related vessel traffic. In contrast, worldwide at least 11 species of cetaceans have been documented as incurring ship collisions (Laist et al., 2001; Jensen and Silber, 2003). In addition to possible collision-related injuries, cetaceans and pinnipeds in the vicinity of an OCS-related vessel may be disturbed by the vessel itself and the noise it generates. Disturbed individuals would be expected to cease their normal behaviors and likely move away from the vessel. Following passage of the vessel, affected individuals may return and resume normal behaviors.

Marine mammals may also be disturbed as a result of overflights of helicopters supporting offshore construction and production activities. Individuals beneath or near the flight paths may be startled by the presence or noise of the passing helicopter, ceasing normal behaviors and diving or fleeing the immediate area to avoid the oncoming helicopter. Because of the transient nature of such overflights, disturbed animals may be expected to return to the area and/or resume normal behaviors shortly after the passage of the helicopter. Because the offshore platforms would not be located near coastal waters, animals on rookery sites or haulouts, or using nearshore habitats for foraging, would not be expected to be affected. Aircraft restrictions associated with Steller sea lion critical habitat protection (50 CFR 223.202, 50 CFR 226.202) would further reduce the likelihood of helicopter flights impacting designated rookery sites for this listed species. Careful planning of flight paths to avoid rookeries and haulouts of other pinnipeds would further reduce or eliminate the potential for disturbing animals in these habitats.

Accidents

A small number of accidental oil spills could occur in Cook Inlet Planning Area under the proposed action (Table IV-4). Oil spills could affect marine mammals in a number of ways, and the magnitude and severity of potential impacts would depend in large part on the location and size of the spill and the species and habitats exposed to the spill. Marine mammals may be exposed to spilled oil by direct contact, inhalation, and ingestion (directly, or indirectly through the consumption of oiled prey species). Such exposures may result in a variety of lethal and sublethal effects (see Sections IV.B.2.c and IV.B.3.c(1) for descriptions of potential effects). Accidental oil spills may also result in the localized reduction, extirpation, or contamination or prey species. Invertebrate and vertebrate species (such as zooplankton, crustaceans, mollusks, and fishes) may become contaminated and subsequently expose marine mammals that feed on these species.

Spills occurring in marine waters of the planning area are not expected to affect the listed blue, sei, sperm, or northern right whales. These species occur only infrequently, if at all, within the marine waters of the planning area (MMS, 2003b), and because of the limited nature of potential spills that could occur under the proposed action (most spill are less than 50 bbl; 1 large spill no greater than 4,600 bbl), it is unlikely that these species would encounter an accidental spill. However, it is important to note that any impacts to northern right whales affecting survival or reproductive capacity could result in population-level impacts to this highly endangered species. The endangered fin and humpback whales, as well as the nonlisted minke and killer whales, which do occur within the planning area, could be affected by accidental spills occurring in or reaching the Shelikof Strait. Grey whales migrating past Cook Inlet could be exposed to accidental spills occurring near the Kennedy and Stevenson entrances to Cook Inlet. Accidental spills in the Cook Inlet Planning Area could also expose smaller cetacean species (such as Dall's porpoise) and pinnipeds foraging in open marine waters. Because of the small number and size of potential spills that could occur under the proposed action, exposures of these species to spilled oil would temporary and likely affect only a few individuals (National Marine Fisheries Service, as cited in MMS, 2003b).

Spills occurring in or reaching coastal areas, especially sheltered coastal habitats such as bays and estuaries, pose the greatest risk to marine mammals. These spills would be more likely to affect species such as the sea otter and the Steller sea lion that utilize coastal habitats for pupping, foraging, and resting. A large spill contacting an active rookery site could result in population-level effects for some species, while spills in nearshore areas could result in the direct oiling of large numbers of pinnipeds and the sea otter, and adversely affect local populations of some of these species (primarily the sea otter and fur seals), while sublethal effects may be incurred by all individuals ingesting or inhaling spilled oil.

Spills associated with onshore facilities (and especially any onshore pipelines) would not be expected to affect marine mammals unless the spilled oil is subsequently transported to coastal habitats. For example, an onshore spill that enters a stream system may be carried to coastal areas, where marine mammals such as the sea otter may be exposed.

Oil-spill response activities may affect marine mammals through exposure to spill response chemicals (e.g., dispersants or coagulants) and through behavioral disturbance during cleanup and restoration operations. The chemicals used during a spill response are toxic, but are considered much less so than the constituents of spilled oil (Wells, 1989), although there is little information regarding their potential effects on marine mammals. The presence of, and noise generated by, oil-spill response equipment and support vessels could temporarily disturb marine mammals in the vicinity of the response action, with affected individuals likely leaving the area. While such displacement may affect only a small number of animals, cleanup operations disturbing adults in pup-rearing areas may decrease pup survival and result in population-level effects.

Conclusion

Marine mammals in the North Aleutian Basin Planning Area could be affected by noise, contaminants, human activity, and ship and helicopter traffic associated with routine OCS operations. Noise generated during exploration, construction, and operations may temporarily disturb some individuals, causing them to leave or avoid the area. While collisions with OCS-related vessels may injure or kill some individuals (especially large cetaceans), such collisions would be relatively unlikely because of the low level of such traffic that could occur under the proposed action. The degree and length of impact to marine mammals are dependent on such factors as tolerance, level of repeated disturbance, activities being disturbed and even the age or sex of the individual. Short-term or periodic disturbances would likely only result in short-term impacts and would not be expected to result in population-level effects. However, repeated exposure at critical life stages or in important areas may lead to more long-term and potential population-level effects. The implementation of appropriate mitigation and monitoring measures would likely reduce the potential for both short- and long-term disturbances.

Many of the listed cetacean species occur infrequently, if at all, within the planning area and thus would not be expected to be affected by normal operations. Compliance with the ESA and MMPA would further limit the likelihood of routine operations impacting marine mammals. Activity restrictions related to protecting important haulout, feeding, breeding, or molting areas would assist in limiting the potential for impacts to occur. Similarly, careful siting of offshore and onshore facilities and OCS-support vessel and helicopter routes to avoid important habitats would greatly reduce the likelihood and magnitude of adverse impacts to marine mammals in the planning area.

Accidental oil spills may result in the direct and indirect expose of marine mammals and their habitats to the oil and subsequent weathering products. Animals could be exposed by the inhalation or ingestion of oil or contaminated foods, which may result in a variety of lethal and sublethal effects. Fouling of fur of some species (e.g., sea otter) could affect thermoregulation and reduce survival. The magnitude of effects from accidental spills would depend on the location, timing, and volume of the spills; the habitats affected by the spills (e.g., coastal habitats); and the species exposed. For ESA-listed species, a major oil spill could result in detrimental effects to the population depending on the location of the spill, the number of animals affected, and the life history stage of the affected animals. The greatest risk to marine mammals would be associated with large spills in coastal habitats, especially those reaching rookeries, haulout, feeding, breeding, or molting areas. Spill cleanup operations could result in short-term disturbance of marine mammals in the vicinity of the cleanup activity, while a collision with a cleanup vessel could injure or kill the affected individual. Disturbance of adults with young during cleanup could reduce survival of the young animals.

d. Marine and Coastal Birds

Four hundred and fifty-seven species of birds occur in Alaska, of which 298 appear ‘regularly’ (Armstrong, 1995). See Section III.B.7 and Table III-63 for more information on marine and coastal bird presence and distribution in Alaska. Refer to Table 2 in Alaska Shorebird Working Group (2000) for list of shorebird species of high conservation concern and their associated Bird Conservation Regions in Alaska. For additional information on Alaska shorebird species of concern, globally important shorebird areas within Alaska, and population estimates of shorebirds in North America refer to Gill et al. (1994); Gill and Senner (1996); Gill and Tibbits (1999); and Morrison et al. (2001).

In general, although there is the potential for direct mortality from activities under the proposed action (i.e., fatal collisions with offshore structures or vessels), secondary habitat changes, including dust deposition, traffic, and other disturbances, have resulted in the most concerns over shorebird responses to oil and gas development (Troy, 2000). The extent to which a species could be affected depends on the specific habitat excavated, the extent of habitat disturbance, and the level of nesting use of the affected habitat. The effect of net habitat loss on most species' productivity would likely be localized to the individual sale area, but persist over the life of any offshore field and beyond. Although the number of and time between lease sales and the resulting development are expected to be low and, therefore, minimize overall adverse effects, the potential exists for long-term sublethal effects to occur (e.g., fecundity reduced after location to suboptimal habitat due to disturbance).

The response of birds to disturbance varies by species and is affected by basic life-history parameters, initial population size, and population status (Lande, 1993; Benton and Grant, 1996; Saether et al., 1996; Saether and Bakke, 2000) in addition to physiological and reproductive status of individuals, distance from the disturbance, and type, intensity, and duration of the disturbance (see Derksen et al., 1979; Burger, 1981; Miller et al., 1994; Ward et al., 1994). Local population segments of species nesting on barrier islands, river deltas or coastal wetlands, or molting/staging/migrating in coastal or offshore areas are expected to be affected either briefly through temporary disruption of activities (e.g., helicopter flights and vehicle traffic on roads in mainland areas although the frequency and intensity of flights and traffic can potentially rise to more long-term effects) or more long-term disruption through habitat displacement (e.g., energetic costs from searching for and traveling to a new location and potential for increased predation at new locations or suboptimal food sources). Routine flights are likely to intercept flocks, causing intermittent displacement of birds from within 1 to 2 km (0.62-1.2 miles) of flight paths, unless they traverse heavily or consistently used areas. Birds nesting or routinely foraging along these routes will experience more frequent disturbance that may result in displacement from foraging and/or nesting areas and, potentially, seasonal abandonment of these local areas. Also, the convergence of routes from offshore sites to the support area will disturb those in the vicinity of the latter more frequently. Disturbance is not likely to increase direct mortality significantly, but decreased nutrient acquisition may result in individuals exposed to the disturbance experiencing increased stress and potentially reduced fitness if the breeding component of the population is displaced from favored foraging sites routinely. Such disturbance is likely to have a greater net negative effect on individuals during nesting, postbreeding, and molting periods (i.e., June-Sept.). Regional populations may be slow to completely recover while in a declining status (see Newton, 1998).

Because seaducks and seabirds typically fly at a relatively low altitude over water (S.R. Johnson and Richardson, 1982; Day et al., 2005a), the potential exists for these birds to collide with offshore structures. This would be true especially under conditions of poor visibility (for example, fog, darkness) or when ice is present near offshore structures (Day et al., 2005a), and may be compounded by the potentially attracting or disorienting effect of lights on the structures at night (Jones and Francis, 2003; Russell, 2005). Gas flaring at night should be avoided because it has the potential to attract and disorient (i.e., abrupt 'burst' of noise and light) low-flying migratory ducks, primarily eiders and long-tailed ducks (Day et al., 2005a). However, in most cases, offshore structures represent relatively small obstructions in offshore waters, and most ducks are expected to see and avoid them when visibility is good. Collision of nesting ducks with the elevated onshore portion of pipelines is considered unlikely because ducks are likely to occur at relatively low densities near onshore structures, and most of their activities would involve walking or swimming rather than flight.

During offshore exploration, disturbance from seismic survey vessels also is expected to be short-term, although more intense in a given survey area, probably resulting in greater instantaneous local effects. Although the potential effect of seismic energy impulses has been studied in long-tailed ducks, the study was not able to determine if molting long-tailed ducks were affected by seismic activities in the Beaufort Sea (Lacroix et al., 2003). However, Lacroix et al. (2003) recommended in their conclusions that seismic activity not be conducted in areas of high densities of long-tailed ducks.

Under the proposed action, a number of facilities could be constructed and operated in offshore and onshore portions of the Arctic, Bering Sea, and South Alaska Subregions. Marine and coastal birds could be affected during routine operations by 1) offshore exploration, 2) construction of offshore platforms and pipelines, 3) construction of onshore processing facilities and pipelines, 4) operations of offshore and onshore facilities, 5) operational discharges and wastes, and 6) vessel and aircraft traffic and the associated effects of disturbance from these activities. The following sections discuss potential impacts under the proposed action on marine and coastal bird resources specific to each Alaska Subregion.

(1) Arctic Subregion

Routine Operations

Under the proposed action, oil and gas activities in the Arctic Subregion (Beaufort Sea and Chukchi Sea Planning Areas) may result in:

- 3-10 offshore platforms and associated gravel islands and ice roads
- up to 3 new offshore pipelines (50-160 miles in length)
- up to 3 new pipeline landfalls
- up to 3 new onshore facilities, with 200 miles of associated new pipeline. (There are currently about 20 processing facilities in North Slope oil fields that average about 45 acres each in size (NRC, 2003b). Applying this average size, the construction of three new onshore facilities could permanently disturb about 135 acres of habitat. Depending on the proximity of the new facilities to existing roads (such as those associated with North Slope infrastructure), one or more new access roads may be needed for each new facility to bring in construction equipment and supplies, and additional land would be needed for other infrastructure such as airstrips and power stations.)
- up to 3 helicopter trips daily and a similar number of vessel trips to each offshore platform. (Additional helicopter or fixed-wing aircraft overflights may also occur.)

Any construction activities that take place in summer, associated with platform installation for field development, temporarily (~1 season) could displace birds from within about one kilometer of such sites. Likewise, localized burial of potential prey and destruction of a few square kilometers of foraging habitat as a result of pipeline trenching or island construction is not expected to cause a significant decline in prey availability. It is likely that much construction, particularly of gravel islands, roads, pads, and pipelines, would take place during winter when most birds are absent. Several studies speculate that increased predator populations sustained by scavenging opportunities around human habitation may indirectly contribute to long-term declines of common eiders and long-tailed duck populations currently in evidence (Day, 1998; S.R. Johnson, 2000; Troy, 2000). The effect of any habitat loss on the species' productivity would likely be localized to these areas but may persist over the life of any offshore field and beyond. The potential exists for long-term sublethal effects to occur (e.g., fecundity reduced after location to suboptimal habitat due to disturbance).

Gravel placement results in nesting and foraging habitat loss in most shorebirds (Troy, 2000). On the North Slope, gravel is generally extracted from the floodplains of large rivers (Pamplin, 1979; BLM

2002). Mining gravel from vegetated islands in rivers is likely to prevent nesting attempts by certain shorebird and waterfowl species. It is not likely that gravel would be obtained from barrier islands which could destroy nest sites of common eider and several other species. Positive effects may be realized from water impoundments in gravel pits, and early-season food-plant growth in dust shadows along roads, which would benefit waterfowl; however, availability of shorebird prey is likely to be adversely affected near roads (Kertell and Howard, 1997; Howard et al., 2000; Troy, 2000). The effects of gravel extraction/placement would be reduced if areas where particular species seasonally concentrate are avoided.

Winter construction would also utilize ice roads to build and access gravel island construction sites. Ice roads may be constructed over both tundra habitats and frozen ocean habitats. Ice roads constructed in tundra habitats may delay ice-off and snow melt (NRC, 2003b), potentially reducing the availability of such areas for early nesting species. Ice roads could also flatten underlying vegetation, which may discourage use of the area by tundra-nesting birds (Walker et al., 1987a, b). Water removal from lakes and ponds for ice road construction may reduce the quality or quantity of aquatic habitats important for breeding and postmolting for some species. In each of these cases, the impacts to potential nesting habitat would be temporary and localized, and birds would likely respond by selecting other areas for nesting or postmolting.

Construction camps to support onshore construction activities would temporarily remove some areas from potential use by birds, and this loss may be short- or long-term depending on the nature and effectiveness of camp abandonment following completion of construction activities. Regardless of the duration of the effect, the amount of habitat that would be disturbed would be relatively small and not be expected to affect more than a few birds.

The construction and operation of up to 200 miles of new overland pipelines would be expected to affect bird populations in a manner similar to that identified for the construction and operation of new onshore processing facilities and associated infrastructure (especially access roads). Potential nesting or post-molting habitat would be permanently lost within the footprint of the new pipelines, causing birds to select habitats in other locations.

Although pipeline trenching would also be carried out in winter when most seabird and waterfowl species are not present, seafloor trenching could locally disrupt benthic invertebrate communities that may serve as food sources for waterfowl during other seasons. The extent to which benthic food sources could be affected and the subsequent impact to waterfowl will depend on the type and amount of benthic habitat that would be permanently disturbed by trenching, the importance of the specific habitats in providing food resources to waterfowl, and the number of waterfowl that could be affected. Because no more than three new pipelines could be built under the proposed action within the entire Arctic Subregion, relatively little benthic habitat would be disturbed (no more than 120 ha within the entire region). In addition, portions of the new pipelines would be in water depths down to 200 feet and potentially unavailable for many marine birds and waterfowl. Thus, any impacts to food sources from pipeline trenching would be very localized and short-term, and not expected to result in population-level impacts to local waterfowl populations.

The construction of new facilities and pipelines would permanently eliminate potential bird habitat at the construction sites. While this habitat loss would be long-term, the areas disturbed would represent a small portion of the habitat present in the Arctic Subregion. Careful siting of any new facilities to avoid important nesting or post-molting habitat would further reduce the magnitude of any potential effects on local bird populations.

During normal operations, birds may be affected by noise and human activities at the onshore and offshore facilities and by the presence of the facilities themselves. In addition, operational facilities may provide additional nesting and feeding opportunities for some species. Unexpected noise can startle birds and potentially affect feeding, resting, or nesting behavior, and often causes flocks of birds to abandon the immediate area. Some species may react by avoiding nearby habitats, while other species may show little response or become acclimated. Because of the small number of new onshore facilities (no more than 4 in the entire Arctic Subregion), the disturbance of birds by operational noise and activity would likely be limited to relatively few individuals and would not be expected to result in population-level effects. Prolonged or repeated periods of maintenance activities could have a greater impact on nesting birds by increasing cooling periods of eggs, and on brood-rearing birds by increasing the time that young and adult birds are separated.

The presence of onshore facilities also has the potential to increase localized predation of marine and coastal birds and their eggs. The likelihood and magnitude of any population-level effects from increased predation would depend on the specific location of any new facility, the length of the new onshore pipeline, the number of new predators that the facilities could support, and the species of the birds nesting in the vicinity of the new facility. Major predators of birds and their nests include the glaucous gull, raven, and arctic fox, and populations of these predators have increased in the Arctic, especially in existing oil fields of the North Slope, presumably due to the presence of increased nest and den sites provided by oil field facilities and the presence of garbage (a potential food resource) at facility landfills and dumpsters (Truett et al., 1997; NRC, 2003b; Burgess, 2000). Gulls are natural predators of bird eggs and young, and populations that are artificially high at oil facilities may increase predation pressure on local bird populations (S.R. Johnson et al., 1993a,b; Bowman et al., 2000; S.R. Johnson 2000). While gull populations have been increasing throughout the Arctic, it is not clear whether the increases are due to oil field development or are a part of a global pattern (Day, 1998; NRC, 2003b). Similarly, increased fox densities associated with increased den sites provided by oil facilities have increased predation on tundra-nesting shorebirds and waterfowl (Garrott et al., 1983; Stickney 1991; S.R. Johnson et al., 1993a, b).

Under the proposed action, normal operational wastes (produced water, drilling muds, and drill cuttings) would be disposed of through onsite injection into NPDES-permitted disposal wells (see Section IV.B.3.b). If allowed, discharges of such wastes from OCS service and construction vessels would be regulated under applicable NPDES permits, and any discharged wastes would be quickly diluted and dispersed and thus not be expected to impact marine birds. Thus, limited impacts from normal operational wastes to marine and coastal birds would be expected under normal operations.

Marine and coastal birds may become entangled in or ingest floating, submerged, and beached debris (Heneman and the Center for Environmental Education, 1988; Ryan, 1987, 1990). Entanglement may result in strangulation, injury or loss of limbs, entrapment, or the prevention or hindrance of the ability to fly or swim; all of these effects may be considered lethal. Ingestion of debris may irritate, block, or perforate the digestive tract, suppress appetite, impair digestion of food, reduce growth, or release toxic chemicals (Fry et al., 1985; Dickerman and Goelet, 1987; Ryan, 1988; Derraik, 2002). Because the discharge or disposal of solid debris into offshore waters from OCS structures and vessels is prohibited by the MMS (30 CFR 250.40) and the U.S. Coast Guard (MARPOL, Annex V, Public Law 100-220 [101 Statute 1458]), entanglement in or ingestion of OCS-related trash and debris by marine and coastal birds would not be expected under normal operations.

Helicopter or fixed-wing aircraft overflights are generally conducted at low altitudes and could disturb birds in onshore and offshore locations (Ward and Stein, 1989; Ward et al., 1994; M.W. Miller, 1994; M.W. Miller et al., 1994). Helicopter and aircraft overflights during spring breakup of pack ice may disturb marine species feeding in open waters and waterfowl in coastal waters, causing birds to leave the area. Similarly, overflights in summer could displace waterfowl and seabirds from preferred foraging areas and waterfowl from coastal nesting or brood-rearing areas such as the lagoon systems of the Beaufort and Chukchi Seas. Molting and staging waterfowl may temporarily leave an area experiencing helicopter overflights (Derksen et al., 1992), while geese have been reported to exhibit alert behavior and flight in response to helicopter overflights (Ward and Stein, 1989; Ward et al., 1994). The type of response elicited by the birds and the potential effect on the birds will depend in large part on the time of year for the overflights and the species disturbed. Birds experiencing frequent overflights may permanently relocate to less favorable habitats (MMS, 2002b). In addition, the temporary absence of adult birds may increase the potential for predation of unguarded nests and young (NRC, 2003b).

Vessel trips could disturb seabirds and waterfowl in preferred foraging, molting, and staging areas, causing them to leave the area to potentially less favorable habitats. Vessel traffic that displaces nesting seabirds or waterfowl may result in increased predation rate on eggs and young, especially in areas near gull colonies (Day 1998; S.R. Johnson 2000; Noel et al., 2005). However, the amount of vessel and aircraft traffic that could occur under the proposed action would be relatively limited. Which birds could be affected, the nature of their response, and the potential consequences to the disturbance will be a function of a variety of factors, including the specific routes, the number of trips per day, the seasonal habitats along the routes, the species using the habitats and the level of their use, and the sensitivity of the birds to vessel traffic. Traffic over heavily utilized feeding or nesting habitats of sensitive species could result in population-level effects, while impacts from traffic over other areas with less sensitive species would largely be limited to a few individuals and not result in population-level effects.

Accidents

Marine and coastal birds could be affected by accidental oil spills from offshore platforms and pipelines, as well as from onshore processing facilities and pipelines. In general, loons, waterfowl, seabirds, and shorebirds are not expected to survive moderate to heavy oil contact. Oiled feathers lose their insulative and water repellent characteristics, and birds die of hypothermia (Albers and Gay ,1982). Swallowed oil is toxic and causes impaired physiological function and production of fewer young. Oiled eggs have significantly reduced hatching success (Albers, 1980). Vulnerability of bird populations to an oil spill is highly variable as a result of their seasonally patchy distribution in areas where probability of spill contact also is variable, depending on location, oceanography, weather patterns, and habitats typically occupied by and habits of the particular species. Because they are unable to fly, molting birds probably are the most vulnerable. For all species, the degree of impact depends heavily on the location of the spill and its timing with critical natural behaviors (e.g., breeding, molting, feeding).

If losses are substantial in a species with a low reproductive rate, including most marine species, recovery may take many years, or populations may not recover to their prespill size. Rate of recovery from oil-spill mortality depends both on the numbers lost from a particular species population and its prevailing population trend, in turn determined by reproductive rate and survival rate. Oil contamination of food resources may influence recovery of a local population by affecting reproductive success and survival with the degree of impact largely dependent on the patterns of prey distribution. Species dependent on widely dispersed prey would have more limited effects. However, seabirds, in particular, are attracted to patchy prey sources found on oceanic fronts (Piatt and Springer, 2003) and would experience greater effects from prey reduction. In addition, nonbreeding individuals and those that have completed annual parental activities are better able to search for prey in uncontaminated areas. However, those individuals actively feeding young and dependent upon food resources in that area would be unable to seek uncontaminated prey elsewhere. If a leak in an onshore pipeline occurs on a pad, the extent of the spill likely would be restricted by containment berms. If the spill occurred along the off-pad portion of the pipeline, the area covered may include several acres; if the spill enters streams or lakes, a larger area could be affected as the oil spreads over a water surface or is carried down a watercourse. From mid- to late summer, such an occurrence could contact broodrearing females and their young, as well as potentially large flocks of nonbreeding and postbreeding individuals undergoing wing molt.

Most bird species are absent from the Arctic Subregion from late October to at least early April. During spring migration, substantial numbers of migrants moving north along the spring lead system in the Chukchi Sea are at risk if oil enters this habitat since there are few alternatives until open water off river deltas is available as the ice breaks up in late spring. The most numerous species include king eider, common eider, long-tailed duck, brant, and murres. Likewise, a similar, rather restricted open-water situation exists in both the Chukchi and Beaufort Seas for migrants that pause awaiting further melting to the north or east, and for birds occupying delta waters and nearshore areas that have melted prior to general ice breakup and awaiting the availability of onshore habitats.

Loons, waterfowl, and shorebirds in onshore habitats are generally at low risk of contacting a spill while nesting, but risk of exposure increases as they leave the mainland nesting areas and concentrate in freshwater or marine habitats for broodrearing, molting, or staging prior to southward migration. In addition, some species (e.g., red-throated loans) forage almost exclusively offshore and bring food back to their nestlings or young, so impacts of oil spills may be greater on these species (Eberl and Picman, 1993). Likewise, species nesting on barrier islands such as common eider, gulls, and terns are at risk when postnesting individuals join other species in lagoons and other nearshore habitats. Substantial numbers occupy Simpson and other Beaufort Sea lagoons, Harrison and Smith Bays, and Kasegaluk Lagoon and Peard and Ledyard Bays in the Chukchi Sea at this time. For example, tens of thousands of long-tailed ducks molting in Beaufort Sea lagoons, far outnumbering other species, are at risk in July and August, and in late August and early September, a large proportion of the Pacific flyway brant population could be exposed to a spill that enters Kasegaluk Lagoon. Substantial numbers of nonbreeding, foraging, or staging birds that occupy offshore areas in both Chukchi and Beaufort Seas, when open water beyond the barrier islands is available, could be exposed to an oil spill. Most broodrearing of loons, swans, and geese occurs on large lakes or coastal saltmarsh. Risk of oil-spill contact is much greater for those using the latter habitat. The most important molting area for brant and several other species of geese (and to a lesser extent ducks) is the Teshekpuk Lake Special Area (Derksen et al. 1979; Derksen et al. 1982). Beached oil along these coastlines could expose hundreds to low thousands or possibly greater numbers of shorebirds that pause along the coast during migration (Connors et al., 1979; Smith and Connors, 1993; Andres, 1994). In the southeastern Chukchi Sea large numbers of murres and kittiwakes nesting in seabird colonies at Capes Lisburne and Thompson, together with nonbreeding individuals, form foraging flocks containing tens to hundreds of individuals that also could be exposed to an oil spill. Major effects on bird populations during the open-water season are expected to follow a spill. A spill occurring in winter, when birds are virtually absent, still may have serious impacts if substantial quantities of oil are entrained in the ice and then released during the following breeding season.

Large flocks of long-tailed ducks molting in Beaufort Sea lagoons, and common eiders occupying barrier islands or lagoons, are particularly susceptible if they are nesting, broodrearing, or flightless. Likewise, brant staging in Kasegaluk Lagoon in the Chukchi Sea would be particularly vulnerable. For all species, the degree of impact depends heavily on the location of the spill and its timing with critical natural behaviors (e.g., breeding, molting, feeding). Survival and fitness of individuals may be affected, but in many cases, this infrequent disturbance is not expected to result in significant population losses. However, effects may be greater if a spill and cleanup were to occur in the spring when large numbers of king and common eiders, long-tailed ducks, and other waterfowl, seabirds, and shorebirds are present following spring ice-lead systems. In addition, it is unlikely that all spilled oil would be removed from the environment, especially in winter, thus the remaining accumulations could move under the ice and into leads.

In addition to the potential impacts from spilled oil, the oil-spill cleanup process may also affect marine and coastal birds in the Arctic Subregion. The presence of large numbers of workers, boats, and additional aircraft during the breeding season following a spill is expected to displace waterfowl or other seabirds occupying affected offshore or nearshore waters, and shorebirds in coastal habitats for one to several seasons. Cleanup in coastal areas late in the breeding season may disturb broodrearing, juvenile, or staging birds. Cleanup and the presence of oil can dramatically influence avian species composition and distribution (Piatt et al., 1990). It is extremely difficult to separate the effects of oiling and disturbance from cleanup activities, but either separately or together, they have the potential to influence habitat use by birds (Wiens ,1996). Survival and fitness of individuals may be affected to some extent, but this infrequent disturbance is not expected to result in significant population losses.

Effects to ESA-Listed Species in the Arctic Subregion: Effects of oil and gas activities under the proposed action on ESA-listed species in the Arctic Subregion, including the spectacled eiders and Steller's eider, are expected to be similar to that noted above for nonlisted species. Compliance with ESA regulations and coordination with the FWS would ensure that lease-specific operations would be conducted in a manner that avoids or greatly minimizes the potential for impacting these species.

Risk of oil contact to spectacled eiders using the spring lead system to move north into the Chukchi Sea during spring migration could be high if a spill entered the area. Since most spectacled eiders probably use overland routes from the Chukchi to complete their spring migration to nesting areas on the Arctic Coastal Plain (ACP), they are not likely to be contacted by an oil spill during migration. During the brood rearing period, when the young are led to watercourses and ultimately to nearshore marine environments for further development, staging, and fall migration, the risk of oil contact is much greater. Males could be exposed to an oil spill in any of the several bays and lagoons occupied for molting and staging in both Beaufort and Chukchi Seas (Petersen et al., 1999:fig.1). The period of highest exposure risk for a given individual migrating across the Beaufort is about 3-5 days. Females and young are at risk of contact primarily when they occupy Smith Bay in the Beaufort (Troy, 2003) and Ledyard and Peard Bay (Laing and Platte, 1994) in the Chukchi (this area is used by nonbreeding, failed breeding, and successful breeders, as well as both sexes) for the molt prior to fall migration (Petersen et al., 1999). Ledyard Bay has been defined as critical habitat for spectacled eiders. Since most, if not all, of the successfully breeding females (and their young) from the ACP could be concentrated in Ledyard Bay critical habitat area during the molt period, a spill affecting this group in this location could have a long-term population-level effect.

The small ACP population of Steller's eider is not likely to be exposed to an oil spill during nesting or postnesting periods since most presumably move to the Russian side of the Chukchi prior to migrating south to molting areas. However, there is some evidence to suggest use of Peard Bay by postbreeding steller's eiders (Martin unpubl. data; Dau and Larned, 2004, 2005).

(2) Bering Sea Subregion

Routine Operations

Under the proposed action, oil and gas activities in the Bering Sea Subregion (North Aleutian Basin Planning Area) may result in the:

- up to 20 exploration and development wells
- 4-6offshore platforms (some of which may be constructed outside of the planning area and towed to their final location)
- up to 150 miles of new offshore pipeline (impacting up to 225 ha of benthic habitat)
- up to 50 miles of new onshore pipeline, 2 new pipeline landfalls, 1 new waste facility, 1 new processing facility, one new shore base, and a new dock or causeway for service vessels in onshore areas along the coast of the Alaska Peninsula, Unimak Island, or north of the Bristol Bay coast
- depending on the proximity of the pipelines and other facilities to existing roads, 1 or more new access roads could be needed to bring in construction equipment and supplies, and additional land could also be needed for other infrastructure such as utilities
- up to 18 vessel trips per week and up to 3 daily helicopter trips (additional helicopter or fixed-wing aircraft overflights may also occur as part of routine visual inspections and maintenance of onshore pipelines)

See Section IV.B.3.d(1) above for general discussions of impacts from the above proposed oil and gas activities. The information to follow only adds to the above analysis any additional information specific to the North Aleutian Basin Planning Area.

Helicopter or fixed-wing aircraft overflights are generally conducted at low altitudes and could disturb birds at both onshore and offshore locations (Ward and Stein, 1989; Ward et al., 1994; M.W. Miller, 1994; M.W. Miller et al. 1994). Helicopter and aircraft overflights may disturb marine species feeding in open waters and waterfowl in coastal waters, causing birds to leave the area. Similarly, overflights in summer could displace waterfowl and seabirds from preferred foraging areas and waterfowl from coastal nesting or brood-rearing areas such as the lagoon systems within Bristol Bay.

Accidents

Under the proposed action, no more than 1 large spill (> 1,000 bbl from either a platform or a pipeline), 2 intermediate spills (50-999 bbl), and 10 small spills (< 50 bbl) may be expected over the lifetime of the lease (Table IV-4).

In the North Aleutian Basin Planning Area, winter spills could affect cormorants, sea ducks, gulls, and alcids; summer spills could affect fulmars, shearwaters, storm petrels, dabbling ducks, shorebirds, and alcids; while a spring or fall spill could affect loons, ducks, geese, shorebirds, and alcids (MMS, 1985b). If a spill entered a heavily used waterfowl staging area (e.g., Izembek or Nelson Lagoon) in spring or fall, significant adverse effects could occur (MMS, 1985b). The liquid hydrocarbons expected to be developed in the North Aleutian Basin are expected to be condensate or light crude oil. These liquids spread and evaporate quickly, resulting in less persistence of the spilled oil in the environment than heavier crude. On the other hand, they are usually more acutely toxic to birds than heavier crude.

Offshore spills that reach coastal areas may expose species that forage or nest in coastal habitats along Bristol Bay. These areas support thousands of migrating shorebirds and waterfowl, as well as numerous seabird colonies (MMS, 1985b). Spills reaching these areas could directly or indirectly expose adults, eggs, and young. Oil spills from onshore facilities, especially pipelines, could reach a stream, wetland, or lake. Such aquatic habitats are used by a variety of waterfowl for brood rearing, molting, and staging. Thus, a terrestrial spill reaching such habitats could expose a much larger number of birds than a spill restricted to a terrestrial environment. Terrestrial spills reaching such habitats could also affect food resources in these areas, reducing prey availability for molting or staging birds and affecting survival.

Effects to ESA-Listed Species in the North Aleutian Basin Subregion: Normal operations may affect listed bird species in the same manner as nonlisted species (i.e., primarily behavioral disturbance). Compliance with ESA regulations and coordination with the FWS would ensure that lease-specific operations would be conducted in a manner that avoids or greatly minimizes the potential for impacting these species.

The short-tailed albatross (endangered) and Steller's eider (threatened) are the only federally listed marine or coastal birds that occur within the North Aleutian Basin Planning Area, and thus could be affected by normal operations of the proposed action. Neither species nests in or near the North Aleutian Basin Planning Area. Thus, normal operations would not be expected to affect nesting habitats of these species. However, the Steller's eider is present in the area during other times of the year (e.g., about mid-September to mid-May) using portions of Bristol Bay for molting, wintering, and staging for spring migration. The short-tailed albatross forages within the Bering Sea, including the North Aleutian Basin area, between May to October, occurring within 5 to 10 km of the coast.

The short-tailed albatross could be disturbed during seismic exploration, offshore platform and pipeline construction, or OCS vessel and aircraft traffic. Disturbed individuals would likely move to areas away from the OCS activity and not be adversely affected. While a bird may collide with OCS-related aircraft or facilities, given the low number of short-tailed albatrosses that could be present around platforms and along associated flightlines, the very low number of platforms that would require service by aircraft, and the relatively low level of OCS-related air traffic, few if any birds would be expected to incur collisions with aircraft. While such collisions would likely result in the mortality of the affected individual, population-level effects would not be expected to result from such collisions.

The short-tailed albatross is considered to be highly vulnerable to the impacts of oil pollution (King and Sanger, 1979). Because this species does not breed in the planning area, accidental spills would not be expected to affect nesting colonies. However, individuals could be affected if they forage in the area of a spill, since they alight on the ocean surface to seize their prey (FWS, 2001c). Because this species is widely dispersed and is only a an irregular visitor to the marine waters of the planning area, few individuals would be expected to be exposed to an accidental spill, and few individuals would be expected to be disturbed during spill cleanup activities. The exposure of a very small number of birds would not be expected to result in population-level impacts to this species. This species forages in open marine waters, and no specific foraging habitat type or location has been identified as being of prime importance for this species. Thus, accidental spills would not be expected to adversely affect foraging habitats and associated prey items available to the short-tailed albatross in the North Aleutian Basin Planning Area.

Overwintering flocks of Steller's eider could be temporarily disturbed by seismic exploration, the construction of offshore platforms and pipelines, and OCS vessel and aircraft traffic. Disturbed birds would move to other suitable habitat that occur throughout the planning area, and would not be expected to be adversely affected. While offshore pipeline construction could result in the loss of potential benthic feeding habitat, the amount of potential habitat loss would be small compared to the habitat available in the planning area, and thus would not be expected to adversely affect overwintering birds. Some birds could be killed or injured as a result of collisions with platforms and OCS aircraft, especially during spring and fall migration and under inclement weather conditions. Because of the small number of platforms (no more than 6) and low level of vessel and aircraft traffic, relatively few individuals may be affected, and no population-level effects would be expected.

The majority of the world's population of Steller's eider migrates along the Bristol Bay coast in spring (FWS, 2004c). Also, the Izembek and Nelson Lagoons are among the most important molting areas for the species and are among the identified critical habitats for the Steller's eider (Sea Duck Joint Venture, 2003). Thus, a large number of Steller's eider could be exposed to a large spill. This species concentrates in shallow, vegetated nearshore habitats, and spills contacting such areas could locally reduce foraging habitat and food resources and contaminate potential prey. The number of birds affected would depend on the size and location of the spill, the number of birds directly exposed to the spill, and the amount of habitat affected. A large to moderate spill could locally affect a relatively large number of Steller's eiders and result in population-level impacts for this species.

(3) South Alaska Subregion

Routine Operations

Under the proposed action, oil and gas activities in the South Alaska subregion (Cook Inlet Planning Area) may result in:

- up to 2 offshore platforms in Cook Inlet (The platforms would be constructed outside of the planning area and towed to their final location. Marine and coastal birds could be temporarily disturbed during the transportation and placement of the production platforms.)
- up to 125 miles of new offshore pipeline (89 ha of benthic habitat)
- up to 75 miles of new onshore pipeline, 2 new pipeline landfalls, 1 new waste facility, and 1 new processing facility could be constructed in onshore areas adjacent to the Cook Inlet Planning Area.
- up to 3 daily helicopter trips and 6 weekly vessel trips (Additional helicopter or fixed-wing aircraft overflights may also occur as part of routine visual inspections and maintenance of onshore pipelines.)
- up to 10 exploration and development wells

See Section IV.B.3.d(1) above for general discussions of impacts from the above proposed oil and gas activities. The information to follow only adds to the above analysis any additional information specific to the Cook Inlet Planning Area.

New pipeline landfalls would likely be located in the general area of existing oil and gas infrastructure, primarily on the Kenai Peninsula in the vicinity of Anchor Point or further north. This area has relatively few seabird colonies (USGS, undated; as presented in MMS, 2003b), and potential impacts could be avoided or minimized by locating pipeline corridors and landfalls away from nesting aggregations (seabird colonies) and/or by scheduling trenching activities to avoid the nesting period.

While habitat impacts from onshore construction may be expected to be long-term in nature, the areas disturbed would be largely limited to the immediate vicinity of the pipelines and represent a very small portion of habitat available in the Cook Inlet Planning Area. Siting new pipelines and facilities away from coastal areas would reduce the amount of marine or coastal bird habitat that could be affected. Potential habitat impacts could be further reduced by locating the new pipelines within existing utility or transportation rights-of-way, and by locating the new pipeline landfalls away from active colony sites or coastal staging areas of migratory birds. Because there are relatively few nesting colonies along the Kenai Peninsula north of Anchor Point (USGS, undated), only a few seabird colonies could be affected by onshore construction activities. The disturbance of birds in these colonies could be reduced or avoided by siting new pipelines and facilities away from colony sites, and by scheduling construction activities to avoid nesting periods. Overall, onshore construction activities are expected to affect only a relatively small number of birds and not result in population-level effects.

Noise and human activities (such as normal maintenance) could disturb birds arriving in the area during spring migration and later in the year during nesting, fall molting, and staging periods, causing them to avoid the area and nearby habitats. Because of the small number of new platforms (no more than 2), the disturbance of birds in offshore waters by operational noise and human activity would likely be limited to the individuals that might be present around a platform. Potential impacts to colonies could be avoided or mitigated by siting platforms and onshore facilities away from colony sites. Noise from airguns and disturbance from survey vessel traffic could displace foraging seabirds in offshore waters, especially if exploration occurs in high seabird density areas such as the open waters adjacent to the Stevenson and Kennedy Entrances to Cook Inlet and off of the northwestern coast of Kodiak Island (MMS, 2003b)

Nesting, staging, migrant, or overwintering loons, waterfowl, and seabirds occurring in areas closer to primary Cook Inlet support facilities on the Kenai Peninsula and vicinity, for example, are more likely to be overflown by aircraft than those in more distant lease areas. This is due to the convergence of routes from offshore sites to the support area, and is expected to be the case in the Gulf of Alaska, Kodiak Island, Alaska Peninsula, and Aleutian Island areas as well, where there are few communities capable of adequate support activity. Effects from disturbance would be greater in areas where higher concentrations of birds occurred and less where birds were more dispersed and in fewer numbers. The degree of effect is also dependent on whether birds are engaged in critical aspects of their seasonal activity and the intensity and type of disturbance (aircraft overflights, seismic surveys, vessel traffic). In addition, several open-water areas in the vicinity of Kachemak and Kamishak Bays represent important wintering areas (December–April) for the threatened Steller eider (FWS unpubl. data), and disturbance during the winter in these areas has a greater potential to effect this listed species.

Only small numbers of nesting birds are likely to be displaced away from the vicinity of onshore pipeline corridors (few hundred meters) by construction activity and vehicle traffic on the Kenai Peninsula (Cook Inlet) or Kodiak (Kodiak Island area), for example. Onshore habitat alteration is likely to be relatively minor in most of the development support centers. Offshore, disturbance of bottom habitats by platform placement may disrupt small areas of potential diving duck and seabird foraging habitat, but these small removals would be inconsequential.

Construction of landfalls, onshore pads, and roads is not expected to affect the relatively low numbers of loons, waterfowl, and shorebirds nesting in southern Alaska adjacent to likely oil development areas, particularly as this activity may take place mainly during the winter season. Like loons and waterfowl that do not migrate out of State, seabirds disperse into nearshore or offshore waters in winter, away from likely development activity. Gravel is expected to be obtained primarily from existing gravel mining sites in the Cook Inlet, Gulf of Alaska, and Kodiak Island areas. Development in the vicinity of Alaska Peninsula and Aleutian Island southern exposures is likely to involve gravel structures placed in low-lying terrain and near existing communities, if possible, rather than near cliffs favored as seabird nesting colonies.

Accidents

No more than 1 large spill (between 1,000 and 5,300 bbl from either a platform or a pipeline), 2 intermediate spills (50-999 bbl), and 100 small spills (< 50 bbl) may be expected over the lifetime of the lease (Table IV-4). Previous modeling of similar-sized oil spills in Cook Inlet indicate that land segments with the highest chance of contact with an offshore platform or pipeline spill are generally along the western shore of lower Cook Inlet in Kamishak Bay and Shelikof Strait (MMS, 2002b). A large number of seabird colonies occur in these areas (USGS, undated), and could be affected by oil spills reaching these areas.

Nesting and broodrearing seabirds, waterfowl, and a few shorebirds, as well as the many species of waterfowl/loons, seabirds, and shorebirds that molt, stage, migrate through, or overwinter in large numbers in the South Alaska Subregion would be vulnerable to the potential disturbance resulting from elevated vessel and aircraft activity associated with cleanup of an oil spill. For all species, the degree of impact depends heavily on the location of the spill and cleanup response and its timing with critical natural behaviors (e.g., breeding, molting, feeding). Survival and fitness of individuals may be affected, but this infrequent disturbance is not expected to result in significant population losses.

As a result of response to the *Exxon Valdez* tanker spill of 1989, and subsequent study of its effect upon regional bird populations, there exists an extensive literature concerning the effects of a large oil spill in the South Alaska Subregion (e.g., Agler and Kendall, 1997; Boersma et al., 1995; Day et al., 1997a, b; Exxon Valdez Oil Spill Trustee Council, 2004; Irons et al., 2000; Klowsiewski and Laing, 1994; Lanctot et al., 1999; Murphy et al., 1997; Piatt and Ford, 1996; Piatt et al., 1990; Rosenberg and Petrula, 1998; van Vliet and McAllister, 1994; Wiens et al. 2001). An estimated 100,000 to 300,000 marine birds died as a result of this spill (Piatt and Ford, 1996), which occurred in March when substantial numbers of overwintering birds were present in Prince William Sound and downstream to the west, as well as large numbers of seabirds aggregating near colonies from Prince William Sound to the western Gulf of Alaska prior to the breeding season. Although surveys and other studies carried out every year since the spill occurred indicate that populations of some marine bird species have recovered from their initial losses (e.g., common murre, black oystercatcher; Exxon Valdez Oil Spill Trustee Council, 2004), or are recovering (e.g., marbled murrelet), several species have shown little or no recovery (e.g., common loon, 3 cormorant species, harlequin duck, pigeon guillemot) or the recovery status is unknown (Kittlitz's murrelet). Although the effect on a bird population that is observed immediately following a spill to have suffered a large mortality is quite obvious, without frequent monitoring of each species following a spill it usually is difficult to be certain whether changes in measured population parameters are the result of lingering spill effects or natural variations that generally occur in all populations over time (Wiens and Parker, 1995; Wiens, 1996; Wiens et al., 2001). For example, forage fish populations utilized by many marine bird species may have experienced severe mortality or interruption of the annual cycle as a result of this oil spill, in turn affecting food availability following the spill and thus influencing the effect of the spill on these bird populations or their recovery from it.

In addition to the birds occupying the open water of bays and inlets, shorebirds numbering in the tens to hundreds of thousands are at risk of oiling where they occupy various shore habitats during their spring passage to northern breeding areas (Gill and Tibbitts, 1999). Particularly large numbers would be at risk on the southern Redoubt Bay, Fox River Delta, northern Montague Island, Kachemak Bay, and Copper River Delta, but substantial numbers may be at risk along most shorelines of the subregion during this season (Gill et al., 1994; Gill and Senner, 1996; Gill and Tibbitts, 1999, Alaska Shorebird Working Group, 2000). Based on the experience of the *Exxon Valdez* oil spill, where studies extending 15 years after the event continue to find oil or effects on organisms of exposure to oil, it is highly probable that not all oil spilled would be removed from the environment. Because substantial numbers of birds are present year round in the marine environment of the South Alaska Subregion, major effects are expected to result from a spill at any time of year.

Effects to ESA-listed Species in the South Alaska Subregion: Effects of oil and gas activities under the proposed action on the endangered short-tailed albatross, threatened Steller's eider, formerly threatened Aleutian Canada goose, and proposed Kittlitz's murrelet are expected to be similar to that noted above for nonlisted species. Compliance with ESA regulations and coordination with the FWS would ensure that lease-specific operations would be conducted in a manner that avoids or greatly minimizes the potential for impacting these species.

Short-tailed albatrosses occur in the South Alaska Subregion waters, and particularly in continental shelf waters, which places them at considerable oil-spill risk. Although their small population is spread throughout the North Pacific Ocean and few would be expected to be present during any given oil-spill event, the species has a high oil vulnerability index (King and Sanger, 1979), and the loss of a few individuals could be detrimental to their small population size (MMS, 2003b). Because Aleutian Canada geese are not known to occupy marine waters during migration to any great extent, their risk of oil-spill contact in that habitat is considered low. Neither of the two nesting areas would likely be locations of development infrastructure where activities would be a source of disturbance and onshore spills could contact this species.

Factors such as disturbance due to increased boat traffic related to wildlife cruises and offshore oil and gas development, impacts related to oil spills, and a high Oil Vulnerability Index (King and Sanger, 1979) make the Kittlitz's murrelet particularly vulnerable to population declines. Though impacts of oil spills have been documented (van Vliet and McAllister, 1994; Carter and Kuletz, 1995), little is known of potential impacts of disturbance on courtship behavior, foraging ecology and feeding, or energetics (Day et al., 1999). The relatively small population size, limited distribution, apparent periodic breeding failures and low reproductive potential (Beissinger, 1995), in conjunction with the above factors has led to Kittlitz's listing as a candidate species (priority 5; 50 CFR 17) under the ESA.

Steller's eiders occupying nearshore areas of the eastern Aleutian Islands to Cook Inlet from late fall to early spring could be exposed to the disturbance of air and vessel traffic, seismic surveys, oil-spill cleanup, and pipeline construction. Such activities would be scattered in occurrence, as are the flocks of eiders, or confined to specific corridors in the case of aircraft and vessels which the flocks are likely to avoid. In general, interactions are expected to result in short-term and localized displacement. Pipeline construction is expected to result in the loss of a small amount of eider nearshore bottom feeding habitat. Steller's eiders could be killed or injured as a result of collisions with platforms. This is most likely during migration, when visual conditions are reduced, such as in foggy weather and during movement among habitats on wintering grounds. Because they typically are present throughout the winter, they are at risk of oil-spill contact, particularly in the northern portion of the subregion including Cook Inlet, where development may first occur, and potentially in the Kodiak Archipelago. However, mortality from a spill is difficult to estimate because of the substantial variation in between-year, seasonal, or even weekly presence and distribution of eiders and uncertainties of where an oil spill might occur. Based on FWS assumptions, there is greater potential for the majority of individuals affected by factors discussed above to be from the Russian-breeding population rather than the ESA-listed Alaska breeding population, which may reduce the likelihood of impacts to the Alaska breeding population.

Kittlitz's murrelets typically show a very patchy distribution and are generally found in the vicinity of glaciated fjords of Cook Inlet, Prince William Sound, and southeast Alaska (Kendall and Agler, 1998; Dat et al., 1999; Kuletz et al., 2003a). Exploration and development activities are expected to be separated in time, so exposure to disturbing factors such as aircraft and vessel traffic, seismic surveys, and pipeline construction could be infrequent and localized in areas where this species concentrates. There is a greater potential for effects if disturbance occurs in areas where murrelets concentrate and displacement becomes a possibility. In addition, the potential impacts from oil spills are greater depending on the timing and location of the spill. For example, oil spills in College or Harrison Fjords during peak breeding or postbreeding would have larger impacts and could cause population-level effects, especially if birds come in contact with spilled oil or larger numbers of breeding age females are impacted. A large spill is likely to spread over a sufficiently large area to contact one or more bays where they may be concentrated during the summer breeding season, or offshore areas where they may be wintering in the Gulf of Alaska. For example, the *Exxon Valdez* spill resulted in the loss of an estimated 500-1,000 individuals, probably a substantial proportion of the world population, and certainly a major effect on this species.

Conclusions

Overall, impacts are dependent on the type of species, location and timing of activities with critical natural behaviors, and the intensity and degree of disturbance. Depending on these factors, the effects of disturbance ranges from temporary disruptions of natural behaviors or displacement from local areas to cumulative physiological and energetic costs, resulting in a decrease of individual reproductive success or other population-level effects. Normal operations could affect listed bird species in the same manner as nonlisted species (i.e., primarily behavioral disturbance). Compliance with ESA regulations and coordination with the FWS would ensure that lease-specific operations would be conducted in a manner that avoids or greatly minimizes the potential for impacting these species.

Marine and coastal birds may be affected by the construction of onshore and offshore facilities; by boats, aircraft, and on-land vehicle traffic; and by noise and human activities during normal operations and maintenance activities. In most cases, affected birds would temporarily leave the area, while in other cases the displacement could be long-term. Construction of onshore facilities and pipelines, offshore pipeline landfalls, and offshore gravel islands (to support drilling platforms) would result in the permanent disturbance of potential habitat within the immediate footprint of the new facilities and gravel excavation areas. Depending on the species present at and in the vicinity of the construction areas, the numbers of birds affected, and the activity (nesting, molting, feeding, staging) that the affected birds were undergoing at the time of disturbance, the displacement could reduce reproductive success, foraging success, and survival and could result in population-level impacts. New onshore facilities may result in local increases of predator species. Increases in these predators would increase predation pressure of local bird populations, and, depending on the birds affected, could result in population-level effects.

In the event of an accidental oil spill, exposed marine and coastal birds may experience a variety of lethal or sublethal effects, and the magnitude and ecological importance of any such effects would depend upon the size and location of the spill, the species and life stage of the exposed birds, and the size of the local bird population. Although the potential for a large spill is unlikely, it could result in the loss of hundreds to thousands of large numbers of birds, depending on the season and location of the spill, and result in potentially long-term reductions in populations. Spills in offshore locations have the greatest potential for affecting the greatest number of birds, especially if a spill occurs in or reaches an area where birds have congregated and are carrying out important activities (e.g., nesting, molting, and staging). A spill in onshore habitats would affect relatively few birds unless the spill was to reach a surface water body such as a stream, pond, or lake that provides important nesting, brood-rearing, foraging, or staging habitat. Spill cleanup activities may also disturb birds in the vicinity of the cleanup, causing them to leave the vicinity of the cleanup activity.

The net result of these additive/cumulative effects is expected to reduce survival and/or productivity somewhat; however, losses are expected to be limited because of the relatively low probability that areas occupied by scattered flocks during the relatively brief staging and migration periods, or scattered nest sites during the brief nesting season, would be exposed consistently to disturbing activities. In cases where localized disturbance (i.e., helicopter and vessel patterns and intensity) are greater, disturbance has the potential to rise to population-level effects.

e. Terrestrial Mammals

(1) Arctic Subregion

The terrestrial mammal communities present within the Arctic Subregion include a variety of small (e.g., mice and voles) and large mammal species. Species of particular concern are the caribou, muskoxen, grizzly bear, and arctic fox. See Section III.B.8.a for general discussions on the distribution of these species in the Arctic Subregion.

Routine Operations

Under routine operations for the proposed action, terrestrial mammals that occur on lands adjacent to the Arctic Subregion could be affected by the construction and operation of new onshore facilities and associated infrastructure, the construction and operation of new overland pipelines for transporting oil from the Beaufort Sea and Chukchi Sea Planning Areas to the Trans-Alaska Pipeline System (TAPS), the operation of offshore platforms, and vehicle traffic and aircraft overflights.

Construction and Operation of Onshore Facilities and Associated Infrastructure: Under the proposed action, one new shore base and one to two new processing facilities could be constructed in the Arctic Subregion. There are currently about 20 processing facilities in North Slope oil fields that average about 45 acres each in size (NRC, 2003b). Applying this average size to the proposed action, up to about 135 acres of wildlife habitat could experience long-term disturbance as a result of two new processing facilities and a new shore base, which would have a similar 45-acre size. Depending on the proximity of the new facilities to existing roads (such as those associated with North Slope infrastructure), one or more new access roads would be needed for each new facility to bring in construction equipment and supplies. Additional habitat would be disturbed for other infrastructure, such as airstrips and power stations. The construction of these facilities would result in elimination of habitat within the immediate footprints of the facilities. While this habitat loss would be long-term, the areas disturbed represent an extremely small portion of wildlife habitat that occurs adjacent to the Arctic Subregion.

Small Mammals—At the locations of new onshore facilities and associated infrastructure, smaller terrestrial mammals species, such as the tundra redback vole (*Clethrionomys rutilus*) and tundra hare (*Lepus othus*), would be permanently displaced from the construction areas, some individuals would be injured or killed, and some additional individuals from nearby areas may be temporarily disturbed by construction activities and noise. Because no more than three new facilities would be constructed under the proposed action, impacts to small mammals during construction and operation of the facilities would be very localized and not expected to result in long-term population-level effects.

Caribou—Four caribou herds—the Western Arctic Herd (WAH), Central Arctic Herd (CAH), Teshekpuk Lake Herd (TLH), and Porcupine Caribou Herd (PCH)—occur in areas adjacent to the Beaufort and Chukchi Sea Planning Areas (Fig. III-39) and could be affected by construction and operation of new processing facilities and associated infrastructure. In general, caribou use of these areas occurs largely in June, July, and August, although a portion of the WAH may overwinter in coastal habitats bordering the Chukchi Sea, and in some years, the TLH may remain on the Arctic Coastal Plain (ACP) throughout the winter.

Because construction of onshore facilities would likely occur in winter to minimize impacts to the ground surface and vegetation, construction activities would not be expected to affect caribou calving or foraging in summer. Construction could, however, disturb caribou in overwintering areas, causing them to vacate preferred overwintering areas and move into less suitable habitats. Such displacement could affect individuals or local populations as a result of increased energy expenditure associated with movement to, and use of, suboptimal habitat, with subsequent mortality and reduced productivity (NRC, 2003b).

If construction were to occur in late spring and summer, calving female caribou, females with newborn calves, and older foraging calves could be disturbed. Affected individuals would likely leave or avoid habitats in the vicinity of the construction activities and move into potentially less suitable habitats. During the calving season from late May until late June, which includes the actual calving dates and the following 2-3 weeks, cows with calves are particularly susceptible to disturbance by human activities, and such displacement could result in population-level effects if calving success and calf survival are reduced (NRC, 2003b). However, because construction would likely occur in winter, the potential for construction activities affecting calving and disturbing females and their calves would be avoided or greatly reduced.

While caribou may be expected to avoid areas undergoing active construction, numerous studies have indicated that in summer months caribou may avoid completed roads and other infrastructure (Dau and Cameron, 1986; Cameron et al., 1992; Griffith et al., 2002; Cameron et al., 2002; NRC, 2003b). Roads may act as barriers to caribou movements, depending on traffic volume and speed, dust levels, the proximity of pipelines to roads, roadside vegetation, dynamics of herd behavior, predator avoidance, insect harassment, and the habituation of individual animals to the presence of such structures (NRC, 2003b). Caribou may also temporarily avoid or delay crossing over roads during their movements to historical habitat (Cronin et al., 1998).

The presence of new onshore facilities and associated infrastructure could cause caribou to abandon or avoid preferred calving, foraging, and insect-avoidance areas (Murphy and Lawhead, 2000, S.A. Wolfe 2000; Cameron et al., 2002; Griffith et al., 2002; NRC, 2003b). For example, much of the CAH's western calving area has shifted from within the Milne Point and Kuparuk areas to the southwest since 1987, apparently in response to an increasing density of oilfield development (Lawhead and Cameron, 1988). However, calving areas are subject to annual variation due to a variety of environmental factors (Cameron et al., 2002; Griffith et al., 2002; NRC, 2003b).

Overall, caribou may be disturbed during construction or affected by the presence of completed infrastructure. The response of caribou may include the avoidance or abandonment of preferred habitats in the vicinity of the new facilities and infrastructure, with subsequent displacement to other potentially suboptimal areas. Affected caribou may also delay movements across roadways and to preferred habitats in the vicinity of the new facilities and infrastructure, which may result in reduced foraging and nutrient acquisition, lower body condition in autumn, reduced overwinter survival, and a lowered probability of producing calves during the following spring (NRC, 2003b). The magnitude of any such affects would be a function of the specific location of the new onshore facilities relative to preferred habitats (such as calving and foraging grounds and insect-avoidance areas), the location and length of associated access roads, and the number of individuals affected—the greater the distance of the new facilities from existing infrastructure (such as that associated with TAPS) the greater the potential for affecting caribou and the greater the number of caribou and caribou herds that could be affected.

Muskoxen—Muskoxen may be expected to avoid the area where construction of new onshore facilities and infrastructure are occurring. While summer construction may disturb muskoxen calving, it is not know if or to what extent calving might be affected. It is also not known whether muskoxen respond to roadways and other infrastructure with avoidance behavior. Because this species is present in the Arctic Subregion throughout the year, the potential for their disturbance would be similar regardless of whether construction occurred in winter or summer. However, the limited distribution and smaller population size of muskoxen in the coastal and inland areas adjacent to the Arctic Planning Areas compared to caribou (see Section III.B.8.a(2)) should greatly reduce the likelihood for disturbance of this species.

Grizzly Bear—The grizzly (brown) bear utilizes the coastal environments and/or terrestrial oil transportation routes onshore throughout the entire Arctic area being considered under the 2007-2012 OCS Oil and Gas Leasing Program. Winter construction of onshore infrastructure could disrupt individual bear dens if they are located near the construction area. In summer, some individuals may temporarily leave habitats in the vicinity of active construction. However, because bears often become habituated to human activities and facilities (Follman and Hechtel, 1990), the presence of three or less new onshore facilities and associated infrastructure is not expected to directly adversely affect the grizzly bear.

The bear’s attraction to human activities, however, often leads to conflicts with people. As many as 21 percent of the grizzlies inhabiting the North Slope oil fields have been reported to supplement their diets by feeding from dumpsters, camp storage areas, and the North Slope Borough landfill at Prudhoe Bay. Cubs with food-conditioned sows have been reported to have a much lower mortality rate than cubs with sows that do not use anthropogenic food sources (5.6% vs. 52%, respectively) (Shideler and Hechtel, 1991, 2000). However, once independent of their mothers, these food-conditioned bears have been found to experience significantly higher mortality rates than do the independent offspring of females that fed solely on natural foods. This increased mortality rate has been attributed, to a large degree, to the defense of life and property (DLP) killing of the adult bears (Shideler and Hechtel, 2000). A similar response may occur if a new onshore facility and associated infrastructure were to provide local grizzlies with an anthropogenic food source.

Arctic Fox—Arctic foxes are distributed throughout the Arctic Subregion, utilizing the coastal and offshore habitats in both the Beaufort and Chukchi Sea Planning Areas. The arctic fox would not be expected to be adversely affected by the construction or operation of a new onshore facility and associated infrastructure. During construction, individuals would likely abandon habitats temporarily in the vicinity of the construction activities. Like the grizzly bear, this species may also become habituated or attracted to human activities related to petroleum development (Eberhardt et al., 1982; Rodrigues et al., 1994), in part because of an increased availability of anthropogenic food sources such as garbage, litter, and handouts. Foxes in the North Slope oilfields have been reported to use a variety of human structures for dens (Eberhardt et al., 1982). As a result of increased availability of food and shelter in Arctic oil fields, the density and rate of occupancy of dens and sizes of litters are greater in oil fields than in adjacent areas (Eberhardt et al., 1982; Perham, 2000; NRC, 2003b).

Increased fox densities caused by human activity resulted in increased predation on local natural prey species, such as tundra-nesting shorebirds and waterfowl, and may impact federally listed and threatened species such as the spectacled and Steller's eiders (Garrott et al., 1983; Stickney 1991; S.R. Johnson et al., 1993a, 1993b). Increased fox densities may also result in an increase in the incidence and transmission of diseases such as rabies, canine distemper, and canine hepatitis. Arctic foxes are a major transmitter of rabies (Dieterich and Ritter, 1982; Robards et al., 1996), and transmission can occur more readily in areas of high arctic fox concentrations (Ritter and Follmann, 1995). Thus, increases in fox abundance associated with the construction and operation of new onshore facilities and associated infrastructure could lead to both increased disease outbreaks among the fox and adversely impact local populations, as well as increased predation pressures on populations of prey species.

Construction and Operation of New Overland Pipelines:

Small Mammals—Small mammals could be injured or killed within the immediate construction footprint, and there would be permanent habitat loss along the pipeline route. Injuries to small mammals and habitat disturbance would be localized to the immediate pipeline route and would not be expected to result in long-term impacts to small mammal populations.

Caribou—A new overland pipeline for the transport of crude oil from the Chukchi Sea Planning Area to the TAPS could extend across up to 200 miles of the ACP, potentially influencing the movement, behavior, and distribution of all four arctic caribou herds. Caribou would be expected to completely avoid active construction areas and avoid, or reduce use of, habitat adjacent to the completed pipeline. Affected individuals would likely be displaced to less preferred habitats, with subsequent decreases in condition, reproductive success, and overwinter survival (NRC, 2003b).

Like roads, pipelines can act as barriers to caribou movements. While pipelines built lower than 1.5 m above the ground surface may act as physical barriers to movement (NRC, 2003b), a pipeline constructed to current clearance standards (with a minimum clearance of 1.5 m) would not be expected to physically hinder caribou crossings (Curatolo and Murphy, 1986). Caribou have been shown to be reluctant in approaching pipelines and to exhibit reduced crossing success of pipelines located in close proximity to roadways with traffic. Thus, the presence of a new pipeline may affect daily or seasonal movements of some individuals and herds.

Muskoxen—The effects of construction and operation of a new pipeline on muskoxen would be similar to those discussed earlier for the construction of new roads. Muskoxen would be expected to temporarily avoid areas of active construction. It is not known how such disturbance or the presence of the completed pipeline would affect muskoxen habitat use and reproductive success. However, muskoxen may be particularly vulnerable to disturbance in winter because of limited habitat, the length of the Arctic winter, and the need to conserve energy throughout the winter, and for females, the need to maintain good body condition throughout winter and spring for calving (Reynolds et al., 2002).

The limited distribution and small population size of muskoxen in the coastal and inland areas adjacent to the Arctic Planning Areas should greatly reduce the likelihood for disturbing this species. However, because of their small population size, disturbance from pipeline construction could result in population level effects, especially if this species is disturbed during winter.

The presence of a completed pipeline may hinder movement by muskoxen if there is insufficient pipeline clearance for this species. However, this species does not exhibit as extensive seasonal or daily movements as does the caribou. If undisturbed, muskoxen remain in relatively small areas throughout the winter, while in summer this species exhibits longer movements that track the emergence of high quality forage plants (Reynolds et al., 2002). In summer, most daily movements of radio-tracked individuals in the Arctic National Wildlife Refuge (ANWR) were reported to be less than 5 km (3 miles) in length, and many were typically less than 1 km (0.6 miles) in length (Reynolds et al., 2002). Existing pipelines associated with the North Slope oil fields and TAPS do not appear to have hindered the westward expansion of this species from ANWR. Thus, the presence of a new pipeline would not be expected to adversely affect muskoxen populations in areas adjacent to the Arctic Planning Areas.

Grizzly Bear—The effects of construction of an onshore pipeline on the grizzly bear would be similar to the potential effects identified for the construction of new onshore processing facilities and associated infrastructure. Summer construction would disturb some individuals, likely causing them to temporarily leave the vicinity of the construction. Winter construction could disrupt individual bear dens that are located within or in the immediate vicinity of a construction area. Because bears may become habituated to human activities and facilities (Follman and Hechtel, 1990), the presence of a new pipeline is not expected to adversely affect the grizzly bear. In contrast to a new processing facility, a new pipeline would not be expected to provide additional feeding areas (such as dumpsters and landfills), thereby reducing the potential for increased DLP-related mortality.

Arctic Fox—Artic foxes could be temporarily disturbed during pipeline construction and temporarily leave areas of active construction. Because the completed pipeline could provide increased shelter and den habitat, populations of artic fox could increase along the pipeline corridor. As previously discussed, an increase in fox abundance could lead to increased outbreak of disease (rabies, canine distemper) among foxes living along the pipeline corridor, as well as increased predation pressures on populations of prey species.

Operation of Offshore Platforms: The operation of offshore platforms is not expected to affect terrestrial mammals except for possibly the arctic fox. Foxes are highly mobile, and in late autumn and winter they disperse out onto the sea ice in search of food. Due to this mobility, foxes may visit new offshore facilities (e.g., drilling platforms, ice roads, exploratory seismic trains) in search of food when sea ice is present. Arctic foxes were regularly observed near Seal Island in the Northstar development during the 1999-2000 ice-covered season (MMS, 2002c). Thus, depending on their number and distance from shore, new offshore platforms may provide additional winter food supplies and increase winter survival of some individuals.

Vehicle Traffic and Aircraft Overflights: Vehicle traffic associated with normal operations of onshore processing facilities and pipeline (e.g., transport of goods, pipeline monitoring, worker transport) could affect wildlife along the pipeline route and associated access roads. In addition, new access roads may also increase the incidence of vehicles associated with recreation, subsistence hunting, and other activities. Vehicle traffic could disturb wildlife foraging along roadways, causing affected wildlife to temporarily stop normal activities (e.g., foraging, resting) or leave the area. Collision with vehicles could result in mortality, especially in areas with concentrations of wildlife or along migration corridors. Vehicle traffic along any access roads associated with the proposed action would likely be light. Thus, the incidence of such collisions would be very low and not expected to result in population-level impacts to wildlife.

Aircraft overflights associated with pipeline monitoring and transport of personnel and supplies may disturb wildlife. The effects of aircraft on wildlife vary by species, populations, habitat type, and environmental variables. Some species may become habituated and experience no adverse effects (for example, see Harting, 1987). Routine overflights by surveillance aircraft would only temporarily disturb animals along the pipeline route, causing them to temporarily alter behaviors, and would not be expected to result in long-term population-level effects.

Caribou—Responses to vehicle and aircraft traffic by caribou can vary from no response to panic behavior. Cow and calf groups appear to be most sensitive (Valkenburg and Davis, 1984, MMS, 1998a). Because caribou tend to avoid transportation corridors (Dau and Cameron, 1986; Griffith et al., 2002; Cameron et al., 2002; NRC, 2003b), disturbance of caribou by vehicle traffic associated with normal operations of onshore processing facilities and pipelines would be infrequent. Single passes by aircraft may result in short-term disturbances that would not be expected to adversely affect caribou (MMS, 1998a). Low-flying jet aircraft and helicopters are more likely to produce negative responses from caribou than are light fixed-wing aircraft (Maier et al., 1998). Studies (McKechnie and Gladwin, 1993) evaluating altitude tolerance thresholds below which aircraft overflights elicit panic and escape responses indicate a fixed-wing tolerance threshold of 61 m (200 feet), with few or no response reactions observed above 153 m (500 feet). In contrast, the tolerance threshold for helicopters has been estimated to be 306 m (1,000 feet) in altitude (Miller and Gunn, 1979).

Muskoxen—Vehicle traffic along access roads would likely result in temporary disturbance of muskoxen in the immediate vicinity of the roadway. The response of muskoxen to aircraft overflights has been reported to range from calm to excitable, and the nature of the response depends in part on the altitude of the overflight, terrain, climate, sex, group size, number of calves present in a group, and habituation (Miller and Gunn, 1979, 1980). Helicopter and low-flying aircraft overflights have been reported to cause muskoxen to stampede and abandon their calves (NRC, 2003b). While responses of muskoxen to vehicle traffic and aircraft overflights associated with the proposed action are not expected to adversely affect muskoxen populations, energetic costs associated with forced movements (especially if frequent) in winter could adversely affect spring calving and could result in population-level effects.

Grizzly Bear—As previously discussed, the grizzly may become habituated to human activities. Some bears may be injured or killed by collisions with vehicles along access roads, while bears in the vicinity of vehicle traffic may be disturbed and temporarily cease normal behavior or leave the area until the vehicle has passed. Aircraft overflights have been reported to elicit a variety of responses in grizzly bear, including escape behavior and hiding (Larkin, 1996). While vehicle traffic and aircraft overflights associated with the proposed action may on occasion temporarily disturb individual bears, long-term population-level effects would not be expected from normal operations.

Arctic Fox—The arctic fox may experience temporary disturbance from vehicle traffic and aircraft overflights, resulting in hiding, departure from the immediate area, or cessation of normal behaviors. Some individuals crossing or traveling along access roads may be injured or killed by vehicle traffic. Relatively few individuals would be expected to be affected, and population-level impacts would not be expected under normal operations.

Accidents

Accidents under the proposed action that could affect terrestrial wildlife would be largely limited to an oil spill from a new onshore facility or pipeline. The impacts to wildlife from an oil spill would depend on such factors as the time of year and volume of the spill, type and extent of habitat affected, and home range or density of the wildlife species. The potential effects to wildlife from oil spills could occur from direct contamination of individual animals, contamination of habitats, and contamination of food resources (State of Alaska, Alaska Department of Natural Resources [ADNR], 1999). Acute (short-term) effects usually occur from direct oiling of animals; chronic (long-term) effects generally result from such factors as accumulation of contaminants from food items and environmental media (e.g., water).

Caribou and Muskoxen—There are no data to suggest that oil or fuel spills from onshore activities have caused mortality of any caribou or muskoxen on the North Slope. An oil spill would be expected to have a population-level adverse impact only if the spill was very large or contaminated a crucial habitat area where a large number of individual animals were concentrated. Only 1 large pipeline spill (4,600 bbl) and no more than 100 small spills (<50 bbl) would be expected over the lifetime of the proposed action. For the muskoxen, the potential for population-level effects would be greatest for a large spill occurring in winter when this species remains in small areas, restricted by the availability of forage (Reynolds et al., 2002). For caribou, population-level effects would be most likely from spills occurring in calving areas and along migration corridors.

Animals directly oiled by an accidental release could be exposed to toxic hydrocarbons via inhalation and/or ingestion of oil while grooming contaminated fur (MMS, 1996a). Staging and support activities for cleanup of a large offshore spill could temporarily displace animals. Oil-spill cleanup activities may displace these animals from not only contaminated habitats but also nearby uncontaminated habitats. This displacement could reduce energy reserves (especially in winter), which in turn could affect body condition and calving success.

Grizzly Bear—An accidental pipeline spill may result in food and fur contamination of grizzly bears in the vicinity of the spill. The bears may then be exposed via ingestion of contaminated food and/or contaminated fur during grooming. Because they are opportunistic omnivores, grizzly bear living in the vicinity of a spill may experience a much greater number of exposure pathways than other wildlife. For example, a grizzly may be exposed by eating a variety of oiled vegetation and wildlife, as well as contaminated carrion. In addition, animals caught within a release area may also be exposed via inhalation of oil droplets. Such exposure would likely result in sublethal or lethal effects. The magnitude of the effect will depend on the level of exposure, the life stage of the exposed bear (i.e., adult, cub), and the condition of the exposed animal (i.e., healthy, injured).

Lewis et al. (1991) examined the impacts of the 1989 *Exxon Valdez* oil spill on Katmai National Park coastal brown bears. Of the 27 bears captured, 4 had been exposed to crude oil. Bears were also observed with oil on their fur, consuming oiled carcasses, and presumably feeding on razor clams in the intertidal area. One yearling bear was found dead with high concentrations of aromatic hydrocarbons in its bile. Crude oil elements were also found in the fecal samples of the bear’s mother. However, no population-level impacts on the bears of Katmai were indicated.

Arctic Fox—Accidental oil spills resulting under the proposed action could potentially affect arctic foxes through contamination of prey, reduction of prey availability, and fouling of fur, causing loss of its insulating capacity. Although arctic foxes are abundant predators on the North Slope, their mobility allows them to disperse from oiled areas, if necessary. Because arctic foxes are opportunistic carnivores, they may prey on oiled birds and small mammals and consume oiled carcasses, thereby increasing their potential for incurring lethal and sublethal exposure to the spilled oil and its breakdown products. While some loss of arctic foxes may occur as a result of this exposure, this loss would be limited to animals in the vicinity of the spill. While a local population-level effect may result, recruitment from other areas would likely quickly replace the lost individuals.

Conclusion

The construction and normal operations of up to three new onshore facilities associated with the proposed action could result in a variety of short-term and long-term impacts to terrestrial mammals. Short-term impacts may be incurred by a variety of species during facility and infrastructure construction. These impacts would largely be behavioral in nature, with affected animals avoiding or vacating the construction areas. Similarly, vehicle and aircraft traffic associated with the proposed action could temporarily disturb mammals near roadways or under flight paths. While the disturbance of these animals would be short-term in nature, the energetic costs incurred by some of the disturbed biota (especially overwintering muskoxen and pre-calving female caribou) could affect reproductive success. The occurrence could result in longer term impacts to the animal populations.

The presence of a new onshore pipeline may result in the displacement from preferred habitats to less suitable habitats for overwintering muskoxen, calving female caribou, and female caribou and their calves. Such displacement may reduce overwinter conditioning or survival as well as calving success. While population-level effects may not be likely for caribou, local population-level effects may occur for muskoxen because of the small population size in Alaska.

Because of their potential for utilizing human facilities, local grizzly bear and arctic fox populations may benefit from the presence of anthropogenic food sources and increased availability of den sites associated with the presence and operation of onshore processing facilities. Conversely, local grizzly bears may incur DLP-related mortality because of the presence of the onshore facilities and human interactions, while arctic foxes may experience increased disease outbreaks because of the higher fox densities that could be found associated with the onshore facilities.

In the event of an accidental spill, terrestrial mammals may be exposed via ingestion of contaminated food, inhalation of airborne oil droplets, and direct ingestion of oil during grooming. A variety of lethal and sublethal effects may be likely. However, because most spills would be relatively small (< 50 bbl), relatively few individuals would likely be exposed. While some individuals may incur lethal effects, population-level impacts would not be expected for most species.

Cleanup activities could temporarily disturb terrestrial mammals in the vicinity of the cleanup operation, causing those animals to vacate the area. As a result, individuals may move from preferred to less-optimal habitats, which in turn could affect overall condition, overwinter survival, and calving success. Such effects would be limited to only those relatively few animals in the vicinity of the spill and, thus, would not be expected to result in population-level impacts. However, because of their small populations and the importance of conserving energy during winter, displacement of muskoxen from overwintering areas could adversely affect overwinter survival and condition, and subsequent calving success, and could result in local population-level impacts to this species.

(2) Bering Sea Subregion

There are approximately 40 species of terrestrial mammal that occur in southern Alaska, many of which use mainland habitats adjacent to the North Aleutian Basin Planning Area (Section III.B.8.b). The species that could be affected by OCS-related activities include caribou, moose, black bear, and brown bear, as well as numerous smaller mammals such as mink, muskrat, river otter, wolves, fox, and wolverine (ADNR, 2005).

Routine Operations

Under the proposed action, terrestrial mammals could be affected during the construction and operation of onshore facilities and pipelines, and by vehicle traffic and aircraft overflights servicing offshore platforms and onshore infrastructure.

Construction and Operation of Onshore Facilities and Pipelines: One onshore waste facility, 1 processing facility, 1-2 pipeline landfalls, and 50 miles of onshore pipeline could be constructed under the proposed action (Table IV-2). Depending on the proximity of existing roads, one or more new access roads could be needed for each facility. Construction of these onshore facilities would result in the permanent loss of some wildlife habitat. While potentially affected habitats could include caribou winter-use areas (such as those in the vicinity of Kvichak Bay and southwest of Port Moller), caribou calving areas (such as those located west of Pilot Point and on Nushagak Peninsula), and moose rutting and calving habitats near Pilot Point (ADNR, 2005), careful siting of new onshore facilities could avoid or greatly reduce impacts to such habitats. Because of the small amount of onshore facilities that could be built under the proposed action, relatively little habitat would be affected in comparison with the amount of habitat available throughout the area. While the disturbed areas would contain only a very small portion of available wildlife habitat that occurs adjacent to the North Aleutian Basin Planning Area, this habitat loss would be long-term in nature.

Construction of the onshore facilities would temporarily disturb mammals in the vicinity of the construction sites, with affected individuals likely moving to other habitats. Small mammals (such as mice and voles) could be injured or killed within the immediate construction footprint. Winter construction could disturb individual brown and black bears if their dens are located near construction areas. Overwintering caribou and moose may be similarly disturbed. Disturbance of wildlife could affect their overall condition and subsequent survival or reproductive success, especially if animals are displaced from calving or wintering habitats to less optimal habitats. Because of the relatively small number of new facilities that might be developed under the proposed action, construction would likely affect relatively few individuals in the immediate vicinity of the construction activity and would not result in long-term impacts to mammal populations. Siting of onshore facilities to avoid important calving or wintering habitats would further reduce the likelihood of long-term impacts to the survival or reproduction of affected species.

Operation of onshore facilities could result in the long-term avoidance of adjacent habitats by species sensitive to noise and human activity. However, many wildlife species, such as the brown bear and red fox, become habituated to human activities and facilities (e.g., Follman and Hechtel, 1990; Rodrigues et al., 1994), and thus would not be expected to be adversely affected by ongoing operations of these facilities. Bears that become habituated or attracted to human activities at the onshore facilities could lead to DLP killing of the adult bears (e.g., Shideler and Hechtel, 2000). Because of the small number of facilities that could be operated under the proposed action, the level of human-bear interaction is expected to be small, and population-level impacts are not expected due to DLP actions.

Vehicle Traffic and Aircraft Overflights: Vehicles associated with normal operations and maintenance of onshore processing and waste facilities and pipelines, as well as aircraft servicing offshore platforms, could disturb terrestrial mammals near the onshore facilities and pipelines or along the overland portions of flight paths between onshore facilities and offshore platforms. Vehicle traffic could disturb terrestrial mammals foraging along pipelines or access roads, causing affected individuals to temporarily stop normal activities (e.g., foraging, resting) or leave the area, while collision with vehicles could injure or kill some individuals. Because of the small amount of onshore facilities that could occur under the proposed action, only very light vehicle traffic would be expected along any roads associated with the proposed infrastructure. Thus, the incidence of disturbance due to vehicle traffic would be very low and not expected to result in population-level impacts to terrestrial mammals.

Aircraft overflights associated with pipeline monitoring and transport of personnel and supplies to offshore platforms have the potential to disturb wildlife present along flight paths. The greatest potential for overflight of terrestrial habitats would occur for flights originating from the southern shore of the Alaskan Peninsula or from the Cook Inlet area. Flights originating from coastal communities located along the planning area would be expected to fly over very little terrestrial habitat. The effect of aircraft on wildlife varies by species, habitat type, and the wildlife activity occurring at the time of the overflight. In response to overflights, some wildlife have been reported to cease normal behavior until the flight has passed, and then resume normal activity or flee the area; some species may become habituated and experience no disturbance (for example, see Harting, 1987). Aircraft overflights would be relatively infrequent (occasional maintenance flights over pipelines and no more than 3 flights per day to individual offshore platforms). Thus, relatively few animals would be affected by overflights, and no long-term population level effects are anticipated.

Accidents

Terrestrial mammals could be affected by oil spills via direct contamination of individual animals, contamination of their habitats, or contamination of their foods. Acute (short-term) effects usually occur following direct oiling of animals and the subsequent inhalation and/or ingestion of oil while grooming contaminated fur (MMS, 1996a). Chronic (long-term) effects generally result from the accumulation of contaminants via ingestion of contaminated foods and environmental media (e.g., sediment or water). Opportunistic omnivores, such as the brown and black bears, may experience a much greater number of exposure pathways than other wildlife. For example, Lewis et al. (1991) examined the impacts of the 1989 *Exxon Valdez* oil spill on Katmai National Park coastal brown bears and observed bears having oiled fur, consuming oiled carcasses, and presumably feeding on razor clams in the oiled intertidal habitats. However, no population-level impacts on the bears of Katmai were indicated.

Under the proposed action, terrestrial mammals could be exposed to oil by an accidental oil release from an onshore pipeline, and by an offshore spill that contacts a beach or other shoreline utilized by terrestrial mammals (such as brown bear). Onshore pipeline spills would not be expected to affect more than a few individuals, or their localized habitat and food resources. However, spills contacting high-use areas, such as riparian areas used by moose, could affect a relatively larger number of animals or habitat. The nature and magnitude of potential impacts to exposed terrestrial wildlife will depend on such factors as the time of year and volume of the spill, type and extent of habitat affected, home range or density of the wildlife species, and sensitivity of the exposed species. Species especially sensitive to exposure to oil, such as the river otter, may incur much greater impacts than other, less sensitive, species.

Staging and support activities for a large oil-spill cleanup could temporarily displace animals not only from the contaminated habitats but also nearby uncontaminated habitats. Depending on the effectiveness of the cleanup activities, chronic exposure may continue for years in some habitats.

Conclusion

The construction and normal operations of new onshore pipelines and facilities could result in a variety of short-term and long-term impacts to terrestrial mammals. Construction activities and vehicle and aircraft traffic associated could temporarily disturb terrestrial mammals at construction sites and along pipelines, roadways, and flight paths. The disturbance of animals by these activities would be short-term in nature and not expected to result in population-level effects. Facility construction would also result in the long-term loss of a relatively small amount of habitat and in the death of a few individuals (primarily small mammals such as mice and voles) unable to flee the construction areas. The amount of permanent habitat loss would be very small compared to habitat available throughout the planning area. Neither the loss of this small amount of habitat nor the loss of a few individuals within the construction areas is expected to adversely affect populations of the affected species. While brown and black bears may incur DLP-related mortality if they become habituated or attracted to the onshore facilities or activities, very few DLP actions are anticipated because of the very small number of facilities that could be operated under the proposed action.

In the event of an accidental spill, terrestrial mammals may be exposed via ingestion of contaminated food, inhalation of airborne oil droplets, and direct ingestion of oil during grooming, which may result in a variety of lethal and sublethal effects. However, because of the small number and volume of potential spills, relatively few individuals would likely be exposed. While some individuals (especially oil-sensitive species such as the river otter) may incur lethal effects, population-level impacts would not be expected for most species.

Cleanup activities could temporarily disturb terrestrial mammals in the vicinity of the cleanup operation, causing those animals to move from preferred to less optimal habitats, which in turn could affect overall condition. Such displacement would be limited to only those relatively few animals in the vicinity of the cleanup activity and, thus, would not be expected to result in population level impacts.

(3) South Alaska Subregion

There are approximately 40 species of terrestrial mammal that occur in southern Alaska. Among these about 10 species may regularly use mainland habitats adjacent to the Cook Inlet Planning Area (Section III.B.8.c) and, thus, could be affected by OCS-related activities in the Cook Inlet Planning Area.

Routine Operations

Terrestrial mammals that occur on mainland areas adjacent to the Cook Inlet Planning Area could be affected by the construction and operation of onshore facilities and pipelines, and vehicle traffic and aircraft overflights (Table IV-2).

Construction and Operation of Onshore Facilities and Pipelines: Up to one onshore waste facility, one processing facility, 2 pipeline landfalls, and 75 miles of onshore pipeline could be constructed in the Cook Inlet Planning Area. Depending on the proximity of the new facilities and pipelines to existing roads, one or more new access roads would be needed for each facility. Construction of these onshore facilities would result in the permanent loss of a relatively small amount of terrestrial wildlife habitat, primarily in the southwestern portion of the Kenai Peninsula between Anchor Point and Ninichik. While this habitat loss would be long-term, the areas disturbed represent an extremely small portion of wildlife habitat that occurs adjacent to the Cook Inlet Planning Area. The amount of habitat that could be affected may be reduced if existing rights-of-way are used for the new pipelines and associated access roads.

Construction of the onshore facilities would temporarily disturb mammals in the vicinity of the construction sites, with affected individuals largely moving to other habitats. Displacement from preferred to less optimal habitats could affect overall condition and affect subsequent survival or reproductive success. Small mammals (such as mice and voles) could be injured or killed within the immediate construction footprint. Winter construction could disturb individual brown and black bears if their dens are located near construction areas. Disturbance of terrestrial mammals during construction would be temporary, would affect a relatively small number of individuals, would be localized to the immediate vicinity of the construction activity, and would not be expected to result in long-term impacts to mammal populations.

Operation of completed onshore facilities could result in the long-term avoidance of adjacent habitats by species sensitive to noise and human activity. However, many wildlife species, such as the brown bear and red fox, become habituated to human activities and facilities (e.g., Follman and Hechtel, 1990; Rodrigues et al., 1994) and, thus, would not be expected to be adversely affected by ongoing operations at these facilities. Bears may become habituated or attracted to human activities, which could lead to conflicts with people and result in the DLP killing of the adult bears (e.g., Shideler and Hechtel, 2000).

Vehicle Traffic and Aircraft Overflights: Vehicle traffic associated with normal operations and maintenance of onshore processing and waste facilities and pipelines, as well as traffic associated with the support of offshore platforms, could disturb wildlife near the onshore facilities and pipelines, or along the overland portions of flight paths between onshore facilities and offshore platforms. Vehicle traffic could disturb wildlife foraging along pipelines or access roads, causing affected wildlife to temporarily stop normal activities (e.g., foraging, resting) or leave the area, while collision with vehicles could injure or kill some individuals. Vehicle traffic along any new access roads would likely be light; thus, incidence of wildlife disturbance would be very low and not expected to result in population-level impacts to wildlife.

Aircraft overflights associated with pipeline monitoring and transport of personnel and supplies to offshore platforms may disturb wildlife. Aircraft overflights of terrestrial habitats would occur primarily in the southwestern portion of the Kenai Peninsula, between Anchor Point and Ninichik. The effects of aircraft on wildlife varies by species, habitat type, and the wildlife activity occurring at the time of the overflight. During overflights, some wildlife will cease their normal behaviors until the flight has passed and then resume their normal activity; others may flee the area, while some species may become habituated and experience no disturbance (for example, see Harting, 1987). Aircraft overflights would be relatively infrequent (occasional maintenance flights over pipelines and no more than 3 flights per day to individual offshore platforms). Thus, no long-term, population-level effects would be expected from aircraft overflights associated with normal operations.

Accidents

Terrestrial wildlife could be adversely affected by the accidental release of oil from an onshore pipeline, and by offshore spills contacting beaches and shorelines utilized by terrestrial mammals (such as Sitka black-tailed deer, brown bear, and river otter). Spills contacting high-use areas, such as coastal habitats along Shelikof Strait heavily used by brown bears, could locally affect a relatively large number of animals (MMS, 2003b). The impacts to wildlife from an oil spill would depend on such factors as the time of year and volume of the spill, type and extent of habitat affected, and home range or density of the wildlife species. The potential effects to wildlife from oil spills could occur from direct contamination of individual animals, contamination of habitats, and contamination of food resources (ADNR, 1999c). Acute (short-term) effects usually occur from direct oiling of animals;

chronic (long-term) effects generally result from such factors as accumulation of contaminants from food items and environmental media (e.g., sediments).

Animals directly oiled by an accidental release could be exposed to oil via inhalation and/or ingestion of oil while grooming contaminated fur (MMS, 1996a). Species especially sensitive to exposure to oil, such as the river otter, may incur much greater impacts than other, less sensitive species. Exposure may also occur through the consumption of contaminated foods. Opportunistic omnivores, such as the grizzly and black bears, may experience a much greater number of exposure pathways than other wildlife. For example, Lewis et al. (1991) examined the impacts of the 1989 *Exxon Valdez* oil spill on Katmai National Park coastal brown bears, and observed bears with oiled fur consuming oiled carcasses and presumably feeding on razor clams in the oiled intertidal habitats. However, no population-level impacts on the bears of Katmai were indicated.

Staging and support activities for a large spill cleanup could temporarily displace animals not only from the contaminated habitats but also nearby uncontaminated habitats. Depending on the effectiveness of the cleanup activities, chronic exposure may continue for years in some habitats.

Conclusion

The construction and normal operations of new onshore pipelines and facilities could result in a variety of short-term and long-term impacts to terrestrial mammals. Short-term impacts would be largely behavioral in nature, with affected animals avoiding or vacating the construction areas. Similarly, vehicle and aircraft traffic from the proposed action in the Cook Inlet Planning Area could temporarily disturb mammals along pipelines or roadways or along flight paths. The disturbance of animals by these activities would be short-term in nature and not expected to result in population-level effects. Construction of new pipelines and facilities would also result in the long-term loss of some wildlife habitats, as well as the death of a few individuals (primarily small mammals) unable to flee the construction areas. Brown and black bears may incur DLP-related mortality if they become habituated or attracted to the new onshore pipelines or facilities. The amount of permanent habitat loss would be relatively small compared to habitat available throughout the planning area, and not expected to result in population-level impacts. Similarly, the loss of a few individuals within the construction areas would not be expected to adversely affect populations of the affected species.

In the event of an accidental spill, terrestrial mammals may be exposed via ingestion of contaminated food, inhalation of airborne oil droplets, and direct ingestion of oil during grooming, which may result in a variety of lethal and sublethal effects. However, because most spills would be relatively small (less than 50 bbl), relatively few individuals would likely be exposed. While some individuals (especially oil-sensitive species such as the river otter) may incur lethal effects, population-level impacts would not be expected for most species.

Cleanup activities could temporarily disturb terrestrial mammals in the vicinity of the cleanup operation, causing those animals to move from preferred to less optimal habitats, which, in turn, could affect overall condition. Such displacement would be limited to only those relatively few animals in the vicinity of the cleanup activity and, thus, would not be expected to result in population-level effects.

f. Fish Resources and Essential Fish Habitat

(1) Arctic Subregion

Fish resources in the Arctic Subregion (Beaufort Sea and Chukchi Sea Planning Areas) may be impacted by routine operations under the proposed action (e.g., disturbance of offshore and coastal sediments during placement of drilling units, exploratory drilling and discharges, construction of artificial islands, installation of pipelines, and seismic surveys), accidental oil spills, and decommissioning activities. In addition, all life stages of the ESA-listed Pacific salmon occur within arctic waters (Section III.B.9.a); therefore, these populations could be affected by the proposed action.

Essential fish habitat (EFH) for Pacific salmon has been designated for both freshwater streams and marine habitats in the Arctic Subregion. Consequently, any activity that degrades freshwater, coastal, or marine habitats could impact EFH for Atlantic salmon.

Routine Operations

Fish Resources: Impacts of routine operations could occur as a result of seismic surveying, development (e.g., drilling, installation or removal of pipelines, construction or removal of platforms, and construction of artificial islands or ice roads), release of operational discharges to the environment, and decommissioning.

Seismic survey data are usually collected by discharging compressed air from arrays of airguns towed behind ships. The effects of airgun discharges on fishes depend on the fish life-history stage and biology, distance to and type of the sound source, and the magnitude of the explosion. Pelagic fish species contain gas bladders that help control buoyancy. Several studies have found that species with gas bladders (e.g., salmonids, coregonids, and gadids) are more vulnerable to injury or mortality from explosions than species without gas bladders because airgun discharges may damage air- or gas-containing organs (MMS, 2004b).

Acute damage to adult and juvenile fishes from airgun discharges appears confined to a radius of 1.5 m from the blast, and the approaching noise source probably scares mobile fishes away before the airgun comes within this range (R.A. Davis et al., 1998). The juvenile and adult fish most likely to be affected by the noise generated from seismic surveys in the Beaufort Sea and Chukchi Sea Planning Areas include the five species of salmon, cod, cisco, and herring. Flatfishes lack gas bladders and would be least impacted by airgun discharges. Acute, lethal effects of seismic survey airgun blasts on adult pelagic fishes are likely to be negligible where waters are of sufficient depth and fishes have the opportunity to escape. Young-of-the-year fish of some species are transported by wind-driven currents and may not be able to move from an area being surveyed. Even where such young-of-the-year fish could be affected by the blasts from seismic surveys, the effect to the overall fish population would be negligible since fishes are distributed over wide geographic areas and airgun operations are localized. Short-term temporary displacement of fishes is the most probable effect of noise generated by seismic surveys.

Fish eggs and larvae are more sensitive than adults to injury and mortality from airgun discharges. Laboratory and field studies have shown that statistically significant mortality of eggs and larvae can occur in close proximity (i.e., 2 and 3 m) to airguns (MMS, 2004b). Eggs and larvae of many fish species are also more likely to come into contact with airgun discharges because eggs drift passively near the ocean surface and larvae often rise diurnally in the water column when feeding on zooplankton (R.A. Davis et al., 1998). In the Arctic Subregion, the fish eggs and larvae that drift offshore are most likely to be impacted by noise associated with seismic surveys. Fish eggs and larvae that grow to the juvenile stage either in fresh or brackish water would not be affected by offshore airgun discharges. Overall, the effects of seismic surveys on fish eggs and larvae would be localized, and only a small proportion of eggs or larvae present in offshore areas at any given time are likely to be affected.

Development and construction activities that could affect fish in the Arctic Subregion include installation of pipelines and construction of platforms, artificial islands, and ice roads. The primary impact factors associated with placement of such structures include sediment disturbance, crushing of benthic organisms, increased turbidity due to suspension of sediments, and changes in the fish communities associated with alteration of the availability of various habitat types. Turbidity caused by activities could temporarily decrease photosynthesis by phytoplankton, locally reducing primary productivity (MMS, 1996c) and the availability of other planktonic organisms that serve as a base of the food chain for some arctic fish. Individual fish would likely move temporarily from affected areas and are likely to return after construction has been completed and after the suspended sediments have settled. In addition, chronic discharges of contaminants in ice roads would occur during every breakup from fluids entrained in the roads. Entrained contaminants from vehicle exhaust, grease, antifreeze, oil, and other vehicle-related fluids would be discharged from the ice roads and potentially impact EFH at each breakup. These discharges are not expected to be major; however, they would exist over the life of the field.

Although some benthic organisms could be smothered and killed by sediment deposition, it is anticipated that most individual fish would move before smothering could occur. Impacts to benthic invertebrate communities could indirectly affect demersal fishes and shellfishes (e.g., Pacific cod and crab) that utilize benthic organisms for food. These demersal organisms would likely relocate to nearby areas until food resources within an affected area recover. Although sediment deposition could locally affect benthic organisms for relatively long periods (recovery could take a few years; see Section IV.B.3.h), the total area affected by seafloor disturbance under the proposed action would be relatively small compared to the availability of similar seafloor habitat in surrounding areas. For example, it is estimated that pipeline installation under the proposed action would disturb approximately 95-120 ha. If it is assumed that the area affected by sediment deposition surrounding platforms or artificial islands extends for a radius of approximately 300 m (1,000 feet) around the structure, approximately 29 ha of seafloor could be affected by each structure. Assuming that up to 10 production platforms or artificial islands could be constructed under the proposed action, up to 290 ha of seafloor habitat could be temporarily affected by sedimentation from platform/island construction. Thus, the total area that could be temporarily affected by sedimentation under the proposed action (approximately 400 ha from pipeline development and platform/island construction combined) would be very small compared to the availability of seafloor habitat in the Beaufort Sea and Chukchi Sea Planning Areas.

Construction of platforms, artificial islands, and ice roads would kill sedentary benthic organisms within the immediate footprint of the project. Development of artificial islands would increase the diversity of habitat available on otherwise homogeneous ocean floors (COE, 1998). Specifically, such construction would introduce an artificial hard substrate that opportunistic benthic species, especially those that prefer gravel substrate, could colonize. Fishes may be attracted to the newly formed habitat complex, and fish population numbers in the immediate vicinity of the platforms are likely to be higher than in surrounding waters away from the structures. The overall change in habitat could result in changes in local community assemblage and diversity (Howarth, 1991). The very small number of platforms projected for the Arctic Subregion under the proposed action (up to 10, Table IV-2) would create a small amount of hard-substrate habitat and would likely have little effect on overall fish populations.

Production wastes such as drilling muds, cuttings, and produced water would not be released into waters surrounding production wells. Under the proposed action, 80 percent of the drilling muds would be recycled for use at future drilling locations. The remaining drilling muds, together with rock cuttings and produced water, would be disposed of by injecting them into permitted disposal wells. Consequently, there would be no impacts to fish from these production wastes.

Essential Fish Habitat: Impacts of routine activities on EFH could occur as a result of disturbing offshore and coastal sediments during placement of drilling units, construction of artificial islands, and installation of pipelines. Under the proposed action, up to 30 ha of seafloor habitat could be permanently covered by up to 10 artificial islands, and as much as 400 ha of seafloor habitat could be temporarily disturbed by sedimentation from the related construction activities. Installation of pipelines also disturbs, suspends, and displaces bottom sediments. It is also estimated that 83 to 120 ha of seafloor habitat in the Beaufort Sea and Chukchi Sea areas could be disturbed by new pipeline installation under the proposed action. Sediment-disturbing activities would result in increased turbidity, which would lower the water quality of EFH in small areas for a limited amount of time, typically causing fish to leave the areas until water quality improves. However, the sediments would eventually settle out and would not have a lasting effect on water quality. Structure placement will introduce a hard substrate that may attract opportunistic species and may result in new habitat for some prey species, which, in turn, could attract some managed species.

Gravel island construction and ice road construction may affect freshwater EFH depending upon the location and timing of the activities. Gravel for island construction is mined from river bars, and water for construction of ice roads is pumped from local rivers and lakes to desired areas to build a rigid surface. Removal of gravel and water could increase turbidity and reduce the water quality of EFH in affected rivers. The ADF&G requires reviews of such activities for potential impacts to salmon and other fish species, and requires permits to be issued before gravel mining and water withdrawals can be initiated.

Pipeline trenching and island construction could damage marine plants associated with EFH by mechanically removing the plants or smothering them through sedimentation. Pipeline trenching could directly disturb 83-120 ha of bottom area in the Arctic Subregion. Construction of platforms or artificial islands could permanently cover as much as 30 ha of seafloor habitat, and as much as 400 ha of seafloor habitat could also be temporarily affected as a result of sedimentation from these construction activities (Section IV.B.3.h). However, marine vegetation is concentrated in relatively few areas within the Beaufort and Chukchi Seas Planning Areas (e.g., the Stefansson Sound Boulder Patch Community), and such areas are typically avoided during construction activities.

Discharges of drilling fluids and cuttings could temporarily increase turbidity and decrease EFH. Settlement of discharged cuttings on the seafloor could smother some prey species and change substrate composition in the area where the cuttings settled. Under the proposed action for the Arctic Subregion, 80 percent of the drilling muds would be recycled for use at future drilling locations, and the remaining drilling muds, together with rock cuttings and produced water, would be disposed of by injection into permitted disposal wells. Consequently, there would be no impacts to EFH from these wastes.

Accidents

Fish Resources: Oil spills can have a range of effects on fish depending on the concentration of oil present, the length of exposure, and the life-history stage of the fish involved (Starr et al., 1981;

C.I. Hamilton et al., 1979; Malins, 1977; Neff and Stubblefield, 1995; MMS, 1996c). Fish eggs, larvae, and juveniles are the most sensitive life-history stages. Mortality caused by oil is seldom observed in nature, and most acute toxicity values for fish are on the order of 1 to 10 ppm (BLM and MMS, 1998). Even during the *Exxon Valdez* spill, the concentration of oil in water was generally not sufficient to cause fish mortalities (Neff and Stubblefield, 1995). Sublethal effects may include changes in growth rates, feeding, fecundity, and survival rates; reductions in food resources; and consumption of contaminated prey (BLM and MMS, 1998). Temporary displacement may occur through interference with movements to feeding, overwintering, or spawning areas.

The sensitivity of marine biota to short-term oil exposure generally increases with trophic level. Within species, sensitivity to oil can change substantially from one life stage to the next. One of the most consistent trends is the correlation between habitat and susceptibility. Pelagic organisms, which inhabit relatively stable habitats, typically are more sensitive to oil exposure than intertidal organisms, which inhabit relatively variable environments (Rice et al., 1984). Fishes are generally more susceptible to oil exposure as embryos and larvae because these early life stages lack organs to detoxify chemicals, are incapable of moving to avoid exposure, and are often concentrated near the surface where they are most likely to be exposed to oil (MMS, 1996a). Although intertidal species may be able to withstand higher levels of oil exposure, they are also generally less mobile and thus less likely to avoid oil driven inshore (Rice et al., 1984).

Pelagic fish species such as salmon and herring are relatively mobile and should be able to avoid surface oil in the offshore environment. Mature salmonids move inshore to spawn, however, and may be forced to pass through oil during reproductive migrations. Juvenile salmonids migrate seaward through these same inshore habitats and, depending upon timing, could come into contact with oil spills driven inshore. Salmonid eggs and alevins appear less sensitive to short-term (96-day) oil exposure than salmonid fry (Rice et al., 1984). Overall, salmonids are most sensitive to acute effects of oil while juveniles, and are most likely to be affected when exposed to oil in nearshore areas where oil avoidance is difficult.

Some pelagic species (e.g., Pacific herring) spawn in intertidal zones where their eggs may be susceptible to oil. (Rice et al., 1984). Herring generally spawn near shorelines over 3-4 week periods, and oil driven onshore could contact spawning adults and developing eggs (MMS, 1996d). Larval herring are also susceptible after moving into deeper water because they rise diurnally to feed on plankton and could be exposed to surface oil repeatedly if a spill occurs.

Demersal fishes such as walleye pollock, halibut, and cod all have buoyant eggs and larvae that float near the surface where they could be exposed to spilled oil (MMS, 1996d).

Shellfish and crustaceans are most susceptible to acute effects from oil exposure during egg and larval stages when they are closest to the water surface. Shrimp also inhabit the upper water column as adults and juveniles, and are thus at risk of exposure throughout their life cycle. Clams that inhabit the intertidal zone are susceptible to oil exposure as both juveniles and adults.

Spilled petroleum hydrocarbons may persist for years (Howarth, 1991; Wiedmer et al., 1996), especially in sediments of cold waters, making it likely that some fish species would be exposed to low levels of hydrocarbons for an extended time after an oil spill. Similarly, petroleum hydrocarbons could remain available for uptake and bioaccumulation by benthic organisms for years following a spill (Howarth, 1991). Commercially important fishes (e.g., Pacific cod and crab) may be particularly susceptible because of their dependence on benthic forage.

Petroleum hydrocarbons can also bioaccumulate in pelagic fishes. For example, hydrocarbons bioaccumulate in herring muscle and ovarian tissue at exposure levels well below lethal concentrations (Rice et al., 1986). Herring are a critical link in the marine food chain because they convert plankton to fish biomass (Outer Continental Shelf Environmental Assessment Program, 1987) and could serve as a pathway for the bioaccumulation of hydrocarbons in higher trophic levels. Because muscle and roe from herring are commercially important, the accumulation of hydrocarbons could have effects on commercial fisheries (Rice et al., 1986).

Recent studies (Boehm, 2001b) found that concentrations of hydrocarbons and metals in the sediments surrounding the Liberty and Northstar oil and gas production units in the Beaufort Sea were lower than criteria developed by Long et al. (1995) for identifying the risk of potential effects on sediment-dwelling organisms. Based upon the results of those studies, Boehm (2001b) determined that hydrocarbons in sediments (largely attributable to natural sources) were apparently not readily bioavailable to marine filter-feeders and deposit-feeders, and concluded that small incremental contaminant additions from future development activities are unlikely to cause immediate ecological harm to organisms in the Beaufort Sea study area. Although conclusions were limited by small sample sizes, results of a study conducted by Spies et al. (2003) were consistent with low levels of bioaccumulation for PAH’s in some fish (arctic cisco and four horn sculpin) collected in the vicinity of the Northstar and Liberty production units; however, natural sources of petroleum or nearby use of motorized vessels could be the source of the PAH’s.

The most abundant marine fish in the Arctic Subregion are arctic and saffron cod, fourhorn sculpin, eelpout, and arctic flounder (MMS, 1996c). Of these, the arctic cod may be the most susceptible to lethal oil effects because the larvae are pelagic and most likely to come into contact with oil. Arctic cod are also susceptible because they are dependent on the production of phytoplankton, which could be affected by oil exposure. Arctic cod are distributed throughout the region, and a localized spill event would be unlikely to have a substantial impact on the population in the overall region. A large spill that contacted arctic cod eggs and larvae could have a somewhat larger, temporary effect on the population. A large oil spill that reduced phytoplankton production in arctic cod feeding grounds could displace the fish until food resources recover.

The most abundant anadromous species are the arctic and least cisco, broad whitefish, Dolly Varden, and rainbow smelt (MMS, 1996c). Most of these populations appear to originate from the Colville and Mackenzie River systems. Fishes most likely to be affected by a large oil spill would be those that migrate extensively (e.g., arctic cisco), those with high fidelity to natal streams (e.g., Dolly Varden), and those confined to nearshore environments (e.g., broad whitefish and rainbow smelt). A large oil spill could have population-level consequences if vital habitat areas were affected or if it occurred in spawning areas or juvenile feeding grounds during the time when fish populations are highly concentrated. Although large spills could cause substantial reductions in population levels for one or more years under such circumstances (e.g., the arctic cisco population concentrated near the Colville River), the effects of small spills would be unlikely to cause noticeable changes in population levels.

Young-of-the-year fish (i.e., arctic cisco) are passively transported by wind-generated coastal currents and may not be able to avoid oil-contaminated areas. The resulting prolonged exposure could result in adverse impacts from an oil spill.

An important, indirect effect of an oil spill would be the contamination of fishes relied on for subsistence (e.g., arctic and least cisco). In terms of fish biota, the Chukchi Sea is a transition zone between the fish communities of the Pacific and Arctic Oceans. Subsistence fishing is critical to the coastal villages, and a small commercial salmon fishery also occurs in the subregion. Oil spills could affect such fisheries by reducing local catches or making fish inedible due to contaminant levels.

Oil spills probably represent the greatest hazard from OCS oil and gas development to the fish species in the Chukchi Sea. Of these fish species, pink salmon, herring, and capelin are the most susceptible to oil spills because they spawn, hatch, and rear in inshore areas that could be contaminated following a spill. If a population of these fishes were concentrated in an area during their more vulnerable life stages (i.e., eggs and larvae), exposure to a large spill could have a substantial effect on population levels. Adults exposed in a similar situation would likely be able to avoid the oil spill to a greater degree and are less likely to be affected. It is not known whether these stocks represent isolated, endemic populations or whether they are contiguous with North Pacific and Beaufort Sea populations. An oil spill that damaged populations would have longer term effects if the populations are endemic than if they are contiguous with other, more abundant populations (Craig et al., 1984).

Essential Fish Habitat: The EFH for the Pacific salmon species includes freshwater streams as well as offshore and coastal waters. Depending upon the timing, location, and magnitude of an oil spill, EFH for eggs and larvae, juveniles, or adult salmon could be affected. Wave and wind action, weathering, and biological degradation would dissipate oil in the surface water, and EFH would be reestablished after some period of time. The period of time needed to reestablish appropriate EFH conditions following a spill would depend upon the characteristics of the individual spill and would be related to many factors, including the location of the spill, the nature of transporting currents, the magnitude of the spill, and the chemical characteristics of the spilled oil.

Accidents that affect EFH in the Beaufort and Chukchi Seas are most likely to come from oil spills that cause oil to wash inshore into freshwater wetlands, intertidal zones, and shorelines. Such areas provide food and nursery habitat for Pacific salmon species. Spilled oil reaching wetland habitat could kill vegetation and associated invertebrates and small fish that are prey species for salmon, thereby adversely affecting EFH. Spilled oil concentrated along the coastline at the mouths of streams or rivers may disrupt salmon species migration patterns by causing fish to avoid contaminated areas. Depending upon the timing and severity of an oil spill, adult fish migrating from marine waters to freshwater to spawn and juvenile salmon migrating seaward from rivers or streams could be harmed by high concentrations of oil-related contaminants.

Kelp and other marine plants are a component of salmon EFH because they provide food and shelter for various life stages of a variety of potential prey in the Boulder Patch (a habitat area of particular concern) and elsewhere in the Beaufort Sea. Spilled oil could smother kelp and other marine plants that grow towards the surface, reducing habitat and substrate for potential prey of salmon juveniles and adults. In some cases, toxic fractions (e.g., PAH's) of spilled oil could also reach freshwater areas where salmon eggs are deposited in stream bottoms. Contamination persisted in some freshwater benthic habitats for at least 4 years following the *Exxon Valdez* oil spill in southern Alaska (Murphy et al., 1999).

Oil spilled under ice is more difficult to locate and clean than surface spills. Adult salmon in the Beaufort and Chukchi Seas would likely avoid oil spills by temporarily moving to other areas. However, planktonic organisms that serve as potential prey for salmon would be unable to avoid oil spills. Since weathering would be greatly reduced by ice cover, prey species such as these could continue to be harmed or killed as they drift into the trapped oil. These prey species could be subjected to short-term, localized reductions as a result.

Conclusion

Assuming compliance with existing Federal, State, and local fisheries regulations, policies and consultations, most impacts to fish resources in the Arctic Subregion will be minimized. The magnitude of impacts would also be limited, in part, by specific permit requirements and would have to be determined during more detailed analyses conducted for particular lease sales and site-specific analyses for exploration, development and pipeline plans. Although some individual fish are likely to be harmed by activities associated with routine operations, the mitigation measures imposed would limit these impacts in scope (see Appendix C). Effects of accidental spills would depend on the location, timing, and volume of spills, distribution and ecology of affected fish species, and other environmental factors. Small spills would be localized and are unlikely to affect substantial number of fish before dilution and weathering would reduce concentrations of toxic fractions to sublethal or nonlethal levels. Under most circumstances, any single large spill would affect only a small proportion of a given fish population; therefore, overall population levels would not be affected. Under some circumstances, however, such as a large spill that affects a vital habitat feature while many individuals of a given species are concentrated there, the spill could adversely affect individuals within a population, and one or more years could be required for population levels to recover.

Considering the small proportion of EFH area that could be affected, potential impacts on EFH due to routine operations under the proposed action would probably be limited. The magnitude of impacts would be limited, in part, by specific permit requirements and would have to be determined during site-specific analyses conducted for particular lease sales. Accidents such as petroleum spills could also have effects on EFH. While most accidents assumed under the proposed action would be small and would have relatively small impacts on EFH, large spills that reach coastal streams used by Pacific salmon species could have more persistent impacts and could require remediation.

(2) Bering Sea Subregion

Fish resources (i.e., pelagic fish, groundfish, and shellfish) and EFH in the waters of the Bering Sea Subregion (North Aleutian Basin Planning Area) are described in Section III.B.9. This section also describes potential impacts to fish and shellfish populations in the vicinity of the North Aleutian Basin Planning Area from routine exploration and development operations and from accidental spills.

The EFH resources in the North Aleutian Basin Planning Area could potentially be affected by activities associated with routine operations (e.g., disturbance of offshore and coastal sediments during placement of drilling units, exploratory drilling and discharges, installation of pipelines, and seismic surveys) and by accidental oil spills. Appendix D describes the legal requirements regarding EFH.

As described in Section III.B.9, the North Aleutian Basin Planning Area contains EFH for a variety of fish and invertebrate species that can be broadly categorized into 3 groups, based upon the relevant fishery management plans (FMP's): (1) Gulf of Alaska goundfish, (2) Alaska salmon, and (3) Alaska weathervane scallop. As identified in the appropriate FMP's, the EFH includes streams, lakes, ponds, wetlands, and other water bodies, including marine and coastal waters, currently or historically used and accessible to the species within these groups. Consequently, activities that degrade these aquatic habitats could adversely affect EFH for one or more species. For the purposes of the analysis here, potential impacts to EFH resources in the North Aleutian Basin Planning Area and adjacent waters (Section III.B.9) are generally addressed. If an oil and gas lease sale occurs in the North Aleutian Basin Planning Area, more detailed EFH assessments would be conducted to address potential adverse effects to EFH resources at a more detailed level.

Routine Operations

Fish Resources: Routine OCS exploration, development, and production activities that could affect fish resources in the North Aleutian Basin include seismic surveying, drilling of wells, offshore and onshore construction activities (e.g., development of platforms or pipelines), and releases of permitted operational discharges (Table IV-2). It is anticipated that no OCS facilities in the North Aleutian Basin Planning Area would be decommissioned during the period covered by the analyses.

Seismic surveys would be conducted in the North Aleutian Basin Planning Area as part of oil and gas exploration and development activities; it is assumed that airguns would be used for these surveys. A comprehensive review of the potential effects of seismic surveys on fish and invertebrates is presented by Thomson and Davis (2001). It is assumed that seismic surveys in the North Aleutian Basin Planning Area would damage hearing organs of adult and juvenile fishes and kill larvae and eggs within 1 to 2 m of airgun discharge ports; cover an area of approximately 23 km^2 around each platform to be constructed; take 14-35 days to complete each survey (not necessarily on concurrent days); and be conducted during the late summer and early fall seasons so that the surveys take place during ice-free periods while reducing conflicts with other users.

Because up to 6 new OCS production platforms could be placed in the North Aleutian Basin Planning Area (Table IV-2), it is assumed that a total area of up to 138 km^2 could be subjected to seismic surveys during the 2007-2012 Leasing Program and that the seismic surveys would require a total of 84-210 days. Thus, approximately 0.11 percent of the total area (131,000 km^2) of the North Aleutian Basin Planning Area could be subjected to seismic surveys, and surveys could occupy 5-12 percent of the days during the proposed action.

Several factors make it unlikely that seismic surveys would have population-level effects on fishes in the North Aleutian Basin. While seismic surveys could temporarily displace fishes from the immediate area where airguns are in use, fishes are likely to return to surveyed areas within relatively short periods following cessation of survey activities (Thomson and Davis, 2001). It is also anticipated that the number of fish contained in the volume of water where injuries or mortality could occur would represent a very small proportion of individuals within any life stage for the affected species, compared to the overall populations within the North Aleutian Basin Planning Area. Additionally, fishes within only a small portion of the available offshore habitat would be subjected to seismic surveys during the 5-year program, each survey would last only 14-35 days, and survey activities would likely be spread over several years.

A study examining potential effects of seismic surveys using airguns on snow crabs found that there were no detectable effects on survival of eggs, juveniles, or adults, even at close range (Christian et al., 2003), even though telemetry studies suggest that snow crabs would not disperse from areas undergoing seismic surveys (Christian et al., 2003). Assuming that effects on other crab species would be similar, it is anticipated that crab populations in the North Aleutian Basin Planning Area would not be adversely affected by seismic surveys.

Noise could also be generated by other routine activities during exploration, development, and production. Sound sources include drilling, construction of platforms and pipelines, and boat traffic associated with OCS activities. Up to 20 exploration wells and up to 200 production wells could be drilled (Table IV-2), which could temporarily cause some fish to move away from the immediate areas of activity. Up to 150 miles of new offshore pipeline could be placed in the North Aleutian Basin Planning Area and in adjacent areas of Bristol Bay. It is also anticipated that 1 to 3 vessel trips per week will occur as part of exploration, development, and production activities (Table IV-2). In 1983, there were approximately 2,300 vessel trips through Unimak Pass in the Aleutian Island chain, with fishery vessels accounting for approximately 60 percent of the total (Louis Berger and Associates, Inc., 1984). Although current vessel traffic levels in the North Aleutian Basin have not been identified, traffic resulting from OCS activities would undoubtedly represent only a very small increase in overall vessel traffic in the North Aleutian Basin Planning Area or surrounding waters. Although the noise associated with construction activities and vessel trips could temporarily disturb or displace fishes from the areas of activity, the duration of such effects would be intermittent and short-lived. The noise associated with these activities would not be expected to cause population-level effects on fish species.

Drilling discharges could affect benthic invertebrates and demersal fishes in localized areas surrounding drilling sites, although the fluid components of drilling discharges would be diluted rapidly following releases. The analysis assumes that approximately 522 tons of drill cuttings would be released to the environment for each exploration well constructed (Table IV-2). Up to 20 exploration wells are anticipated, which could result in the release of up to 10,440 tons of cuttings. Drilling discharges are released intermittently during drilling activities, generally for a few hours or less at a time. Such releases could result in localized increases in sediment load and deposition. It is assumed that all produced waters, drilling muds, and cuttings that result from development of production wells would be reinjected into existing wells. Consequently, drilling muds and cuttings would not be released from up to 200 production wells that could be developed. Deposition of sediments could smother more sedentary invertebrates (e.g., clams or scallops) located within a given radius of discharge points. It is anticipated that such effects would not extend beyond approximately 100 m from the discharge points and that overall populations or stocks of such species would not be altered.

Section 403(c) of Federal Water Pollution Control Act (Clean Water Act) regulations requires that initial dilution of discharges in OCS waters must occur within a 100-m radius from the discharge location. Because the waters of the North Aleutian Basin Planning Area generally are well mixed, drilling discharges are likely to be substantially diluted over an even shorter distance. The typical concentrations of contaminants in these releases are considered to be of negligible toxicity to juvenile and adult fishes, based upon USEPA standards. Consequently, it is considered unlikely that juvenile and adult fishes would be exposed to concentrations of contaminants that are acutely toxic as a result of permitted discharges from OCS activities. Juvenile and adult fishes inhabiting the mixing zone could be exposed to concentrations that elicit sublethal effects (e.g., reduced growth rates) if exposed for extended periods of time. Given the small area affected (compared to the overall area of similar habitat that would be available in the planning area) and the intermittent nature of such releases from discharge points, it is anticipated that such effects would be experienced only by small numbers of individuals. Effects on overall subpopulations or populations of fishes in the vicinity of the North Aleutian Basin Planning Area from permitted discharges would not be expected.

Eggs, fry, and small prey occurring in or entering the mixing zone during discharge of muds and cuttings could experience lethal and sublethal effects if they are within 1-2 m of the discharge point and if the volumes of muds and cuttings are released at the rates permitted by the USEPA (500-1,000 bbl/ hour). Such lethal and sublethal effects most likely would result from physical damage or from smothering due to the bulk constituents comprising muds and cuttings. Only very small numbers of eggs, larvae, or prey are believed susceptible to such close exposure because of the limited periods of high discharge rates, the low number of exploratory wells anticipated (up to 20), and the small area affected. This source of mortality to eggs, larvae, and prey would not alter the population dynamics of fisheries resources in the vicinity of the planning area.

Sediment deposition during discharges and physical activities associated with the drilling operations could disturb and displace some fishes and mobile shellfishes (e.g., adult crabs) from the immediate area. In some cases, discharge points may be located at or near the seafloor. If demersal fishes are present at the time of discharge, they could be displaced up to 100 m (i.e., outside the allowable mixing zone) from the discharge point. Some fishes would probably return to the immediate drilling area within minutes to hours after drilling or discharging operations ceased. Such localized movements would have no discernible effects on populations of fish or shellfish resources inhabiting the waters of the North Aleutian Basin Planning Area or surrounding areas.

If it is assumed that 1.5 ha (3.7 acres) of seafloor habitat would be disturbed by construction of each production platform and up to 9 ha (22 acres) of seafloor habitat used by demersal or bentho-pelagic fishes or benthic shellfish could be affected. Similarly, if it is assumed that construction of offshore pipelines would disturb 1.5 ha (3.y acres) of seafloor habitat for each mile of pipeline, up to 225 ha (555 acres) of habitat could be disturbed by pipeline construction. After construction has been completed, some species and their prey could be positively affected by the presence of offshore structures that provide high-relief habitat or refuge. Disturbance or displacement due to construction activities should be localized and short-term (hours to months), limited to only the construction period and shortly thereafter. Because only a limited number of individuals are likely to be affected and because the disturbance would be relatively short-term, population-level effects would be unlikely for most species. There is a potential for greater effects on populations of species that are limited in distribution or rare if construction activities affected a spatially limited habitat resource needed by a particular species. Compliance with lease stipulations requiring avoidance of biological resources (including habitats) that are identified as important or unique would minimize the potential for such effects.

Onshore, up to 50 miles of oil pipeline could be constructed (Table IV-2). While an exact route cannot be determined at this time, the pipeline route would be required to comply with various Alaska Coastal Management Program policies. As a consequence, construction activities in sensitive aquatic habitat would be minimized. Specifically, the route for onshore pipeline facilities would probably be sited inland from shorelines and beaches, and crossings of anadromous fish streams would be minimized and consolidated with other utility and road crossings of such streams. Onshore pipelines would be designed, constructed, and maintained to minimize risk to fish habitats from a spill, pipeline break, or construction activities. It is anticipated that oil and gas development from lease sales in the North Aleutian Basin Planning Area could require onshore construction of a shore base, a waste treatment facility, and a new processing facility. Similar to construction of onshore pipelines, construction of these facilities would also be required to comply with various Alaska Coastal Management Program policies. If such facilities are deemed necessary in the future, site-specific National Environmental Policy Act review would be conducted to evaluate potential impacts.

Essential Fish Habitat: Impacts of routine activities on EFH could occur as a result of placement of drilling units and construction of drilling platforms, vessel traffic associated with support activities, discharges associated with exploratory drilling, seismic surveys, and installation of pipelines. See Section IV.B.3.f(2)(a), above, for discussions on potential impacts to fishery resources from noise, seismic surveys, development and construction disturbances, and operational discharges.

It is anticipated that a total area of up to 138 km^2 could be subjected to seismic surveys during the 2007-2012 Leasing Program and that seismic surveys would occur for 84-210 days. Thus, approximately 0.11 percent of the total area (131,000 km^2) of the North Aleutian Basin Planning Area could be subjected to seismic surveys, and surveys could occur during 5-12 percent of days during the proposed action. It is expected that seismic surveys would typically be conducted during the late summer and early fall seasons. While it is anticipated that there would be no permanent population-level effects on fishes in the planning area from seismic surveys, individual fishes, especially egg and larval life stages in close proximity to airgun arrays, could be injured. Pelagic species and life stages would be more likely to be affected in this way because of the typical depths at which seismic arrays are towed. It is anticipated that the number of individual fish contained in the volume of water where such injuries could occur would represent a very small proportion of similar life stages for affected species, compared to overall numbers in the waters of the planning area. juvenile and adult fishes located more distant from the towed airgun arrays could exhibit temporary behavioral responses during seismic surveys, but it is anticipated that behavioral and distributional responses to such acoustic stimuli would be small and temporary. It is anticipated that EFH for shellfish would not be affected by these surveys.

Additional sources of noise from activities, including drilling, construction of platforms and pipelines, and boat traffic, could also temporarily disturb or displace individual fish. However, as described in Section IV.B.3.f.(2)(a), the noise associated with these activities would not be expected to noticeably affect populations of fishery resources found in the North Aleutian Basin Planning Area.

Up to 9 ha (22 acres) of seafloor habitat in the North Aleutian Basin Planning Area could be affected by construction of drilling platforms. Installation of pipelines also disturbs, suspends, and displaces bottom sediments. It is also estimated that up to 225 ha (555 acres) of seafloor habitat in the Planning Area and adjacent coastal waters could be disturbed by new offshore pipeline installation. Sediment-disturbing activities could result in increased turbidity, which would lower the water quality of EFH in small areas for a limited amount of time. Such increases in turbidity could also cause groundfish species (e.g., rockfish, soles, flounders, sand lance) to leave the affected areas until water quality improves. Platform placement would also introduce a high-relief hard substrate that would likely provide habitat and/or foraging opportunities for some managed species.

Offshore pipeline construction, especially in nearshore subtidal habitats, could damage marine plants (e.g., eelgrass) associated with EFH by mechanically removing plants or smothering them through sedimentation. This could affect some life stages of some managed species or prey species that utilize such areas as substrate for egg laying (e.g., Pacific herring), or as foraging and nursery habitats (e.g., some rockfish species). Although it is assumed that pipeline construction could directly disturb up to 225 ha of bottom area in the Planning Area and adjacent coastal waters, most of the affected areas would not be within vegetated habitat. Areas containing high densities of aquatic vegetation are typically avoided during construction activities, due to a lease stipulation calling for protection of important or unique biological populations or habitats.

In addition to offshore construction, up to 50 miles of onshore pipeline construction could occur (Table IV-2). Pipeline crossings of streams could affect EFH for several life stages of managed anadromous salmon, including eggs, larvae, juveniles, and adults. The Alaska Department of Game and Fish reviews plans for such construction activities for potential impacts to salmon and other fish species and requires permits to be issued before stream pipeline crossings can be installed. It is anticipated that impacts on anadromous salmon from freshwater pipeline crossings would be minimized through appropriate permitting and management actions once site-specific assessments are conducted.

Discharges of drilling fluids and cuttings could temporarily increase turbidity and affect some EFH resources. Settling of discharged cuttings on the seafloor could smother some prey species, displace some managed groundfish species, and change substrate composition in the area where the cuttings settle. It is anticipated that such effects would extend no farther than approximately 100 m around discharge locations; under this assumption, less than 1 km^2 of bottom habitat would be affected by such discharges. Up to 10,440 tons of cuttings could be released intermittently during exploration drilling activities, assuming that up to 20 exploration wells could be drilled (Table IV-2). While toxicity of those cuttings is expected to be low and within permitted levels, there could be localized effects on some prey species due to increased turbidity and sediment deposition, and small numbers of groundfish could be temporarily displaced. All cuttings and produced water from development of production wells would be disposed of by injection into permitted disposal wells.

Accidents

Fish Resources: Fisheries resources could become exposed to oil as a consequence of accidental oil spills. This analysis assumes that one large spill with a volume greater than or equal to 1,000 bbl could occur as a result of accidents at either pipelines or platforms. In addition, it is assumed that two intermediate-sized spills (between 50 and 1000 bbl in volume) and 10 small spills (less than 50 bbl in volume) could occur (Table IV-4). Because of the geological characteristics of the North Aleutian Basin Planning Area, it is assumed that liquid hydrocarbons recovered from production wells within the Planning Area would consist equally of gas condensates and light crude oil that would be transported via pipeline to a shore-based facility on the Alaska Peninsula for subsequent transport to a processing facility (Section IV.B.1.c). Compared to heavier crude oils, light crude oil and condensates contain a higher proportion of volatile compounds that evaporate more quickly (NRC, 2003a). As a consequence, spills of lighter crude oils and condensates tend to disperse and weather more quickly than spills composed of heavier crude oils, typically resulting in oil slicks that persist for shorter periods of time and cover less area (NRC, 2003a). However, lighter crude oils and condensates also tend to be more acutely toxic to marine organisms.

Prolonged exposure to elevated levels of petroleum hydrocarbons can be acutely toxic to fishes a short distance from and a short time after a spill event. Oil spills in the North Aleutian Basin Planning Area or adjacent waters could affect fish populations by causing mortality or abnormal development of eggs, larvae, juveniles, or adults; impeding the access of migratory fishes (e.g., salmon) to spawning habitat; altering behaviors; displacing individuals from preferred habitat; reducing or eliminating prey populations available for consumption; impairing feeding, growth, or reproduction; causing adverse physiological responses; increasing susceptibility to predation, parasitism, diseases, or other environmental perturbations; and increasing or introducing genetic abnormalities. Effects on populations could be followed by recovery to pre-impact population levels after some period of time. Changes in the quality of large proportions of habitat required by a particular species or a change in competitive or predation pressures could result in long-term changes in the abundance of some species.

While most adult and juvenile demersal and bentho-pelagic fish would probably not be harmed by spilled oil at the surface, due to avoidance behaviors, individuals in coastal shallow waters with slow water exchange could be injured or killed if they are unable to escape contact with oiled areas. Species only using waters deeper than 50 m are assumed to be primarily at risk in the event of a pipeline spill at depth. Pipeline spills and surface spills that reach nearshore areas could contaminate sediments, potentially resulting in chronic effects on growth and health of the adults or juveniles of demersal or bentho-pelagic fish species in the affected areas (Moles and Norcross, 1998). Eggs and larvae of fishes that come into contact with high concentrations of oil are likely to be killed. Because the eggs and/or larvae of many demersal and bentho-pelagic species are pelagic, these life stages could be affected by spilled oil at the surface.

Oil spills within the North Aleutian Basin Planning Area also have the potential to adversely impact shellfish. At depth, pipeline spills could affect a limited number of adults or juveniles before the released oil rises to the surface. Many commercially important shellfish species have pelagic larvae and, depending on timing and location of a spill, large numbers of shellfish larvae could be killed by spilled oil at the surface. Surface spills that reach shallower nearshore waters could also affect some shellfish species.

Even though adult pelagic fishes are believed to avoid oil slicks, a large spill could adversely impact hundreds of millions of eggs and juvenile stages of pelagic species, including those of anadromous fishes that spawn upstream in tributaries of Bristol Bay. These immature fishes could suffer mortality and sublethal effects that reduce individual fitness, fecundity, and survival. A large oil spill during the summer or autumn seasons could have the greatest potential to affect pelagic fishes, because this is when many pelagic migratory fishes are most abundant and when the greatest densities of pelagic eggs and juvenile life stages are present in the North Aleutian Basin Planning Area.

Because pelagic fish species or pelagic life stages of fishes and shellfishes are relatively abundant and widely distributed in waters of the North Aleutian Basin Planning Area, even a large oil spill of up to 4,600 bbl is not likely to affect an area large enough to significantly affect overall fisheries resource populations in the North Aleutian Basin Planning Area. Spilled oil that comes into contact with nearshore and intertidal areas could result in the greatest impacts to fisheries resources. As described in Section IV.B.3.b, studies by MMS have shown that a spill in portions of the North Aleutian Basin Planning Area near the Alaska Peninsula could result in oil moving north along the Alaska Peninsula at all times of the year (Armstrong et al., 1984; Thorsteinson, 1984). Oil spilled farther offshore on the North Aleutian Shelf would likely be driven by winds northeast into Bristol Bay if spilled during the summer, or would move west-southwest into the Bering Sea during winter (MMS, 1985b). Previous oil-spill modeling conducted for potential OCS lease sales in the North Aleutian Basin Planning Area indicated that the probability of a spill of 1,000 bbl or greater occurring and contacting important nearshore habitat areas during the lease period was 5 percent or less for a slick that persisted for 10 days, and 9 percent or less for a slick that persisted for 30 days (MMS, 1985b).

For any spill, the magnitude of lethal and sublethal effects would depend on seasonal timing and environmental factors influencing the concentration and distribution of oil in the waters of the planning area and beyond. Although several small spills and 1 spill exceeding 1,500 bbl in volume could occur in the North Aleutian Basin Planning Area (Table IV-4), such spills are considered unlikely to result in a significant impact to an overall fish population inhabiting the planning area. However, depending upon specific conditions (e.g., volume, timing, and location), a large spill could potentially affect local subpopulations or stocks of some fisheries species for one or more generations.

Essential Fish Habitat: Depending upon the timing, location, and magnitude of an oil spill, EFH for eggs and larvae, juveniles, or adult salmon and other fishery species could be affected in portions of the North Aleutian Basin Planning Area or adjacent waters. The potential for severe impacts from accidents would be greatest from oil washed inshore into wetlands, intertidal zones, and shorelines. Such areas provide food and nursery habitat for anadromous salmon, other pelagic species, groundfish species, and shellfish. Spilled oil reaching areas containing submerged aquatic vegetation or wetlands could kill vegetation and associated invertebrates and small fish that are prey species, thereby adversely affecting EFH. Spilled oil concentrated along the coastline at the mouths of streams or rivers may disrupt migration patterns for some species, such as eulachon or salmon, by causing fish to avoid contaminated areas. Oil in intertidal areas could contaminate sediments, where it could continue to affect survival and development of eggs for anadromous salmon for a number of years. Depending upon the timing and severity of an oil spill, adult fish migrating from marine waters to freshwater to spawn and juvenile salmon migrating seaward from rivers or streams could be harmed by high concentrations of oil-related contaminants.

Valuable shellfish species, including various crabs and weathervane scallops, could be affected by oil spills that occur when planktonic life stages are present in surface waters. Because of the depths at which they occur, EFH areas for adult shellfish are unlikely to be affected by surface spills. However, localized areas of shellfish EFH could be affected by leaks from offshore pipelines.

Marine plants are a component of salmon and groundfish EFH, because they provide food and shelter for various life stages of a variety of potential prey, especially in nearshore subtidal areas. Spilled oil could smother kelp, eelgrass, and other marine plants that grow toward the surface, reducing habitat and substrate for potential prey of salmon and groundfish juveniles and adults. In some cases, toxic fractions (e.g., polyaromatic hydrocarbons) of spilled oil could also reach freshwater areas where salmon eggs are deposited in stream bottoms. Contamination persisted in some freshwater benthic habitats for at least 4 years following the *Exxon Valdez* oil spill (Murphy et al., 1999). An oil-spill model used for an oil-spill risk analysis of potential lease sales in the North Aleutian Basin Planning Area predicted that the majority of nearby coastal areas important for salmon had less than a 10-percent chance of being contacted by oil within 30 days, should a large (≥1,000 bbl) oil spill occur (MMS, 1985b).

Wave and wind action, weathering, and biological degradation would dissipate spilled oil in the surface water, and EFH resources would likely recover after some period of time. The period of time needed to reestablish appropriate EFH conditions following a spill would depend upon the characteristics of the individual spill and would be related to many factors, including the location of the spill, the nature of transporting currents, the magnitude of the spill, and the chemical characteristics of the spilled oil. As evidenced by effects of the *Exxon Valdez* oil spill, recovery of some affected EFH resources could occur within less than a year, while other resources could continue to be affected at some level for 10 years or more. However, even the quantity of oil assumed for large spills (up to 4,600 bbl from a pipeline spill, 1,500 bbl from a platform spill) are considerably less than the 257,000 bbl released to Prince William Sound during the *Exxon Valdez* oil spill. It is, therefore, anticipated that potential effects of the assumed spills on EFH resources would be considerably smaller than effects observed following the *Exxon Valdez* accident.

Oil spilled under ice is more difficult to locate and clean than surface spills. Adult pelagic fish (e.g., salmon) in the waters of the North Aleutian Basin Planning Area would likely avoid oil spills by temporarily moving to other areas. However, pelagic eggs and larvae and some organisms that serve as potential prey for commercially important species would be unable to avoid oil spills and could be killed. Since weathering would be greatly reduced by ice cover, prey species could continue to be harmed or killed as they drift into the trapped oil. As a result, these prey species could be subjected to short-term, localized reductions.

Conclusion

Fishes could be disturbed and displaced from the immediate vicinity of drilling discharges within a radius probably not to exceed 100 m. Displacement of demersal fishes likely would be limited to only the short time periods that discharges are being released. Offshore construction also could temporarily disturb and/or displace fishes near the construction activity. Any disturbance or displacement is expected to be short-term (hours to days) and limited to only the time of construction activity and shortly thereafter. Although seismic surveys may kill or injure eggs and fry of some fishes, this injury is limited to within 1 or 2 m from the airgun-discharge ports. Thus, seismic surveys probably would have no appreciable adverse effects on fish stocks in the vicinity of the North Aleutian Basin Planning Area. Seismic surveys are not expected to have adverse effects on populations or distributions of shellfish.

Adult salmon and adult Pacific herring would probably not be greatly affected by an oil spill in open-water areas. Oiled intertidal areas could lead to considerable mortality of eggs and juvenile stages of some pelagic species in the affected areas, and studies indicate that impacted eggs and juvenile stages could lead to reduced adult survival. Eggs, larvae, or fry of some bentho-pelagic and demersal fishes and some shellfishes could experience lethal and sublethal effects from oil contact. Although several small spills or a single large spill could cause localized declines in the abundance of some fishes or shellfishes inhabiting the North Aleutian Basin, it is anticipated that there would be no long-term effects on overall populations in the area.

For the North Aleutian Basin Planning Area, the MMS will participate in EFH consultations with NMFS at the individual project levels. Assuming compliance with the results of these processes, most impacts to EFH from routine activities under the proposed action will be avoided. The magnitude of impacts would also be limited, in part, by specific permit requirements that would be determined during site-specific analyses conducted for particular lease sales. Accidental oil spills could impact EFH and the species that depend upon them. Although it is not possible to predict the precise degree of potential effects, contact with some EFH resources from an oil spill would probably be unavoidable. The nature of the impact would be largely dependent on the size of the spill, its location, environmental factors, and uniqueness of the affected EFH. Large spills that reach coastal streams and intertidal areas used for spawning by anadromous salmon could have more persistent impacts and require remediation.

(3) South Alaska Subregion

Fish resources (i.e., pelagic fish, groundfish, and shellfish) in the lower Cook Inlet Planning Area are described in Section III.B.9.c. In this section, potential impacts to fish and shellfish populations in the vicinity of Cook Inlet from routine exploration and development operations and from accidental spills are described. Because of the connection with adjacent marine areas, this evaluation also considers the potential for effects on fish populations in the overall Gulf of Alaska.

The EFH resources could be impacted as a result of conducting routine activities (e.g., disturbance of offshore and coastal sediments during placement of drilling units, exploratory drilling and discharges, installation of pipelines, and seismic surveys) and by accidental oil spills. Appendix E describes the legal requirements regarding EFH. Because of the connection with adjacent marine areas, this evaluation also considers the potential for effects on EFH resources in the overall Gulf of Alaska.

As described in Section III.B.9.c, the Cook Inlet Planning Area contains EFH for a variety of fish and invertebrate species that can be broadly categorized into three groups based upon the relevant fishery management plans (FMP's): Gulf of Alaska groundfish, Alaska salmon, and Alaska weathervane scallop. As identified in the appropriate FMP's, the EFH includes streams, lakes, ponds, wetlands, and other water bodies, including marine and coastal waters, current or historically accessible to the species within these groups. Consequently, activities that degrade these aquatic habitats could adversely affect EFH for one or more species. For the purposes of this analysis, potential impacts to EFH resources in the Cook Inlet Planning Area and adjacent waters are generally addressed. In the event that oil and gas lease sales occur in Cook Inlet during the 2007-2012 Leasing Program, more detailed EFH assessments would be conducted to address potential adverse effects to EFH resources at a more site-specific level. Overall, potential site-specific impacts to EFH resources in Cook Inlet would be expected to be similar to those previously described for two earlier oil and gas lease sales in the Cook Inlet Planning Area (MMS, 2003b).

Routine Operations

Fish Resources: Routine activities that could affect fish resources in the Cook Inlet Planning Area or the surrounding portions of the Gulf of Alaska include seismic surveying, drilling of wells, offshore and onshore construction activities (e.g., installation of platforms or pipelines), and releases of permitted operational discharges (Table IV-2). It is anticipated that no OCS facilities in Cook Inlet would be decommissioned during the period covered by the analyses.

Seismic surveys would be conducted in Cook Inlet as part of oil and gas exploration and development activities; it is assumed that airguns would be the type of device used for these surveys. Studies have indicated that seismic surveys can affect at least some fish species in various ways. A comprehensive review of the potential effects of seismic surveys on fish and invertebrates is presented by Thomson and Davis (2001).

All fish species in the Cook Inlet Planning Area are presumed to be able to detect, with varying degrees of sensitivity, the frequency range of sounds produced by exploration, development, and production activities. These sounds have a potential to mask the sounds normally used by some fishes for communication or foraging. Continuous, long-term exposure to high-pressure sound waves has been shown to cause damage to the hair cells of the ears of some fishes under some circumstances (Popper, 2003). Although the indirect impacts of noise exposure on the fecundity and survival of fishes are not certain, fishes with impaired hearing may have reduced survival if the ability to locate prey, avoid predators, or communicate with other fishes is affected (Popper, 2003). Due to attenuation of the associated pressure waves, the probability of hearing impairment decreases as the distance between a fish and the noise source increases (Thomson and Davis, 2001), and movements to avoid areas with intense sound sources could allow fish to avoid damage to hearing structures under natural conditions (Popper, 2003). Loud sounds could cause fishes near a sound source to change their behavior (Pearson et al., 1992), and resulting movements by some species to avoid areas with excessive levels of noise could temporarily alter the distribution of fish within the planning area. Catchability of some fish species could also be affected by seismic survey activities, although the duration of such effects is not clear (Skalski et al., 1992). This analysis assumes that adult and juvenile fishes within 1-2 m of the airgun discharge ports would incur hearing damage and that larvae and eggs within the same distance would be killed.

It is estimated that a site-specific seismic survey would cover an area of approximately 23 km^2 around the location selected for each platform (MMS, 2003b). If an exploration well emanating from a platform was selected for production, it is further assumed that a more detailed seismic survey could be subsequently conducted in a 23- km^2 area surrounding the platform location. Because up to 2 new OCS platforms could be placed in Cook Inlet, it is assumed that a total area of 46 km^2 could be subjected to seismic surveys during the 2007-2012 Leasing Program, which represents approximately 0.15 percent of the total area of the Cook Inlet Planning Area. Each seismic survey would take between 14 and 35 days to complete (not necessarily on concurrent days). Such surveys are typically conducted during the late summer and early fall seasons in order to allow surveys to take place during the ice-free period while minimizing conflicts with other users of Cook Inlet (MMS, 2003b).

Seismic surveys could temporarily displace fishes from the immediate area where airguns are in use. However, fishes displaced due to avoidance behaviors are likely to return to surveyed areas within relatively short periods following cessation of survey activities (Thomson and Davis, 2001). Fishes of any life stage in close proximity (1 to 2 m) to airgun arrays during seismic surveys could suffer injuries that reduce individual fitness or survival. However, it is anticipated that the number of fish contained in the volume of water where such injuries could occur would not represent a large proportion of most fish populations present in Cook Inlet or the Gulf of Alaska. Species that are rare or locally concentrated could be more greatly affected if timing and location of seismic surveys coincided with locations of population concentrations for those species. Juvenile and adult fishes located more distant from the towed airgun arrays may exhibit temporary behavioral responses during seismic surveys, but it is anticipated that population-level effects would not result from these behavioral changes. Eggs and fry of most fish species are believed to be widely distributed in Cook Inlet, and it is anticipated that most adult and juvenile fishes would move away from the immediate vicinity of airgun arrays. Given that fish within an area of approximately 46 km^2 could be affected by seismic surveys expected to occur during the 2007-2012 Program and that each survey would last for 14-35 days dispersed over several years, permanent population-level effects on fishes in Cook Inlet or the Gulf of Alaska from seismic surveys would not be expected.

In addition to noise from seismic surveys, there would also be noise generated by other routine activities during exploration, development and production (Table IV-2). Sound sources include drilling noises, construction of platforms and pipelines, and boat traffic associated with OCS activities. Up to 10 exploration wells and up to 100 production wells could be drilled, which could temporarily cause some fish to move away from the immediate areas of activity. Up to 125 miles of new offshore pipeline could be placed in Cook Inlet, and noise associated with construction could also temporarily disturb or displace individual fish. In addition, 1-3 vessel trips per week would occur as part of exploration, development and production activities. This would represent a small increase in overall vessel traffic in Cook Inlet. Although the noise associated with such vessel trips could temporarily disturb or displace fishes from areas of activity, the duration of such effects would be short-lived. The noise associated with these activities would not be expected to cause population-level effects on fish species found in Cook Inlet.

Drilling discharges could affect benthic organisms in localized areas surrounding drilling sites, although the fluid components of drilling discharges are diluted rapidly following release. It is assumed that approximately 522 tons of drill cuttings would be released to the environment for each exploration well constructed (Table IV-2). Up to 10 exploration wells are anticipated, which could result in the release of up to 5,200 tons of cuttings. Although such releases could result in localized increases in sediment load and deposition, this amount of sediment is small compared the more than 44 million tons of suspended sediment carried annually into Cook Inlet by runoff from area rivers (Brabets et al., 1999). Cook Inlet waters are naturally high in suspended sediments and analyses conducted for pipeline construction for previous lease sales indicated that turbidity from pipeline construction was expected to be within the natural range of turbidities from silt-laden rivers of Cook Inlet (MMS, 2003b).

Under the most recent general NPDES permit for Cook Inlet oil and gas discharges (USEPA, 1999b), only drill cuttings with negligible toxicity are allowed to be discharged. It is anticipated that all produced waters, drilling muds, and cuttings that result from development of production wells would be reinjected into existing wells. Consequently, drilling muds and cuttings would not be released from the estimated 100 production wells that could be developed.

Section 403(c) of the Federal Water Pollution Control Act (Clean Water Act) regulations requires that initial dilution of discharges in OCS waters must occur within a 100-m radius from the discharge location. Because the waters of Cook Inlet generally are vertically well mixed and strongly influenced by the tidal cycle, dilution of drilling discharges would be expected to occur over an even shorter distance. In addition, the concentrations of contaminants in these releases are considered to be of negligible toxicity to juvenile and adult fishes based upon USEPA standards. Consequently, it is considered unlikely that juvenile and adult fishes would be exposed to concentrations of contaminants that are acutely toxic as a result of permitted discharges from OCS activities. Juvenile and adult fishes occurring within the mixing zone could be exposed to concentrations that elicit sublethal effects (e.g., reduced growth rates) if exposed for extended periods of time. Given the small area affected (compared to the overall area of similar habitat that would be available in Cook Inlet) and the intermittent nature of such releases from discharge points, it is anticipated that such effects would be experienced only by small numbers of individuals. A study of sediment quality in depositional areas of Shelikof Strait and Cook Inlet in 1997-1998 found that the concentrations of metals and polyaromatic hydrocarbons (PAH's) in sediments (1) posed no significant risk to benthic biota or fish and (2) were not linked to oil and gas development in upper Cook Inlet or to oil from the 1989 *Exxon Valdez* oil spill (MMS, 2001e). Consequently, effects on overall subpopulations of fishes in Cook Inlet or populations of fishes in the Gulf of Alaska from permitted discharges would not be expected.

Eggs, fry, and small prey occurring in or entering the mixing zone during discharge of muds and cuttings may experience lethal and sublethal effects if they are within 1-2 m of the discharge point and if the volumes of muds and cuttings are released at the rates permitted by the USEPA (500-1,00 bbl per hour, depending on water depth). Such lethal and sublethal effects most likely would result from physical damage or from smothering due to the bulk constituents comprising muds and cuttings. Only very small numbers of eggs, larvae, or prey are believed susceptible to such close exposure, due to the limited periods of high discharge rates and the low number of exploratory wells anticipated (up to 10 wells). Assuming a relatively widespread distribution of eggs, larvae, and prey in Cook Inlet, only a very small increase in mortality rates would be expected. Consequently, this source of mortality to eggs, larvae, and prey would not alter the population dynamics of fisheries resources in Cook Inlet or the Gulf of Alaska.

Sediment deposition during discharges and physical activities associated with the drilling operations could disturb and displace some fishes from the immediate area. In some cases, discharge points may be located at or near the seafloor. If demersal fishes are present at the time of discharge, they could be displaced up to 100 m (i.e., outside the allowable mixing zone) from the discharge point. Some fishes would probably return to the immediate drilling area within minutes to hours after drilling or discharging operations cease. It is anticipated that there would be no discernible effects on subpopulations of fish resources inhabiting the waters of the Cook Inlet Planning Area or on overall populations of fishes within the central Gulf of Alaska from such movements.

If it is assumed that 1.5 ha of seafloor habitat would be disturbed by construction of each platform, up to 3 ha of seafloor habitat used by demersal or bentho-pelagic fishes or benthic shellfish could be affected. Similarly, if it is assumed that construction of offshore pipelines would disturb 1.5 ha of seafloor habitat for each mile of pipeline, less than 190 ha of habitat would be disturbed by pipeline construction. After construction has been completed, some species and their prey could be positively affected by the presence of offshore structures that could provide high-relief habitat or refuge. Disturbance or displacement due to construction activities should be localized and short-term (hours to months), limited to only the construction period and shortly thereafter. Because only a limited number of individuals are like to be affected and because the disturbance would be relatively short-term, population-level effects would be unlikely for most species. There is a potential for greater effects on populations of species that are limited in distribution or rare if construction activities affected a spatially limited habitat resource needed by a particular species. Compliance with lease stipulations requiring avoidance of biological resources (including habitats) that are identified as important or unique would minimize the potential for such effects.

Onshore, up to 75 miles of oil pipeline could be constructed. While an exact route cannot be determined at this time, the pipeline route would be required to comply with various Alaska Coastal Management Program policies. As a consequence, construction activities in sensitive aquatic habitat would be minimized. Specifically, the route for onshore pipeline facilities would be sited inland from shorelines and beaches, and crossings of anadromous fish streams would be minimized and consolidated with other utility and road crossings of such streams. In addition, onshore pipelines would be designed, constructed, and maintained to minimize risk to fish habitats from a spill, pipeline break, or construction activities.

Essential Fish Habitat: Impacts of routine activities on EFH could occur as a result of disturbing offshore and coastal sediments during placement of drilling units, construction of drilling platforms, vessel traffic, exploratory drilling and discharges, seismic surveys, and installation of pipelines. See above, for discussions on potential impacts to fish resources from noise, seismic surveys, development and construction disturbances, and operational discharges.)

It is anticipated that a total area of up to 46 km^2 could be subjected to seismic surveys during the 2007-2012 Leasing Program. This represents approximately 0.15 percent of the total area of the Cook Inlet Planning Area. Each seismic survey would take between 14 and 35 days to complete (not necessarily on concurrent days). Such surveys are typically conducted during the late summer and early fall seasons in order to allow surveys to take place during the ice-free period while minimizing conflicts with other users of Cook Inlet (MMS, 2003b). While it is anticipated that there would be no permanent population-level effects on fishes in Cook inlet or the Gulf of Alaska from seismic surveys conducted, individual fishes, especially egg and larval life stages in close proximity (1-2 m) to airgun arrays during seismic surveys, could suffer injuries that reduce individual fitness or survival. Pelagic species and life stages would be more likely to be severely affected in this way because of the typical depths at which seismic arrays are towed. It is further anticipated that the number of individual fish contained in the volume of water where such injuries could occur would represent a very small proportion of similar life stages for affected species compared to overall numbers in Cook Inlet or the Gulf of Alaska. Juvenile and adult fishes located more distant from the towed airgun arrays could exhibit temporary behavioral responses during seismic surveys. It is anticipated that behavioral and distributional responses to such acoustic stimuli would be small and that these temporary effects would not persist for more than several hours after acoustic surveys are ended.

Additional sources of noise from activities, including drilling, construction of platforms and pipelines, and boat traffic, could also temporarily disturb or displace individual fish. However, as described above, the noise associated with these activities would not be expected to cause population-level effects on fish species found in Cook Inlet.

Up to 3 ha of seafloor habitat in the Cook Inlet Planning Area could be affected by construction of drilling platforms. Installation of pipelines also disturbs, suspends, and displaces bottom sediments. It is also estimated that up to 190 ha of seafloor habitat in Cook Inlet could be disturbed by new offshore pipeline installation. Sediment-disturbing activities could result in increased turbidity, which would lower the water quality of EFH in small areas for a limited amount of time. Such increases in turbidity could also cause groundfish species (e.g., rockfish, soles, flounders, sand lance) to leave the affected areas until water quality improves. However, platform placement would introduce a high-relief hard substrate that could provide habitat for some prey species, which could subsequently attract some managed species.

In addition to offshore construction, up to 75 miles of onshore pipeline construction could occur. Pipeline crossings of streams could affect EFH for several life stages of anadromous salmon, including eggs, larvae, juveniles, and adults. The Alaska Department of Game and Fish reviews plans for such construction activities for potential impacts to salmon and other fish species and requires permits to be issued before stream pipeline crossings can be installed. It is anticipated that impacts on anadromous salmon from freshwater pipeline crossings would be minimized through appropriate permitting and management actions once site-specific assessments are conducted.

Pipeline construction, especially in nearshore subtidal habitats, could damage marine plants associated with EFH by mechanically removing plants or smothering them through sedimentation. This could affect some life stages of some managed species. It is assumed that pipeline construction could directly disturb up to 190 ha of bottom area in Cook Inlet, although most of the affected areas would probably not be within vegetated habitat. Construction of platforms would permanently cover as much as 3 ha of seafloor habitat, and a small amount of additional seafloor habitat could also be temporarily affected as a result of sedimentation from these construction activities. Areas containing high densities of aquatic vegetation are typically avoided during construction activities due to a lease stipulation calling for protection of important or unique biological populations or habitats.

Discharges of drilling fluids and cuttings could temporarily increase turbidity and affect some EFH resources. Settlement of discharged cuttings on the seafloor could smother some prey species, displace some managed groundfish species, and change substrate composition in the area where the cuttings settle. Up to 5,200 tons of cuttings could be released intermittently during exploration drilling activities, assuming that up to 10 exploration wells could be drilled. While toxicity of those cuttings is expected to be low and within permitted levels, there could be localized effects on some prey species due to increased turbidity and sediment deposition, and small numbers of groundfish could be temporarily displaced. Cuttings and produced water from development of production wells would be disposed of by injection into permitted disposal wells.

Accidents

Fish Resources: Fisheries resources could become exposed to oil as a consequence of accidental oil spills. It is assumed that 1 large oil spill with a volume greater than or equal to 1,000 bbl could occur as a result of accidents at either pipelines (a volume of 4,600 bbl is assumed) or a platform (a spill volume of 1,500 bbl is assumed). In addition, it is assumed that 2 intermediate-sized spills (50-999 bbl in volume) and 10 small spills (< 50 bbl in volume) could occur (Table IV-4).

Prolonged exposure to elevated levels of petroleum hydrocarbons can be acutely toxic to fishes located a short distance from and a short time after a spill event. Oil spills in Cook Inlet could affect fish populations by causing mortality of eggs, larvae, juveniles or adults; abnormal development; impeding the access of migratory fishes (e.g., salmon) to spawning habitat; altering behaviors; displacing individuals from preferred habitat; reducing or eliminating prey populations available for consumption; impairing feeding, growth, or reproduction; causing adverse physiological responses; increasing susceptibility to predation, parasitism, diseases, or other environmental perturbations; and increasing or introducing genetic abnormalities. Effects on populations could be followed by recovery to pre-impact population levels after some period of time. Changes in the quality of large proportions of habitat required by a particular species or a change in competitive or predation pressures could result in long-term changes in the abundance of some species.

Some of the potential effects that oil spills in Cook Inlet could have on fish resources can be inferred based upon the impacts of the 1989 *Exxon Valdez* oil spill, which released approximately 257,000 bbl of oil into nearby Prince William Sound. The effects of the *Exxon Valdez* oil spill on fish and invertebrate populations have been documented by S.D. Rice et al. (1996) and other researchers. Studies conducted following the spill indicated effects from the spill on Pacific herring, pink salmon, Dolly Varden char, cutthroat trout and other aquatic biota (S.D. Rice et al., 1996). However, due to natural variability in population parameters, confounding environmental factors, differences in study design, and inconclusive results, there has not been full consensus among researchers that changes in population levels of some potentially affected species were fully attributable to effects of spilled oil (S.D. Rice et al., 2001). As of June 2003, the level of population recovery, compared to pre-spill population levels, remained unclear for Dolly Varden char, cutthroat trout, and rockfish, while pink and sockeye salmon populations were considered to have recovered (Exxon Valdez Oil Spill Trustee Council, 2003). After a record harvest in 1992 (following the *Exxon Valdez* spill), the Pacific herring population in Prince William Sound collapsed and has remained depressed, with reduced or no commercial harvest allowed since then. Declines in the abundance of Pacific herring in Prince William Sound have been attributed, in part, to increased mortality from viral disease and fungus.

Evidence indicates that the majority of adult pelagic fish can likely detect and avoid heavily-oiled waters in the open sea, thereby avoiding acute effects (Patin, 1999). Conversely, it is anticipated that pelagic eggs and larval stages of fish, whose movements are largely controlled by water currents, would be killed if they came into contact with surface oil spills (Patin, 1999). The potential effects of oil spills on pelagic fishes in the Gulf of Alaska are best known for salmon and Pacific herring. Adult salmon in open waters are believed to be able to detect and avoid hydrocarbons in the water. Adult salmon are apparently relatively unaffected by oil spills and are able to return to natal streams and hatcheries even under very large oil-spill conditions, as evidenced by the return of pink and sockeye salmon to Prince William Sound and sockeye salmon to Cook Inlet during and after the *Exxon Valdez* oil spill, and by studies with chinook (Brannon et al., 1986) and coho salmon (Nakatani and Nevissi, 1991).

Spilled oil may persist for years in intertidal areas and could represent a persistent source of exposure for some aquatic organisms. Because of their long incubation period in intertidal gravel and because salmon embryos have a large lipid-rich yolk that can accumulate hydrocarbons from low-level exposures, salmon embryos are vulnerable to contamination from oil spills that reach intertidal areas (Heintz et al., 1999). Pink salmon embryos in oiled intertidal stream areas of Prince William Sound continued to show higher mortality than those in nonoiled stream areas through 1993 (over 4 years after the oil spill), but appeared to recover in 1994 (Bue et al., 1998).

The *Exxon Valdez* oil spill occurred a few weeks before Pacific herring spawned in Prince William Sound. Adult herring returning to spawn in Prince William Sound in 1989 appeared to be relatively unaffected by the spill and successfully left one of the largest egg depositions since the early 1970’s. About half of the egg biomass was deposited within the oil trajectory, and an estimated 40-50 percent sustained oil exposure during early development (Brown et al. 1996). McGurk and Brown (1996) tested the instantaneous daily rates of egg-larval mortality of Pacific herring at oiled and nonoiled sites and found that mean egg-larval mortality in the oiled areas was twice as great as in the nonoiled areas and that larval growth rates were about 50 percent less than growth rates measured in populations from other areas of the North Pacific Ocean. Brown et al. (1996) estimated that oiled areas produced only 0.016×10^9 pelagic larvae compared with 11.82×10^9 from nonoiled areas.

The Pacific herring stock of Prince William Sound is still classified as “not recovered” from the *Exxon Valdez* oil spill (Exxon Valdez Oil Spill Trustee Council 2003). Herring populations are dominated by occasional, very strong year classes that are recruited into the overall population. The harvest has been highly variable in recent years, with all-time record harvests in 1991-1992 and complete fishery closures in 1994-1996. The stock collapsed in 1993 following an outbreak of viral hemorrhagic septicemia, and the fishery has been sporadic ever since (Sharp et al., 1996).

The principal demersal fishes in the Cook Inlet area include Pacific halibut, a number of other flatfishes, and rockfishes that inhabit benthic areas over much of the Cook Inlet Planning Area.

Bentho-pelagic species, including pollock, sablefish, Pacific cod, eulachon, and Pacific sand lance, are species that can inhabit benthic habitats or pelagic waters at different times. For example, Pacific sand lance are typically located in the water column during the day, but bury themselves in bottom sediments at night.

While most demersal and bentho-pelagic fish would probably not be harmed by spilled oil at the surface, individuals in coastal shallow waters with slow water exchange could be injured or killed if they are unable to escape contact with oiled areas due to geographic barriers or habitat requirements. In addition, some fish in deeper waters could be affected by oil from pipeline spills before it is able to rise to the surface. Spills that reach nearshore areas could contaminate sediments, potentially resulting in chronic effects on the growth and health of some fish species juveniles, such as juvenile flatfishes, that utilize such areas (Moles and Norcross, 1998). Recruitment of juveniles to adult-age classes could be affected if slower growth resulted in increased susceptibility to predation.

Oil spills within the Cook Inlet region also have the potential to adversely impact shellfishes. Sessile shellfish in nearshore waters, such as the bivalves, are susceptible to smothering by heavy oiling in addition to protracted exposures from spills. Carls et al. (2001) monitored the persistence and weathering of *Exxon Valdez* oil in intertidal mussel beds in Prince William Sound and along the Gulf of Alaska from 1992-1995. They found that hydrocarbon concentrations declined significantly with time in some, but not all, mussels and sediments, and estimated up to three decades for concentrations to reach background levels in some beds. Motile shellfish such as shrimp and crabs could also be susceptible to lethal and sublethal effects from spilled oil. Moles and Stone (2002) found that red king crabs avoided sediments containing 500-800 micrograms per gram total hydrocarbons, while lower concentrations did not result in avoidance. Lack of avoidance from areas containing low concentrations could lead to long-term exposure to contaminated sediments that could elicit chronic effects (Moles and Stone, 2002).

While adult pelagic fishes are believed to avoid oil slicks, a large spill could adversely impact hundreds of millions of eggs and juvenile stages of pelagic species, including those of anadromous fishes that spawn upstream in tributaries of Cook Inlet. These immature fishes could suffer mortality and sublethal effects that reduce individual fitness, fecundity, and survival. A large oil spill during the summer or autumn seasons could have the greatest potential to affect pelagic fishes, because this is when many pelagic migratory fishes are most abundant and when the greatest densities of eggs and juvenile stages are present in the Cook Inlet Planning Area. An oil-spill risk analysis conducted for two lease sales in the Cook Inlet Planning Area (MMS, 2002g) indicated that a 4,600-bbbl spill in lower Cook Inlet during summer months could spread over a discontinuous area of approximately 56 km^2 after 3 days, 265 km^2 after 10 days, and up to 1,100 km^2 after 30 days.

Spilled oil impacting nearshore and intertidal areas would likely result in the greatest impacts to fisheries resources. An oil-spill trajectory model used for an oil-spill risk analysis for two specific lease sales in Cook Inlet predicted that the majority of nearby coastal regions had less than a 20-percent chance of being contacted by oil within 30 days should a 4,600-bbl oil spill occur. The greatest predicted likelihood of spilled oil contacting identified sensitive coastal beaches and intertidal areas within that period was a 2-percent chance for the upper Shelikof Strait and Kamishak Bay (MMS, 2002g).

A large oil spill and/or multiple smaller spills could result in a decline in local abundances of pelagic fish stocks or subpopulations, potentially requiring multiple generations for the impacted stock or subpopulation to recover to its former status. Some stocks are already in decline due to non-OCS anthropogenic and natural impact-producing factors (e.g., commercial fisheries, climatic shifts).

However, because pelagic species of fishes in Cook Inlet are relatively abundant and widely distributed in waters across much of the central Gulf of Alaska, even a large oil spill (up to 4,600 bbl) is not likely to cause a significant impact to an overall fisheries resource population inhabiting the central Gulf of Alaska (i.e., South Alaskan Peninsula, Kodiak Archipelago, Shelikof Strait, Cook Inlet, and Prince William Sound regions).

Bentho-pelagic and demersal fishes and benthic shellfishes could also be exposed to oil spills. Species that use intertidal and nearshore habitats during their life history are most vulnerable to exposure that could result in lethal and sublethal effects to stocks and subpopulations within affected areas. Some bentho-pelagic and demersal finfishes and shellfishes produce large amounts of pelagic eggs and larvae that may die or incur sublethal effects if exposed in pelagic habitats. Because little is known regarding the fecundity of many bentho-pelagic and demersal finfishes, it is difficult to assess the potential impacts of egg and larval mortality from a large oil spill. Developing eggs and juvenile stages could suffer sublethal effects that reduce individual fitness, fecundity, and survival. Species only using waters deeper than 50 m or more are assumed to be primarily at risk in the event of a pipeline spill at depth, the effects of which are poorly studied. In each oil-spill case, the magnitude of lethal and sublethal effects would depend on seasonal timing and environmental factors influencing the concentration and distribution of oil in the waters of Cook Inlet and beyond. Pacific sand lance spawn in late September and October, depositing eggs in intertidal waters just below the waterline. Consequently, the greatest impact to Pacific sand lance would occur if a large spill was to occur in autumn and subsequently reached spawning sites or nursery areas. Oil-spill impacts to stocks or subpopulations of walleye pollock or Pacific sand lance could have consequences to higher vertebrate predators because these fishes are among the most important forage fishes in the central Gulf of Alaska. Although frequent small spills, or one or more spills exceeding 1,500 bbl in volume, could occur in Cook Inlet, such spills are considered unlikely to result in a significant impact to an overall fish population inhabiting the central Gulf of Alaska. However, depending upon specific conditions (e.g., volume, timing, and location), a large spill could potentially affect local subpopulation or stocks of some demersal or bentho-pelagic fish species for one or more generations.

Essential Fish Habitat: Depending upon the timing, location, and magnitude of an oil spill, EFH for eggs and larvae, juveniles, or adult salmon and other fish species could be affected throughout Cook Inlet. The potential for severe impacts from accidents would be greatest from oil washed inshore into wetlands, intertidal zones, and shorelines. Such areas provide food and nursery habitat for anadromous salmon and other pelagic and groundfish species. Spilled oil reaching wetland habitat could kill vegetation and associated invertebrates and small fish that are prey species, thereby adversely affecting EFH. Spilled oil concentrated along the coastline at the mouths of streams or rivers may disrupt migration patterns for some species, such as eulachon or salmon, by causing fish to avoid contaminated areas. Oil in intertidal areas could contaminate sediments, where it could continue to affect survival and development of eggs for anadromous salmon for a number of years. Depending upon the timing and severity of an oil spill, adult fish migrating from marine waters to freshwater to spawn and juvenile salmon migrating seaward from rivers or streams, could be harmed by high concentrations of oil-related contaminants.

Although not common within the Cook Inlet Planning Area (MMS, 2003b), kelp and other marine plants are a component of salmon and groundfish EFH because they provide food and shelter for various life stages of a variety of potential prey, especially in nearshore subtidal areas. Spilled oil could smother kelp and other marine plants that grow towards the surface, reducing habitat and substrate for potential prey of salmon and groundfish juveniles and adults. In some cases, toxic fractions (e.g., PAH's) of spilled oil could also reach freshwater areas where salmon eggs are deposited in stream bottoms. Contamination persisted in some freshwater benthic habitats for at least 4 years following the *Exxon Valdez* oil spill (Murphy et al., 1999). An oil spill trajectory model used for an oil spill risk analysis for two specific lease sales in Cook Inlet predicted that the majority of nearby coastal regions had less than a 20-percent chance of being contacted by oil within 30 days should a large oil spill occur (MMS, 2002g). The greatest predicted likelihood of spilled oil contacting identified sensitive coastal beaches and intertidal areas was a 2-percent chance for the upper Shelikof Strait and Kamishak Bay.

Wave and wind action, weathering, and biological degradation would dissipate spilled oil in the surface water, and EFH resources would likely recover after some period of time. The period of time needed to reestablish appropriate EFH conditions following a spill would depend upon the characteristics of the individual spill and would be related to many factors, including the location of the spill, the nature of transporting currents, the magnitude of the spill, and the chemical characteristics of the spilled oil. As evidenced by effects of the *Exxon Valdez* oil spill, recovery of some EFH resources could occur within less than a year, while other resources could continue to be affected at some level for ten years or more. However, even the quantity of oil assumed for large spills (4,600 bbl from a pipeline spill; 1,500 bbl from a platform spill) are considerably less than the 257,000 bbl released to Prince William Sound during the *Exxon Valdez* oil spill. It is, therefore, anticipated that potential effects of the assumed spills on EFH resources would be considerably smaller than effects observed following the *Exxon Valdez* accident.

Oil spilled under ice is more difficult to locate and clean than surface spills. While most of the waters within the Cook Inlet Planning Area remain open throughout the winter, ice could be transported under ice cover in surrounding areas as a result of currents. Adult salmon in Cook Inlet would likely avoid oil spills by temporarily moving to other areas. However, pelagic eggs and larvae and some organisms that serve as potential prey for salmon would be unable to avoid oil spills and could be killed. Since weathering would be greatly reduced by ice cover, prey species could continue to be harmed or killed as they drift into the trapped oil. These prey species could be subjected to short-term, localized reductions as a result.

Conclusion

Fishes could be disturbed and displaced from the immediate vicinity of drilling discharges within a radius probably not to exceed 100 m. Displacement of demersal fishes very likely would be limited to only the short time periods of the discharge. Offshore construction also could temporarily disturb and/or displace fishes proximate to the construction activity. Any disturbance or displacement is expected to be short-term (hours to days) and limited to only the time of construction activity and shortly thereafter. Although seismic surveys may kill or injure eggs and fry of some fishes, this injury is limited to within 1 or 2 m from the airgun-discharge ports. Thus, seismic surveys probably would have no appreciable adverse effects on fish subpopulations.

Adult salmon and adult Pacific herring would probably not be greatly affected by an oil spill in open-water areas. Oiled intertidal areas could lead to considerable mortality of eggs and juvenile stages of some pelagic species in the affected areas, and studies indicate that impacted eggs and juvenile stages could lead to reduced adult survival. Eggs and fry of some bentho-pelagic and demersal fishes could experience lethal and sublethal effects from oil contact. Although multiple small spills or a single large spill could cause declines of subpopulations of multiple species inhabiting the Cook Inlet Planning Area, it is anticipated that there would be no long-term effects on overall fish populations in the central Gulf of Alaska.

For the Alaska OCS planning areas, MMS will participate in EFH consultations with NMFS at the individual project levels. Assuming compliance with the results of these processes, most impacts to EFH from routine activities under the proposal will be avoided. The magnitude of impacts would also be limited, in part, by specific permit requirements and would have to be determined during site-specific analyses conducted for particular lease sales. Accidental oil spills could impact EFH and the species that depend upon them. Although it is not possible to predict the precise degree of potential effects, contact with EFH resources from an oil spill would probably be unavoidable. The nature of the impact would be largely dependent on the size of spill, location, environmental factors, and uniqueness of the affected EFH. Large spills that reach coastal streams and intertidal areas used for spawning by anadromous salmon could have more persistent impacts and require remediation.

g. Coastal Habitats

(1) Arctic Subregion

Routine Operations

Coastal Barrier Beaches: The potential effects on coastal barrier beaches from routine operations would primarily be associated with direct impacts from ground-disturbing activities during pipeline construction and indirect effects from vessel traffic.

Up to three new pipeline landfalls might be constructed in the Arctic Subregion. Because barrier islands occur along much of the Bering Sea and Chukchi Sea coastline, barrier beaches and dunes may be affected by pipeline construction at landfalls. Pipeline construction may also impact sand beaches and dunes along lagoon shorelines and on the margins of lakes and rivers on the ACP. Trenching and excavation for pipeline installation could disturb beaches and dunes, as well as barrier island tundra habitats, resulting in direct habitat losses. Pipeline landfalls may require the construction of short gravel causeways, displacing beach or dune habitat. Coastal currents and water salinity near causeways may be altered, resulting in localized changes in invertebrate communities.

Arctic coastal habitats are exposed to strong wave and sea ice action, and the shoreline is generally unstable and prone to erosion (MMS, 2002b; Viereck et al., 1992; Macdonald, 1977). In addition to direct impacts from excavation, erosion of sand beaches and dunes and peat shores could be promoted adjacent to pipelines and along the excavation trench. Stabilization of dune margins could be difficult, and establishment of vegetation cover might be slow, possibly resulting in prolonged losses of dune habitat near pipeline routes.

Sand beach infauna and epifauna may be indirectly impacted by trenching for pipeline construction. Excavated sediments may cover areas adjacent to the trench. The area disturbed along the pipeline trench may extend 9 m to each side (MMS, 2002c). Sand beach fauna could also be impacted by sedimentation resulting from increased turbidity during trench excavation and backfilling. Intertidal benthic fauna populations would be expected to recover within 3 years of construction (MMS, 2003a). Impacts could be reduced by implementing measures to restrict the dispersal of sediments.

Under the proposed action, one new shore base, as well as one dock or causeway for service vessels, would be constructed along the arctic coast. Barrier beach and dune habitat could be lost as a result of shore base and dock or causeway construction if the facility is located on the shoreline where beach or dune habitat occurs. In addition, sand beach fauna may be indirectly impacted by sedimentation and turbidity from disturbance of bottom sediments during construction.

Service vessel traffic to exploration and production wells and barge traffic in support of shore bases, could contribute to erosion along barrier beaches. Under the proposed action, up to three vessel trips per week would be made to each of the up to 10 new platforms in the Arctic Subregion. Increases in wave activity from vessel traffic could contribute to the removal of sediments along barrier beaches. Wave activity could be minimized by maintaining reduced vessel speeds in the vicinity of barrier islands.

Wetlands: The potential effects on wetlands from routine operations would primarily be associated with direct impacts from ground-disturbing activities during construction of pipelines, pipeline landfalls, pipeline yards, facilities, and road construction, as well as the indirect impacts from decreased water and air quality, altered hydrology, and facility maintenance. Wetland losses could result in the localized reduction or loss of wetland functions, such as fish and wildlife habitat, attenuation of flooding and shoreline erosion, and removal of substances that reduce water quality. Avoidance of wetlands during site selection for facilities might be difficult on the ACP due to the high density of wetlands.

The construction of pipelines through coastal wetlands would result in direct wetland losses due to excavation for pipeline emplacement. Wetlands such as coastal marshes and inundated lowland tundra, which occur along much of the Bering Sea and Chukchi Sea coastlines, may be affected by pipeline construction at landfalls. Pipeline construction may also impact marshes along lagoon shorelines and within lakes and ponds on the ACP. Where pipeline segments are buried, such as in the intertidal zone, trenching and excavation for pipeline installation would disturb coastal wetlands, resulting in direct habitat losses. In addition, excavated sediments may cover adjacent areas. Wetland substrate infauna and epifauna could also be impacted by sedimentation resulting from increased turbidity during trench excavation and backfilling. Invertebrate populations would be expected to recover within 3 years of construction (MMS, 2003a). Pipeline landfalls may also require the construction of short gravel causeways, potentially displacing marsh or other coastal wetland habitats, or a landfall gravel pad, potentially displacing tundra wetland habitats. Because arctic coastal habitats are exposed to strong wave and sea ice action, the erosion of disturbed substrates could occur adjacent to pipeline landfalls or along the excavation trench. However, use of appropriate construction methods for coastal protection would minimize increases in erosion (MMS, 2003b).

Pipeline construction would also occur on the ACP. Up to 200 miles of pipeline would be constructed onshore to transport oil from the Chukchi Sea and Beaufort sea to existing North Slope pipelines. A pipeline from the Chukchi Sea to the TAPS may also cross the arctic foothills. A number of wetland types, including wet or moist tundra habitat, lakes, ponds, or marshes could be impacted by pipeline construction. Construction of a pipeline gravel workpad (service roadway), haul road, and access roads would replace wetland habitat with unvegetated surfaces or with upland habitat having few species in common with nearby undisturbed habitats. Because of the high density of wetlands on the coastal plain, as well as those of the foothills, extensive areas of wetland habitat would be expected to be lost, as occurred during the construction of the TAPS (Pamplin, 1979, BLM, 2002). Construction of buried pipeline segments would impact similar amounts of wetland habitat as would be impacted by a workpad. However, construction of aboveground pipeline segments without a workpad would result in the loss of only small areas of wetland habitat at the locations of the vertical support members. Wetland areas may also be disturbed by the establishment of work camps. Additional impacts of construction could include altered hydrology from changes in surface drainage patterns or isolation of wetland areas from water sources, such as from blocking natural surface flows. Wetland impacts associated with degraded water quality could include sedimentation and turbidity, and introduction of contaminants in stormwater runoff. Resulting changes in affected wetlands could include a reduction in biodiversity, replacement of one wetland type for another (such as by dewatering or ponding), conversion to upland communities, or conversion of vegetated wetlands to open water. Wetlands adjacent to a gravel workpad would be indirectly affected by airborne dust. Impacts may include reduced growth and density of vegetation and changes in community composition to more tolerant species. Additional wetland habitat may be lost through thermokarst associated with new impoundments and heavy dust accumulations (BLM, 2002).

The construction of new facilities would also likely result in the direct loss of wetlands from the placement of fill material during construction, as well as the construction of access roads and transmission corridors. Under the proposed action, one new shore base, including a dock for service vessels, would be constructed along the Arctic coast. Wetland habitat could be lost as a result of shore base and dock construction if the facility is located on the shoreline where wetland habitat occurs. Short docks are unlikely to result in adverse hydrologic conditions (such as water circulation changes, or temperature and salinity discontinuities) that could affect lower trophic-level organisms (MMS, 2003a). In addition, one to two new processing facilities could be constructed in the Arctic Subregion, and may average about 45 acres in size. Therefore, up to about 90 acres of habitat, a portion of which would likely include wetlands, could be permanently disturbed by the construction of two processing facilities. In addition, depending on the proximity of the new shore base or processing facilities to existing North Slope infrastructure, one or more new access roads could be needed for each new facility.

Additional wetland habitat could be disturbed by other forms of infrastructure such as employee camps, airstrips, and power stations. The construction of these facilities could permanently eliminate wetland habitat within the immediate footprints of the facilities. While this wetland loss would be long term, the areas disturbed represent an extremely small portion of habitat that occurs on the ACP adjacent to the Arctic Subregion. Impacts to wetlands from construction could be minimized by maintaining buffers around lakes and ponds and by the use of best management practices for erosion and sedimentation control.

The impacts of the construction of roads and facilities on the North Slope are often reduced by the restriction of construction activities to the winter months when the ground is frozen, and the use of ice roads rather than gravel roads. Although ice roads avoid the permanent loss of habitat associated with gravel roads, delayed melting in spring may affect vegetation communities. Tundra communities generally recover from such effects, however, within several years (MMS, 2002b, 2003a).

Large amounts of gravel may be required for pipeline construction, road construction, or for the construction of gravel pads for new facilities. On the North Slope, gravel is often extracted from the floodplains of large rivers (Pamplin, 1979; BLM, 2002). The excavation of gravel from these material sites may impact wetland communities on river floodplains. Extensive wetland areas may be destroyed by gravel excavation.

Additional factors, such as reduced air quality, might also impact wetlands near new facilities. Exhaust emissions, such as from construction equipment or pump stations, atmospheric releases from processing facilities, or fugitive dust generated from exposed soils or roadways could have adverse effects on nearby wetland communities. Contaminants from land storage or disposal sites could be present in water runoff that flows into wetlands. Contaminants might also be released to surface waters in service vessel discharges, and might subsequently affect wetlands. Impacts to wetlands could be minimized by the implementation of practices to minimize air quality and water quality impacts.

Accidents

Coastal Barrier Beaches: The potential effects on coastal barrier beaches and dunes from accidents would primarily be associated with impacts from spills of oil and other petroleum hydrocarbons, such as fuel oil or diesel fuel, and subsequent cleanup efforts. Oil or other spilled materials might be transported to barrier island beaches, coastal beaches, or lagoon beaches by currents or tides. Because all offshore activities would occur in relatively shallow water (up to 61 m deep), contamination of beaches from platform spills as well as pipeline or vessel spills could occur. Beach habitat could be impacted by oil spills, and the direct mortality of biota could result. Although beach and foredune areas are often sparsely vegetated, impacts to vegetation might occur if oil was carried to higher elevations by storm waves and tides.

Spilled oil that becomes stranded on beaches might occur only on the surface, or it could penetrate into subsurface layers. Permeable substrates, generally associated with larger sand grain sizes, and holes created by infauna could increase oil penetration, especially that of light oils and petroleum products. Penetration into coarse-grained sand beaches may be up to 25 cm (NOAA, 1994b, 2000). Light oils may penetrate peat shores; however, peat resists penetration by heavy oils (NOAA, 2000).

Although any residual oil that could remain following cleanup might be largely removed in highly exposed locations through wave action, oil could remain in the shallow subsurface for extended periods of time. In some locations, oil might become buried by new sand deposition. Natural degradation and persistence of oil on beaches are influenced by the type of oil spilled, amount present, sand grain size, degree of penetration into the subsurface, exposure to weathering action of waves, and sand movement onto and off shore. Although petroleum-degrading microbial communities are present, biodegradation along arctic coastlines would likely be slow (Braddock et al., 2004) and is limited to only a few months per year. Spilled oil might persist for many years, with continued effects to infauna. On sheltered beaches, heavy oiling left for long periods could form an asphalt pavement relatively resistant to weathering (Hayes et al., 1992). Lagoon shorelines include low-energy beaches where spilled oil would likely persist for many years. Spilled oil may persist for extended periods on peat shores; however, if cleaned up, it would be expected to persist for less than a decade (Owens and Michel, 2003).

Spill cleanup operations might adversely impact beaches and dunes if the removal of contaminated substrates affects beach stability and results in accelerated shoreline erosion. Vehicular and foot traffic during cleanup could mix surface oil into the subsurface, where it would likely persist for a longer time. Manual cleanup rather than use of heavy equipment would minimize the amount of substrate removed.

Wetlands: The potential effects on wetlands from accidents would primarily be associated with impacts from spills of oil and other petroleum hydrocarbons, such as fuel oil or diesel fuel, and subsequent cleanup efforts. Oil or other spilled materials might be transported from offshore areas to coastal wetlands by currents or tides, and may result from spills involving platforms, pipelines, or service vessels. Freshwater wetlands on the ACP or arctic foothills could be affected by spills from onshore pipelines or from new facilities.

Impacts to wetlands from oil spills could result in extensive injury or mortality of vegetation and invertebrates in or on the substrate. Other effects of spills could include a change in plant community composition or the displacement of sensitive species by more tolerant species. Impacts to soil microbial communities might result in long term wetland effects, and wetland recovery would likely be slowed. Various factors influence the extent of impacts to wetlands. Impacts would depend on site-specific factors at the location and time of the spill. The degree of impacts are related to the oil type and degree of weathering, the quantity of the spill (lightly or heavily oiled substrates), duration of exposure, season, plant species, percentage of plant surface oiled, substrate type, soil moisture level, and oil penetration into the soil (Hayes et al., 1992; Hoff, 1995; NOAA, 1994b). Higher mortality and poorer recovery of vegetation generally result from spills of lighter petroleum products (such as diesel fuel), heavy deposits of oil, spills during the growing season, contact with sensitive plant species, completely oiled plants, and deep penetration of oil and accumulation in substrates. Vegetation regrowth and recovery are generally better where oil spills occur in flooded areas or on saturated soils, than on unsaturated soils (BLM, 2002). Coastal wetlands in protected areas, such as bays and lagoons, that are not exposed to strong water circulation or wave activity would be expected to retain oil longer with longer-lasting effects on biota.

Oil spill on ice or snow in winter would likely be easily cleaned up with little oil remaining; however, spills during other times may be difficult to clean up, and considerable amounts of oil may remain. Following cleanup, the spilled oil remaining degrades naturally by weathering and biodegradation by soil microbial communities. However, biodegradation would likely be slow due to generally cool temperatures and a short growing season. Full recovery of wetlands, including invertebrate communities, might require more than 10 years depending on site and spill characteristics (Hoff, 1995). Oil could remain in some wetland substrates for decades, even if it was cleaned from the surface. Heavy deposits of oil in sheltered areas of coastal wetlands or in the supratidal zone could form asphalt pavements resistant to degradation (Hoff, 1995).

Oil spilled on the ACP or arctic foothills could potentially flow into a nearby stream. Vegetation along the path of the spill would be injured or killed, including wetland vegetation along the stream. Oil reaching the arctic coastline may persist for extended periods of time and slow or reduce vegetation recovery. Wetlands in river deltas and estuaries could be impacted by oil spilled in upstream areas.

Spill cleanup actions might damage wetlands through trampling of vegetation, incorporation of oil deeper into substrates, increased erosion, and inadvertent removal of plants or sediments, all of which could have long-term effects (NOAA, 1994b, 2000; Hoff, 1995). These actions could result in plant mortality and delay or prevent recovery. Complete recovery of coastal wetlands disturbed by cleanup activities could take several decades. Effective low-impact cleanup actions could include bioremediation, low-pressure flushing, or use of chemical cleaners.

The NOAA Environmental Sensitivity Index (ESI) shoreline classification system classifies coastal habitats, on a scale of 1 to 10, according to habitat sensitivity to spilled oil, oil-spill retention, and difficulty of cleanup (NOAA, 1994b). Habitats with high ESI values are given a higher priority for protection. The ESI shoreline classification for the Beaufort Sea and Chukchi Sea coasts includes habitats with high values, such as inundated lowland tundra or salt/brackish-water marshes, both ranked 10 (MMS, 2002d, Owens and Michel, 2003).

Conclusions

Routine operations could affect coastal habitats as a result of pipeline construction, shorebase construction, vessel traffic, and infrastructure maintenance and repair activities. These activities could result in direct loss of habitat by replacing habitat with infrastructure and by damaging habitats during maintenance. These direct losses would be minimized through existing Federal and State environmental review and permitting procedures that would attempt to mitigate impacts through appropriate siting and construction requirements. Secondary impacts to wetlands could occur from water and air quality degradation and from altered drainage caused by pipeline canals, navigation channels, gravel dredging on floodplains (for causeways and offshore islands), and other onshore construction. Causeways, pipeline canals, and navigation channels could also change sediment transport patterns along the coast.

Potential impacts from spills could be expected to occur from the direct effects of oil on coastal vegetation. Killed or damaged vegetation would recover slowly, providing an opportunity for accelerated erosion during the time of weakened or reduced vegetation. Much of the arctic shoreline includes habitats that are sensitive to oil-spill impacts, such as tundra shorelines, salt and brackish marshes, and protected embayments. In these settings, oil could persist for 10 years or more during which time the oil in the soils could be slowly released back into the environment as a result of erosion or exposure of oiled sediments and soils.

While some of the impacts described above would be expected to occur as a result of activities related to the 2007-2012 Leasing Program, the impacts likely would be localized. Given the modest amount of activity assumed to occur during the 2007-2012 Program and the great extent of arctic coastal habitats, no impacts to the overall condition of coastal habitats in the Arctic Subregion are expected to occur.

(2) Bering Sea Subregion

Routine Operations

Coastal Barrier Beaches: The potential effects on coastal barrier beaches from routine operations would primarily be associated with direct impacts from ground-disturbing activities during onshore pipeline and facility construction. Indirect impacts from vessel traffic could also occur.

According to Table IV-2, up to 2 new pipeline landfalls would be constructed in the North Aleutian Basin Planning Area as a result of the proposed 5-year program. Pipelines from four to six new platforms would likely extend to the Alaska Peninsula at Herendeen Bay. Barrier islands and spits are located at Herendeen Bay, including the Kudobin Islands near the entrance to the bay, and at Deer Island also located at the entrance to the bay. Barrier beaches could be directly affected by pipeline construction; however, it is expected that barrier landforms would be avoided. Beach infauna and epifauna in Herendeen Bay or Port Moller could be indirectly impacted by sedimentation resulting from increased turbidity during trench excavation and backfilling. Impacts could be reduced by implementing measures to restrict the dispersal of sediments.

Additional coastal development includes one new shore base, as well as one dock or causeway for service vessels, constructed along the coast of the Alaska Peninsula, Unimak Island, or the northern Bristol Bay coast. Barrier beach habitat could be lost as a result of shore-base and dock or causeway construction if the facility is located on the shoreline where beach habitat occurs. In addition, beach infauna or epifauna may be indirectly impacted by sedimentation and turbidity from disturbance of bottom sediments during construction.

Service vessel traffic to exploration and production wells and barge traffic in support of a shore base could contribute to erosion along barrier beaches. Up to 3 vessel trips per week would be made to each of up to 6 new platforms in the planning area. Increases in wave activity from vessel traffic could contribute to the removal of sediments along barrier beaches. Wave activity could be minimized by maintaining reduced vessel speeds in the vicinity of barrier islands.

Coastal beaches could be affected by the construction of new marine and coastal facilities at Balboa Bay, on the south coast of the Alaska Peninsula (see Section IV.J.3.g for a discussion of impacts associated with those facilities).

Wetlands: The potential effects on wetlands from routine operations would primarily be associated with direct impacts from ground-disturbing activities during offshore and onshore construction of pipelines, pipeline landfalls, pipeline yards, facilities, and road construction, as well as the indirect impacts from decreased water and air quality, altered hydrology, and facility maintenance.

Pipeline installation would include trench excavation through intertidal and shallow subtidal areas. One or two pipelines would likely extend to the Alaska Peninsula at Port Moller and continue through Herendeen Bay to the Portage Creek Valley. Trenching and excavation for pipeline installation could directly disturb tidal mud flats, eelgrass beds, marshes, or other coastal habitats (depending on the location of the pipeline route) resulting in direct habitat losses. In addition, excavated sediments may cover adjacent wetland areas. Wetland substrate infauna and epifauna could also be indirectly impacted by sedimentation resulting from increased turbidity during trench excavation and backfilling. Impacts could be reduced by implementing measures to restrict the dispersal of sediments.

According to Table IV-2, up to 50 miles of new onshore pipelines would be constructed. These pipelines would likely extend through Portage Creek Valley and Foster Creek Valley, to Left Hand Bay of Balboa Bay. Wetlands along the pipeline route would be affected by construction. A number of freshwater wetland types, such as wet or moist tundra habitat, ponds, riparian shrub habitat, or marshes, could be directly impacted by pipeline construction. Indirect impacts of construction could include altered hydrology from changes in surface drainage patterns or isolation of wetland areas from water sources, such as from blocking natural surface flows. Wetland impacts associated with degraded water quality could include sedimentation and turbidity and introduction of contaminants into stormwater runoff. Resulting changes in affected wetlands could include a reduction in biodiversity, replacement of one wetland type for another (such as by dewatering or ponding), conversion to upland communities, or conversion of vegetated wetlands to open water. Impacts would be reduced by maintaining natural drainage patterns along the route. Wetland areas may also be disturbed by the establishment of work camps. Indirect impacts to coastal wetlands could result from sedimentation originating along the pipeline route.

The construction of new facilities could also result in the direct loss of wetlands from the placement of fill material during construction, as well as the construction of access roads and transmission corridors. One new shore base, as well as one dock or causeway for service vessels, would be constructed along the coastline (Table IV-2). Wetland habitat could be lost as a result of shore-base and dock or causeway construction if the facility is located where wetland habitat occurs. Intertidal and shallow subtidal wetlands occur along much of the Bristol Bay coastline, and freshwater wetlands are abundant on the coastal lowlands. One new processing facility and one new waste facility would also be constructed in the North Aleutian Basin Planning Area. Additional wetland habitat could be disturbed for other infrastructure such as employee camps, airstrips, and power stations. The construction of these facilities could permanently eliminate wetland habitat within their immediate footprints. Indirect effects could include habitat fragmentation, reduced infiltration and increased surface runoff, altered hydrology including increased or reduced inundation or saturation of substrates, sedimentation and turbidity, and introduction of contaminants in stormwater runoff. Impacts to local streams could affect coastal wetlands. Impacts could result in changes in plant community structure, reduction in plant biodiversity, and establishment and dominance of invasive plant species. However, activities that may potentially impact wetlands, such as facility construction, are regulated by State agencies and the U.S. Army Corps of Engineers. Standard mitigation measures would be applied to any construction project. For example, construction-related impacts could be minimized by maintaining buffers around wetlands and implementation of best management practices for erosion control.

Operation of new facilities could have local indirect effects on wetlands from reduced air or water quality. Exhaust emissions, atmospheric releases from processing facilities, or fugitive dust generated from exposed soils or roadways could have adverse effects on nearby wetland communities. Contaminants from waste storage or disposal sites could be present in stormwater runoff or migrate into groundwater that flows into wetlands. Contaminants might also be released to surface waters in service vessel discharges, and might subsequently affect wetlands. Wetland impacts could be avoided or minimized by the implementation of practices that eliminate or minimize impacts to air or water quality.

Accidents

Coastal Barrier Beaches: The potential effects on coastal barrier beaches from accidents would primarily be associated with impacts from spills of light crude oil, condensate, and other petroleum hydrocarbons (such as diesel fuel) and from subsequent cleanup efforts. Contamination of beaches from platform, pipeline, or vessel spills could occur. Spills from platforms and pipelines would likely be a mixture of condensate and light crude oil. Oil or other spilled materials might be transported to beaches on barrier landforms or coastal beaches by currents or tides. However, light crude oils and, particularly, condensate are more volatile than heavier types of crude oil. They tend to weather through evaporation more quickly and are less likely to be transported long distances.

Beach habitat could be impacted by spills that contact the shoreline, and the direct mortality of infauna and epifauna could result. Although beach habitats are often sparsely vegetated, impacts to vegetation might occur if spilled materials were carried to higher elevations by storm waves and tides. Impacts to North Aleutian Basin beach habitats and fauna from spills would be similar to those identified for the Arctic Subregion and Cook Inlet Planning Area. However, light crude oil is generally more acutely toxic than heavier oils, and condensate is more toxic than crude oils. Spilled oil that becomes stranded on beaches could penetrate into subsurface layers. Permeable substrates, generally associated with larger sand-grain sizes, and holes created by infauna could increase oil penetration, especially that of light oils and petroleum products. Penetration into coarse-grained sand beaches may be up to 25 cm (NOAA, 1994b; 2000).

Residual oil remaining after cleanup might be largely removed in highly exposed locations through wave action. However, oil could remain in the shallow subsurface for extended periods of time, particularly in sheltered areas. Oil can remain in intertidal sediments and organisms for more than a decade, persisting as a long-term source of exposure (NOAA 1997; MMS, 2003b; Short et al., 2004; Exxon Valdez Oil Spill Trustee Council, 2003). Natural degradation and the persistence of oil on beaches are influenced by a number of factors, such as the type of oil and amount present, degree of penetration into the subsurface, exposure to weathering action of waves, and sand movement onto and off the shore. In some locations, oil might become buried by new sand deposition. Natural removal of subsurface oil from gravel beaches is greatly reduced by surface armoring of boulders, as observed in Prince William Sound (NOAA, 1997). Spilled oil might persist for many years, with continued effects to fauna. On sheltered beaches, heavy oiling left for long periods could form an asphalt pavement relatively resistant to weathering (Hayes et al., 1992). Studies in Cook Inlet indicate that full recolonization of sheltered rocky shorelines may require 5 to 10 years (Highsmith et al., 2001).

Spill cleanup operations might adversely impact beaches if the removal of contaminated substrates affects beach stability and results in accelerated shoreline erosion. Vehicular and foot traffic during cleanup could mix surface oil into the subsurface, where it would likely persist for a longer time. Manual cleanup, rather than use of heavy equipment, would minimize the amount of substrate removed.

Wetlands: The potential effects on wetlands from accidents would primarily be associated with impacts from spills of light crude oil, condensate, and other petroleum hydrocarbons (such as diesel fuel) and from subsequent cleanup efforts. Spills from platforms, pipelines, or service vessels could result in contamination of wetlands, and would likely involve mixtures of condensate and light crude oil. Oil or other spilled materials might be transported to coastal wetlands by currents or tides. However, light crude oils and, particularly, condensate are more volatile than heavier types of oils. They tend to weather more quickly through evaporation and are less likely to be transported long distances. In addition, freshwater wetlands on the Alaska Peninsula could be affected by spills from onshore pipelines or new facilities.

Impacts to North Aleutian Basin wetland communities from spills would be similar to those identified for the Arctic Subregion and Cook Inlet Planning Area. Intertidal wetlands would be highly vulnerable to spills that reach the coastline, and repeated influxes of oil may contaminate wetland surfaces with each subsequent tidal cycle. Because of the wide tidal range (up to 7 m in some portions of Bristol Bay), extensive areas of shoreline habitat may be affected by a spill, especially soft-bottom habitats (sands and muds) which typically have a relatively flat topography. Oil that slumps from intertidal areas and accumulates below the low-tide line could also affect shallow subtidal habitats.

Vulnerable coastal wetlands sensitive to disturbance from spills occur around much of Bristol Bay. Highly sensitive shoreline habitats include marshes, sheltered tidal flats, and sheltered rocky shores (NOAA, 1994b). The vulnerability of intertidal habitats is generally rated as highest for vegetated wetlands and semipermeable substrates, such as mud, that are sheltered from wave energy and strong tidal currents. Oil or other hydrocarbons contacting these habitats are less likely to be removed by waves. Cleanup activities are very difficult to conduct on soft mud substrates, such as tidal flats (NOAA, 1994b; 2000). Although oil is not likely to adhere to the surface of mud flats, oil may be deposited if concentrations are high; penetration of the surface is unlikely except when entering burrows or crevices (NOAA, 2000).

Direct mortality of biota could result from spilled oil or condensate contacting intertidal wetlands. Oil readily adheres to marsh vegetation (NOAA, 1994b, 2000; Hayse et al., 1992), and effects may range from short-term reduction in photosynthesis to extensive vegetation injury or mortality. Many invertebrates are sensitive to oil exposure, and spills may result in injury or mortality of invertebrates in or on contaminated substrates. The abundance of many species of algae and invertebrates may be reduced at affected sites, as was observed following the *Exxon Valdez* oil spill (NOAA, 1997; Peterson, 2000; Exxon Valdez Oil Spill Trustee Council, 2003). In particular, both the abundance and reproductive potential of *Fucus gardneri,* a common and important brown alga species also found in Bristol Bay habitats, were reduced and have since remained unstable (Exxon Valdez Oil Spill Trustee Council, 2003). Although adult Fucus appear to have some resistance to oil toxicity, earlier life stages appear to be much more sensitive (NOAA, 1998). Impacts were less pronounced in shallow subtidal habitats, although kelp, eelgrass, and many invertebrates were adversely affected (Peterson, 2000).

Light crude oil is generally more acutely toxic to biota than heavier oils, and condensate is more toxic than crude oils. The degree of weathering of an oil spill affects the toxicity to wetland plants and fauna. The greater the time span before a spill contacts a coastal habitat, the more the lighter and more toxic components evaporate. Although the most acutely toxic components of crude oil are rapidly lost through weathering, the more persistent components have been associated with long-term pathologies such as carcenogenicity (NOAA, 1997). Greater mortality of vegetation and poorer recovery generally result from spills of lighter petroleum products (such as diesel fuel), heavy deposits of oil, spills during the active growing period of a plant species, contact with sensitive plant species, completely oiled plants, and deep penetration of oil and accumulation in substrates.

In addition to direct mortality of organisms, spilled oil or other hydrocarbons that contact coastal wetlands can cause changes in community structure and dynamics. Effects could include a change in plant community composition or a displacement of sensitive species by more tolerant species. Toxic compounds in oil can selectively remove the more sensitive organisms, such as echinoderms and some crustaceans, while organic enrichment from oil can stimulate the growth and abundance of opportunistic infaunal invertebrates, such as some polychaetes and oligochaetes (McCammon et al., 2002). Some opportunistic species, such as species of barnacle, oligochaetes, and filamentous brown algae, colonized affected shorelines following the *Exxon Valdez* oil spill and cleanup (Peterson, 2000; Exxon Valdez Oil Spill Trustee Council, 2003). Indirect effects also included the spread of *Fucus gardneri* onto lower shoreline areas in some regions, which inhibited the return of red algae (Peterson, 2000). The reduction of predators or herbivores can also result in changes in lower-trophic levels for extended periods. The adverse effects of oil on intertidal organisms, such as macroalgae, clams, and mussels, can last for more than a decade (MMS, 2003b, Exxon Valdez Oil Spill Trustee Council 2003).

Extended periods may be required for intertidal communities to fully recover from an oil spill. The degree of effects and length of recovery depend on a number of site-specific factors such as the type of oil and degree of weathering, extent and duration of exposure of biota, substrate type and moisture level, degree of substrate contamination and subsurface penetration, time of year, and species sensitivity (NOAA, 1994b, 1998; Hayse et al., 1992; Hoff, 1995). Impacts to soil microbial communities might result in long-term wetland effects, and wetland recovery would likely be slowed. Full recovery of wetlands, including invertebrate communities, may require more than 10 years (Hoff, 1995). Although studies in Prince William Sound indicate that some organisms can recover quickly, recovery in some intertidal and shallow subtidal habitats takes more than a decade (Peterson, 2000;, 2003). The effects of light crude oil or condensate will likely result in acute toxic impacts to wetland vegetation, but recovery could occur more rapidly than in areas affected by spills involving heavier crude oils that persist longer in the environment. Depending on the concentration of oil affecting a wetland area, some wetlands may never recover if the toxic effects cause plant dieback and subsequent erosion of the subsoil in the affected area occurs before revegetation can occur.

Spills may be difficult to clean up, and considerable amounts of oil may remain. Spilled oil remaining following cleanup degrades naturally by weathering and biodegradation by soil microbial communities; however, oil can remain in some wetland substrates for decades. Many protected wetlands in the North Aleutian Basin Planning Area, such as those in Izembek Lagoon and Nelson Lagoon, are less likely to be contaminated by spills than exposed wetlands because of the presence of barrier islands and spits (MMS, 1985b). However, if oil or other hydrocarbons enter these protected areas that are not exposed to strong water circulation or wave activity, they would be expected to persist longer, likely resulting in longer lasting effects on biota. Because Herendeen Bay is partially protected by Deer Island, oil spills in the bay would be expected to persist for extended periods of time. Condensate is more volatile than crude oils and evaporates more quickly and, therefore, would likely be less persistent.

Oil spilled on the Alaska Peninsula at the pipeline crossing could potentially flow into a nearby stream. Vegetation along the path of the spill would be injured or killed, including wetland vegetation along the stream. Wetlands in estuaries could be impacted by oil spilled in upstream areas.

Spill cleanup actions may also adversely affect coastal wetlands, as occurred following the *Exxon Valdez* oil spill (NOAA, 1997; McCammon et al., 2002; Exxon Valdez Oil Spill Trustee Council, 2003). The removal of organisms from affected surfaces and washing out of fine particles from substrates likely inhibited and slowed the recovery of intertidal communities in some areas. Trampling of vegetation and other biota during cleanup activities, working oil deeper into sediments from foot traffic and equipment, increased erosion, and inadvertent removal of plants or sediments can have long-term effects and delay or prevent recovery from oil spills (NOAA, 1994b, 2000; Hoff, 1995). Extensive vessel traffic may increase turbidity and adversely affect organisms, such as eelgrass, in shallow subtidal communities (Exxon Valdez Oil Spill Trustee Council, 2003).

Conclusion

Routine operations could affect coastal habitats as a result of pipeline construction, shorebase construction, vessel traffic, and infrastructure maintenance and repair activities. These activities could result in direct loss of habitat by replacing habitat with infrastructure and by damaging habitats during maintenance. It is expected that pipeline landfalls will avoid barrier beaches and islands. These direct losses would be minimized through existing Federal and State environmental review and permitting procedures that would attempt to mitigate impacts through appropriate siting and construction requirements. Secondary impacts to wetlands could occur from water and air quality degradation and from altered drainage caused by pipeline canals, navigation channels, and other onshore construction.

Potential impacts from spills could occur from the direct effects of oil on coastal vegetation. The light crude and condensate expected to be developed in the North Aleutian Basin would result in acute mortality and die back to contacted vegetation, but because the liquid hydrocarbons would not persist in the environment for a long time period, recovery would be expected to occur more quickly than in cases involving heavier liquid hydrocarbons. If killed or damaged vegetation experienced accelerated erosion during the recovery time, wetland areas could be permanently altered.

While some of the impacts described above may occur as a result of activities related to the 2007-2012 Leasing Program, the impacts would be localized. Given the modest amount of activity assumed to occur during the 2007-2012 Program and the great extent of Bering coastal habitats, no widespread impacts to the overall condition of coastal habitats in the North Aleutian Basin area would likely occur.

(3) South Alaska Subregion

Routine Operations

The potential effects on coastal habitats from routine operations would primarily be associated with direct impacts from ground-disturbing activities during pipeline and facility construction as well as the indirect impacts from decreased water quality and air quality, altered hydrology, and facility maintenance.

Up to 2 new pipeline landfalls would be constructed in the Cook Inlet Planning Area. Pipelines from one or two new platforms would likely extend to the Kenai Peninsula, north of Anchor Point, on the eastern side of Cook Inlet. Pipeline installation would include trench excavation through intertidal and shallow subtidal areas. Installation could directly disturb tidal marshes, beaches, rocky shores, or other coastal habitats, depending on the location of the landfall. A few acres of habitat would likely be altered at each landfall site, and some intertidal and shallow subtidal organisms would be displaced (MMS, 2003b). Organisms that could potentially be affected along the Kenai Peninsula include razor clams near Clam Gulch, the site of a large sport fishery (see Section IV.B.3.p for impacts to fisheries).

Recovery of some invertebrates, such as some species of mussels, following a large disturbance may be slow (NOAA, 1998). Some species of mussel may recover in 1-3 years, while other species may require at least 6-7 years (NOAA, 1998).

Intertidal and shallow subtidal vegetation, infauna and epifauna could be indirectly impacted by excavation for pipeline installation. Areas adjacent to the trench may be covered by excavated sediments, and organisms could be affected by sedimentation and turbidity associated with the disturbance of bottom sediments during trench excavation and backfilling. Impacts could be reduced by implementing measures to restrict the dispersal of sediments.

Up to 75 miles of new onshore pipelines would be constructed. These pipelines would likely extend along the Kenai Peninsula between Anchor Point and Nikiski. Impacts to coastal habitats during pipeline construction would be minimized by pipeline placement inland from shorelines and beaches. Although wetlands along the pipeline route could be affected by construction, impacts would be reduced by locating pipelines in existing utility or transportation system rights-of-way, when possible, and maintaining natural drainage patterns. Indirect impacts to coastal habitats from sedimentation originating along the pipeline route could be reduced by minimizing crossings of anadromous fish streams and consolidating pipeline crossings with other utility and road crossings.

One new waste facility and one new processing facility could be constructed. Ground-disturbing activities during facility construction, as well as the construction of access roads and transmission corridors, could directly impact wetlands. Indirect effects could include habitat fragmentation and isolation of wetland areas, reduced infiltration and increased surface runoff from soil compaction on the construction site, altered hydrology including increased or reduced inundation or saturation of substrates, sedimentation and turbidity, and introduction of contaminants in stormwater runoff. Impacts to local streams could affect coastal wetlands. Impacts could result in changes in plant community structure, reduction in plant biodiversity, and the establishment and dominance of invasive plant species. However, activities that may potentially impact wetlands, such as facility construction, are regulated by State agencies and the COE. Standard mitigation measures would be applied to any construction project associated with these activities. For example, construction-related impacts could be minimized by maintaining buffers around wetlands and implementing erosion and sediment controls.

Operation of new facilities could have local indirect effects on wetland vegetation from exhaust emissions, atmospheric releases from processing facilities, and fugitive dust from exposed soils. Contaminants could be introduced into wetlands from waste storage or disposal sites if contaminants migrate into groundwater or enter stormwater that flows into wetlands. Discharges from service vessels that support drilling platforms may contain materials that adversely affect coastal wetlands or other intertidal or shallow subtidal habitats. Wetland impacts could be avoided or minimized by the implementing practices that eliminate or minimize impacts to air quality or water quality.

Accidents

The potential impacts to coastal habitats from accidents would primarily be associated with impacts from spills of oil or other petroleum hydrocarbons, such as fuel oil or diesel fuel, and the methods used for spill cleanup. This analysis assumes 1 large spill of 4,600 bbl from a pipeline or 1,500 bbl from a platform, as well as 2 smaller spills (50-999 bbl) and 10 spills less than 50 bbl. Currents and tides within Cook Inlet could transport oil or other materials to coastal habitats from drilling platforms, pipeline leaks, or vessel accidents. The Cook Inlet Planning Area is unlike any other OCS planning area in that it is almost entirely surrounded by coastal habitat. Therefore, there is a very high likelihood that spills in the planning area would make contact with coastal habitats. Because of the patterns of Cook Inlet surface currents, habitats along the western shoreline of the Inlet and along Shelikof Strait would have the greatest likelihood of contact from spills within the planning area, while the eastern shoreline would have a lower potential for contamination from spills (MMS, 2003b).

Extensive winter ice can develop along the western shores of Cook Inlet, and epibiota are seasonally removed by ice scour. Intertidal communities affected by glacier ice melt, such as along the Shelikof Strait mainland, are subject to turbidity and freshwater stresses (McCammon et al., 2002).

Intertidal habitats would be highly vulnerable to spills that reach the coastline, and repeated influxes of oil may contaminate intertidal surfaces with each subsequent tidal cycle. Because of the wide tidal range (over 9 m in some portions of upper Cook Inlet, north of the planning area), extensive areas of shoreline habitat may be affected by a spill, especially soft-bottom habitats (sands and muds) which typically have a relatively flat topography. Shallow subtidal habitats could be affected by oil that slumps from intertidal areas and accumulates below the low-tide line.

Vulnerable intertidal habitats sensitive to disturbance from oil spills extend around most of lower Cook Inlet (MMS, 2003b). Highly sensitive shoreline habitats include marshes, sheltered tidal flats, and sheltered rocky shores (NOAA, 1994b). The vulnerability of intertidal habitats is generally rated as highest for vegetated wetlands and semipermeable substrates, such as mud, that are sheltered from wave energy and strong tidal currents. Oil contacting these habitats is less likely to be removed by waves. Cleanup activities are very difficult to conduct on soft mud substrates, such as on tidal flats (NOAA, 1994b, 2000).

Direct mortality of biota could result from spilled oil contacting intertidal habitats. Oil readily adheres to marsh vegetation (NOAA, 1994b, 2000; Hayse et al., 1992), and effects may range from a short-term reduction in photosynthesis to extensive vegetation injury or mortality. Many invertebrates are sensitive to oil exposure. Following the *Exxon Valdez* oil spill, the abundance of many species of algae and invertebrates were reduced at affected sites (NOAA, 1997; Peterson, 2000; Exxon Valdez Oil Spill Trustee Council, 2003). In particular, the abundance and reproductive potential of *Fucus gardneri*, a common and important brown alga species, was reduced and has since remained unstable (Exxon Valdez Oil Spill Trustee Council, 2003). Although adult Fucus appear to have some resistance to oil toxicity, earlier life stages appear to be much more sensitive (NOAA, 1998). In shallow subtidal habitats, impacts were less severe, although kelp, eelgrass, and many invertebrates were adversely affected (Peterson, 2000). Although studies of the *Exxon Valdez* oil spill provide valuable information on oil spill effects and recovery, a spill of that magnitude is not included in this accident scenario. The spills assumed for this analysis are considerably smaller.

Spilled oil that contacts intertidal habitats can cause changes in community structure and dynamics. Toxic compounds in oil can selectively remove the more sensitive organisms, such as echinoderms and some crustaceans, while organic enrichment from oil can stimulate the growth and abundance of opportunistic infaunal invertebrates, such as some polychaetes and oligochaetes (McCammon et al., 2002). Some opportunistic species, such as species of barnacle, oligochaetes, and filamentous brown algae, colonized affected shorelines following the *Exxon Valdez* oil spill and cleanup (Peterson, 2000; Exxon Valdez Oil Spill Trustee Council, 2003). Indirect effects also included the spread of *Fucus gardneri* onto lower shoreline areas in some regions which inhibited the return of red algae (Peterson, 2000). The reduction of predators or herbivores can also result in changes in lower trophic levels for extended periods. The adverse effects of oil on intertidal organisms, such as macroalgae, clams, and mussels, can last for more than a decade (MMS, 2003b; Exxon Valdez Oil Spill Trustee Council, 2003).

Extended periods may be required for intertidal communities to fully recover from an oil spill. The degree of effects and length of recovery depend on a number of factors such as the type of oil, extent of biota exposure, substrate type, degree of sediment contamination, time of year, and species sensitivity (NOAA, 1998; Hayse et al., 1992; Hoff, 1995). Although the most acutely toxic components of crude oil are rapidly lost through weathering, the more persistent components have been associated with long-term pathologies such as carcenogenicity (NOAA, 1997). Full recovery of wetlands including invertebrate communities may require more than 10 years (Hoff, 1995). Studies indicate that full recolonization of sheltered rocky shorelines in Cook Inlet may require 5-10 years (Highsmith et al., 2001). Although studies in Prince William Sound indicate that some organisms can recover quickly, recovery in some intertidal and shallow subtidal habitats takes more than a decade (Peterson, 2000; Exxon Valdez Oil Spill Trustee Council, 2003).

Spilled oil may penetrate into subsurface layers or may remain on the surface. Oil can remain in intertidal sediments and organisms for more than a decade and may remain a long-term source of exposure (NOAA, 1997; MMS, 2003b; Short et al., 2004; Exxon Valdez Oil Spill Trustee Council, 2003). Coarse-grained sand beaches are more conducive to subsurface penetration than fine-grained sands (NOAA, 2000) and subsequent deposition of sand may bury oil deposits. Natural removal of subsurface oil from gravel beaches is greatly reduced by surface armoring of boulders, as observed in Prince William Sound (NOAA, 1997). Although oil is not likely to adhere to the surface of mudflats, oil may be deposited if concentrations are high; penetration of the surface is unlikely except for entering burrows or crevices (NOAA, 2000).

Cleanup activities may also adversely affect intertidal habitats and biota, as occurred following the Exxon Valdez oil spill (NOAA, 1997; McCammon et al., 2002; Exxon Valdez Oil Spill Trustee Council, 2003). The removal of organisms from affected surfaces and washing out of fine particles from substrates likely inhibited and slowed the recovery of intertidal communities in some areas. Trampling of vegetation and other biota during cleanup activities as well as working oil deeper into sediments from foot traffic and equipment can also delay recovery from oil spills. Extensive vessel traffic may increase turbidity and adversely affect organisms, such as eelgrass, in shallow subtidal communities (Exxon Valdez Oil Spill Trustee Council, 2003).

Conclusions

Routine operations could affect coastal habitats as a result of pipeline construction, shorebase construction, vessel traffic, and infrastructure maintenance and repair activities. These activities could result in direct loss of habitat by replacing habitat with infrastructure and by damaging habitats during maintenance. These direct losses would be minimized through existing Federal and State environmental review and permitting procedures that would attempt to mitigate impacts through appropriate siting and construction requirements. Secondary impacts to wetlands could occur from water and air quality degradation and from altered drainage caused by pipeline canals, onshore infrastructure, and navigation channels.

Because the Cook Inlet Planning Area is almost entirely surrounded by coastal habitat, it is likely that a large spill would contact these habitats. Habitats along the western shoreline have the greatest likelihood of contact based on surface currents in the inlet. Spills could result in changes in community structure as well as direct loss of habitat.

While some of the impacts described above may occur as a result of activities related to the 2007-2012 Leasing Program, the impacts would be localized. Given the small amount of activity assumed to occur during the 2007-2012 Program in Cook Inlet, no widespread impacts to the overall condition of coastal habitats in the Cook Inlet would occur.

h. Seafloor Habitats

(1) Arctic Subregion

The Stefansson Sound Boulder Patch is a unique kelp-dominated community only occurring in the central portion of the Beaufort Sea Planning Area (Fig. III-40). Because of its uniqueness and its extremely restricted distribution, the Boulder Patch community is considered vulnerable to potential effects from oil and gas leasing in the Beaufort Sea. In addition to the Stefansson Boulder Patch community in the Beaufort Sea, there are other subtidal benthic communities and habitats present in the Arctic Subregion, as described in Section III.B.11.

Routine Operations

Stefansson Sound Boulder Patch: Biological communities associated with the Boulder Patch and other seafloor habitats in the arctic waters of Alaska could be affected by routine operations from such activities as placement and removal of structures and by operational discharges that could occur as a result of exploration, delineation, development, and production activities. Routine operations that may impact the Boulder Patch and other seafloor habitats include pipeline placement and burial and gravel island construction, which increase turbidity and sedimentation. Increased water turbidity could directly affect kelp growth by altering the optical properties of the water column and limiting photosynthesis (Maffione, 2000, Dunton et al., 2005). It is estimated that kelp contributes 50-56 percent of annual productivity in the Boulder Patch and is an important source of organic matter that supports various members of the epilithic community (Dunton, 1984). Sedimentation could cause direct impacts to the Boulder Patch community by burying kelps and other organisms. Overall, measurements have indicated natural inputs of suspended sediment from runoff and erosion are large relative to any anthropogenic inputs of sediment (Trefry et al., 2004). Therefore, unless activities are located in the immediate vicinity of the Boulder Patch, it is anticipated that the proposed action will not substantially increase turbidity or sedimentation on the Boulder Patch. If activities occur in the immediate vicinity of Boulder Patch communities, effects could be somewhat greater; however, under current regulations, proposed development near the Boulder Patch area requires detailed surveys to identify the boundaries of the Boulder Patch habitat and the expected levels of impacts from proposed activities must be identified. Discharges of drilling fluids or cuttings within 1,000 m of the Steffansson Sound Boulder Patch or between individual units of the Boulder Patch where the separation between units is greater than 2,000 m but less than 5,000 m are prohibited under NPDES Permit Number AKG280000.

It is estimated that one to three new offshore pipelines, traversing between 110 and 160 miles of seafloor habitat, could be constructed in the Arctic Subregion as a consequence of the proposed action and about 95-120 hectares (ha) of seafloor could be disturbed as a result. If construction activities were located in the vicinity of (but outside of) the Boulder Patch, the kelp community would probably recover quickly from resulting minor and temporary changes in turbidity and sedimentation (Dunton et al., 2004; MMS, 2002b). Although the effects and recovery periods would be greater if construction were to occur directly within the Boulder Patch community, planning and permitting procedures and requirements will likely be sufficient to avoid such occurrences. The construction of offshore pipelines in other seafloor areas would affect only a very small proportion of the overall kelp habitat area available outside the Boulder Patch. For example, a recent estimate for construction of pipelines to connect the Liberty production facility to shoreline facilities assessed that up to 14 acres of low-density kelp habitat could be disturbed, which would equal less than 0.1 percent of the area encompassed by the Boulder Patch; the biomass of kelp that would be affected was estimated at less than 0.001 percent of the total biomass present in the Boulder Patch (MMS, 2002b). It is estimated that recovery of kelp growth in areas trenched for pipeline construction could occur within a decade in some cases or could be much longer depending upon the proportion of hard substrate that was exposed after pipeline construction was competed (MMS, 2002b).

Under the proposed action, 80 percent of the drilling muds would be recycled for use at future drilling locations. The remaining drilling muds, together with rock cuttings and produced water, would be disposed of by injecting them into permitted disposal wells. Consequently, there would be no impacts to Boulder Patch benthic communities from these wastes.

Other Benthic Communities: Construction and maintenance of artificial islands; pipeline trenching, burial, and maintenance; and platform construction and maintenance have the potential to affect subtidal benthic communities. It is assumed under the proposed action that all activity would take place shoreward of (i.e., within) the 200-ft water-depth contour. It is assumed that as many as 10 platforms or artificial islands could be constructed during the lease period with a footprint of approximately 3 ha per platform or island. The area of burial around constructed islands could increase over time due to erosion from storm action and ice gouging on island slopes. For example, the COE estimated the Northstar project constructed island would eventually bury an additional 1.6 ha of soft-bottom seafloor (COE, 1999). It is also assumed that 110-160 miles of offshore pipeline would be placed during the lease period under the proposed action, disturbing a total of approximately 83-120 ha of bottom area. Except for the most mobile species, benthic organisms beneath the footprint of such construction sites could be killed. However, the total bottom area that could be disturbed by pipeline and platform construction assumed under the proposed action would be relatively small (83-120 ha for pipelines and up to 30 ha for platforms—Table IV-2) compared to the overall area of benthic habitat available in the Arctic Subregion.

Organisms living in or on sediments adjacent to trenching operations may experience suffocation from burial, crushing from ice removal, and physiological stress from increased turbidity during trenching and backfilling activities. Stationary organisms such as clams and worms would be affected the most, although mobile isopods and amphipods could also be affected. The benthic community in these areas experiences similar naturally occurring disturbances from ice gouging, strudel scour, and severe storms. Recolonization of disturbed areas would be expected within a few years (Woodward-Clyde Consultants, 1996). The presence of platforms or artificial islands would favor organisms requiring hard substrates, thus shifting community composition in some areas.

Increased turbidity and sedimentation will also occur in habitats near construction activities. In the Arctic, ice gouging and strudel scour lead to bottom disturbances in the offshore zone, and hyposaline and highly turbid conditions occur naturally during spring breakup. Turbidity plumes from construction activities under the proposed action would be temporary and likely would not exceed the range of natural conditions. Given this, resulting impacts to benthic organisms would also be temporary, and disturbed areas would probably be recolonized within a few years.

Under the proposed action 80 percent of the drilling muds would be recycled for use at future drilling locations. The remaining drilling muds, together with rock cuttings and produced water, would be disposed of by injecting them into permitted disposal wells. Consequently, there would be no impacts to seafloor organisms from these production wastes.

Accidents

Stefansson Sound Boulder Patch: Oil spills contacting the Stefansson Sound Boulder Patch community could have direct impacts on organisms inhabiting the area. Under the proposed action, it is assumed that one pipeline spill (4,600 bbl) and one platform spill (1,500 bbl) could occur in the Arctic Subregion over the leasing period (Table IV-4). In addition, it is assumed that 10 medium-sized spills (50 to 999 bbl) and 100 smaller spills (< 50 bbl) could occur during the lease period under the proposed action. Oil can cause both lethal and sublethal effects to marine plants and invertebrates. Sublethal effects occur at lower concentrations and include reduced growth and/or fecundity, increased physiological stress, and behavioral changes. Sublethal effects may increase the probability of death from other environmental stress factors and lead to reductions in population size. Concentrations of oil less than 1 ppm can produce a variety of negative effects in marine organisms. *Laminaria solidungula*, found in the Stefansson Sound Boulder Patch, has not been studied directly, but other Laminaria species from the Canadian Beaufort Sea showed marked physiological impairment when exposed to oils of several types and concentrations. In general, exposure to concentrations of 43 parts per million (ppm) caused a 25-percent reduction in photosynthesis, while 4,000 ppm reduced photosynthesis 45-60 percent (Hsiao et al., 1978). Shiels et al. (1973) reported inhibition of photosynthesis in *Laminaria saccharina* and two green algae species at 7 ppm.

Oil spills in the Beaufort Sea contacting the Boulder Patch community would probably have short-term effects on kelp since the subtidal plants would, in most cases, not be coated by oil. Photosynthesis would probably be reduced by the floating oil due to reduced light penetration, and, if the floating oil persisted long enough, it could impact growth and reproduction of the kelp. Benthic animal communities have been shown to have major shifts in species composition following exposure to oil. Such changes may alter food web dynamics. Changes occur when new species colonize an area following an oil spill that kills the local population, or when some species within the community are more resistant to the effects of oil. Most macroscopic benthic organisms inhabiting the Boulder Patch are longer lived, and shifts in species composition could last for extended periods if recruitment or recolonization by previously dominant species is inhibited.

The amount of oil that sinks to the bottom and the location of the oil spill in relation to the Boulder Patch would determine oil-spill impacts on the Boulder Patch community. If a large amount of oil were to sink and inundate the Boulder Patch, sensitive species could take 10 or more years to recover (MMS, 1996a). However, most of the oil associated with spills usually remains floating at the water surface; even in the case of a leak or rupture in a buried pipeline, most of the oil would float to the surface. The benthic area directly contaminated by such a leak would be expected to be within a 100-m radius of the leak or break in the pipeline (COE, 1999). The magnitude of impacts to the Boulder Patch from a pipeline leak would depend on the location and severity of the spill. Planning and permitting procedures and requirements will likely be sufficient to minimize impacts from pipeline construction within the Boulder Patch area.

Other Benthic Communities: As with the Boulder Patch area, other seafloor benthic communities are unlikely to be heavily oiled, even if spill volumes were large, since most of the oil would float. Sublethal impacts associated with low concentrations of oil in the water column would be expected in the immediate vicinity of the spill. A large (assumed 4,600 bbl) spill associated with rupture or leakage from buried offshore pipelines could contaminate sediments within a 100-m radius of the leak or rupture (COE, 1999). Organisms in those sediments could experience high levels of contamination and mortality, but this represents a very small proportion of the overall area available to support similar benthic communities.

Conclusion

Impacts to the Stefansson Sound Boulder Patch community could occur as a result of routine operations and accidents under the proposed action. However, it is expected that planning procedures and survey requirements would result in bottom disturbing activities avoiding the Stefansson Sound Boulder Patch community. These procedures and requirements would also minimize possible contacts to the boulder patch from oil spills. While a spill could contact kelp beds in the boulder patch, it is likely that such an event would result in short-term effects on kelp since the plants would most likely not be coated with oil.

Some impacts on other benthic communities in the Arctic Subregion could also occur due to routine operations and accidents under the proposed action. Given the great extent of Arctic seafloor habitats, the modest amount of offshore activity assumed to occur as a result of the 2007-2012 Program, and the stipulations, mitigations and survey requirements that would apply to activities with the potential to affect seafloor habitats, only localized and short-term impacts to other benthic communities would be expected to occur.

(2) Bering Sea Subregion

Resources associated with seafloor habitats and lower trophic levels (benthic invertebrates, aquatic vegetation, zooplankton, and phytoplankton) in the North Aleutian Basin Planning Area are described in Section III.B.11.b. This section describes potential impacts to these resources from routine exploration, development, and production operations and from accidental spills associated with lease sales in the North Aleutian Basin Planning Area.

Routine Operations

This section examines the potential effects to lower trophic-level organisms from routine operations during exploration, development, and production that could occur as a result of lease sales in the North Aleutian Basin Planning Area. These routine activities that could affect seafloor habitats in the Planning Area include seismic surveying, drilling of wells, offshore construction activities (e.g., installation of platforms and pipelines), and releases of permitted operational discharges (Table IV-2). It is anticipated that no OCS facilities in the North Aleutian Basin Planning Area would be decommissioned during the lease period. During the lease period, up to 20 exploratory wells and 200 production wells could be drilled and up to 6 platforms and 240 km (150 mi) of pipeline could be placed in offshore areas.

While benthic invertebrates can undoubtedly detect vibrations and pressure changes and do react to such stimuli, available information suggests that seismic surveys are unlikely to discernibly affect benthic organisms (Christian et al., 2003; Thomson and Davis, 2001). Fishes, which are considered more sensitive to injury from seismic pulses than invertebrates because they have gas bladders, are typically not considered to be at risk of serious injuries from airgun blasts unless they are within 1-2 m of the source (Thomson and Davis, 2001). Because water depths in the North Aleutian Basin Planning Area range from 30 m to 180 m (MMS, 1985b), it is unlikely that airguns would be within 2 m of benthic organisms during surveys. Consequently, it is anticipated that there would be no effects on benthic invertebrates from seismic surveys for the possible lease sales in the North Aleutian Basin Planning Area. Based upon information presented by Thomson and Davis (2001), it appears that effects on zooplankton from seismic surveys would be limited to organisms located very near an airgun. The numbers of planktonic organisms that could be affected in this volume of water would be unlikely to have appreciable effects on overall zooplankton concentrations in the survey area. Consequently, it is concluded that seismic surveys conducted as result of leasing activities would have no effect on invertebrate populations in the overall North Aleutian Basin Planning Area.

Exploration in deep water could involve the use of semisubmersible or floating drilling rigs, although jackup rigs and bottom-founded rigs could be used in water less than 60 m deep (MMS, 2003b). Because these types of drilling rigs affect only small areas of the bottom, and because benthic organisms in the Planning Area are expected to be relatively widespread and dispersed, it is anticipated that there would be little effect on lower trophic-level organism communities from placement of these temporary drilling rigs during exploration. Construction during development would involve installing up to 6 offshore platforms and laying up to 240 km (150 mi) of offshore pipeline (Table IV-2). These activities could affect benthic organisms in the immediate vicinity. Organisms in soft substrates (e.g., bivalves and polychaetes) could be adversely affected in the immediate footprint of the structure, and the seafloor immediately surrounding the structure, due to construction disturbance and sedimentation. It is assumed that placement of 6 permanent platforms would disturb approximately 9 ha of seafloor in the North Aleutian Basin Planning Area and placement of 240 km of pipeline would disturb approximately 225 ha of seafloor in the Planning Area. Platforms would add a hard substrate to the marine environment, providing small amounts of habitat for marine plants and animals (e.g., kelp and mussels) that require a hard substrate. Therefore, the overall probable effect of platform and pipeline installation would be to alter species diversity in small areas of the North Aleutian Basin Planning Area. Small areas of intertidal habitat could be affected at pipeline landfalls. It is anticipated that these development activities could displace some coastal organisms but would have no measurable effect on local populations. The stipulation on protection of biological resources, which requires surveys near and avoidance of special benthic habitats, would help to reduce potential impacts to both nearshore and deepwater biota.

Drilling discharges could affect benthic organisms in localized areas surrounding drilling sites, although the fluid components of drilling discharges are diluted rapidly following release. It is assumed that approximately 522 tons of drilling muds and cuttings would be released to the environment for each exploration well constructed. Up to 20 exploration wells could be placed in the Planning Area as a consequence of the leasing activities, which could result in the release of up to 10,440 tons of mud and cuttings.

Assuming that a general NPDES permit similar to the one currently in place for Cook Inlet oil and gas discharges (USEPA, 1999b) would be implemented for the North Aleutian Basin Planning Area, only drill cuttings with negligible toxicity would be allowed to be discharged. It is anticipated that all drilling muds, cuttings, and produced waters that result from development of production wells would be reinjected into existing wells. Consequently, drilling muds, cuttings, and produced waters would not be released from the estimated 200 production wells that could be developed under this alternative.

Section 403(c) of the Federal Water Pollution Control Act (Clean Water Act) requires that initial dilution of discharges in OCS waters must occur within a 100-m radius from the discharge location. Because the waters of the North Aleutian Basin Planning Area are generally well mixed, considerable dilution of drilling discharges would be likely to occur over an even shorter distance. While lower trophic-level organisms occurring within the mixing zone could be exposed to concentrations that elicit sublethal effects (e.g., reduced growth rates), the small area affected (compared to the overall area of similar habitat in the North Aleutian Basin Planning Area) and the intermittent nature of such releases from discharge points would suggest that such effects would be experienced only by small numbers of individuals. Consequently, effects on populations of benthic organisms in the vicinity of the North Aleutian Basin Planning Area would not be expected from permitted discharges.

Accidents

Seafloor habitats and organisms in lower trophic levels could become exposed to oil as a consequence of accidental oil spills. It is assumed that the potential lease sales in the North Aleutian Basin Planning Area could result in 1 large oil spill with a volume greater than or equal to 1,000 bbl as a result of accidents at either pipelines (a volume of 4,600 bbl is assumed) or a platform (a spill volume of 1,500 bbl is assumed). In addition, it is assumed that 2 intermediate-sized spills (50-999 bbl in volume) and 10 small spills (< 50 bbl in volume) could occur (Table IV-4). It is assumed that liquid hydrocarbons recovered from production wells within the North Aleutian Basin Planning Area would consist equally of gas condensates and light crude oil.

Based upon previous oil-spill analyses conducted for lease sales in Cook Inlet, spills of less than 1,000 bbl would be expected to degrade water quality for up to 10 days in an area less than 50 km2 in size, and the expected concentrations of hydrocarbons at a depth of 5 m or more below a surface spill would be low relative to concentrations found to be toxic to mysid shrimp (MMS, 2003b). If it is assumed that concentrations resulting from a similar spill in the North Aleutian Basin Planning Area would be similar, the effect of these smaller spills on plankton populations in pelagic areas would probably be small and temporary.

Water concentrations of hydrocarbons from a surface spill decrease quickly with depth, and it is anticipated that seafloor habitats below approximately 30 m in depth would be largely unaffected by spills of the sizes assumed for this alternative. Although some oil from spills will eventually settle to the bottom as it weathers, such contamination would be localized, and the toxicity associated with these settled fractions would be low. Pipeline spills could affect larger areas of the bottom than surface spills. However, it is anticipated that oil leaking from pipelines would rise to the surface relatively quickly, and only a small proportion of available bottom habitat would likely be affected. Because only a small proportion of individuals within populations of seafloor organisms could be affected by such spills, effects on overall population levels would not be expected to occur.

The toxicity of a surface slick from oil spilled in the North Aleutian Basin Planning Area would probably decrease rapidly because of evaporation, dispersion, and dilution, especially since the composition of oil spilled in this Planning Area is likely to be a mix of natural gas condensate and light crude oil. It is anticipated that planktonic organisms, including planktonic life stages of benthic organisms, contacted by oil at the surface would be killed during the first few days of a spill. Following additional spreading, weathering, and dilution, subsurface concentrations could elicit sublethal responses such as reduction in growth or reproductive rates, and lethal effects could occur at the surface boundary of an oil slick. Significant changes in overall plankton populations in the North Aleutian Basin Planning Area are considered unlikely because only a small proportion of the pelagic habitat available within the Planning Area would be affected by such a spill.

In contrast to the temporary effect of spills on pelagic organisms, the effect on intertidal and shallow subtidal fauna would probably persist longer. Small spills would likely affect only a small amount of shoreline and would not, therefore, present a substantial risk to populations of lower trophic-level organisms. Larger spills, such as the 4,600-bbl spill assumed for the proposed action, could affect larger areas of shoreline and, depending upon the nature of the shoreline community contacted, could have larger effects. Studies of the *Exxon Valdez* oil spill showed that significant hydrocarbon concentrations in intertidal sediments remained at heavily oiled sites many years after the spill, followed by an apparent migration of the oil into the shallow subtidal zone (D.A. Wolfe et al., 1996). Spilled oil that contacts shoreline areas can persist in sediments for long periods of time (years), sometimes in a relatively unweathered state. As a consequence, oiled intertidal areas can become sources of chronic hydrocarbon contamination for biota in these areas, potentially affecting growth, reproduction, or survival of exposed organisms. Depending on the amount of shoreline area affected and the proportion of a biological population that utilizes those areas, changes in year-class strength for some localized stocks of seafloor organisms could result. Many of the bays and lagoons along the northern side of the Alaska Peninsula support sensitive habitats that contain submerged aquatic vegetation (e.g., eelgrass) and nursery areas for some commercially important invertebrate species. Consequently, oil spills that contacted these areas could be especially detrimental.

The sublethal effects of oil on marine plants include reduced growth and photosynthetic and reproductive activity. Marine plants in deeper subtidal areas are not likely to be contacted by an oil spill or exposed to concentrations of hydrocarbons that would result in significant effects. Marine plants in intertidal and shallow subtidal areas could come into contact with an oil spill, and lethal or sublethal effects could result. Attempts to clean oiled habitats could add to adverse effects and increase recovery time by physically damaging marine plants and disturbing associated fauna.

Oil-spill-response plans and dispersant-use guidelines would likely provide some protection to sensitive intertidal and subtidal habitats. Lessees are informed about sensitive habitats that should be protected in the event of an oil spill, and appropriate responses are considered in oil-spill contingency plans. Regardless, oil-spill responses may be unsuccessful in preventing a large spill from contacting some coastline areas. Furthermore, some oil-spill response activities could adversely affect lower trophic-level organisms. For example, dispersants could temporarily affect subtidal benthic organisms and cleanup techniques; the presence of large numbers of people or use of heavy equipment on shorelines could kill some coastal organisms during cleanup responses.

Conclusions

Routine activities during exploration, development, and production probably would not measurably affect local populations of lower trophic-level organisms. In the unlikely event that a large oil spill occurred, the spill and associated cleanup activities would be unlikely to greatly affect populations of lower trophic-level organisms in pelagic waters. However, a large spill would likely contact some shoreline areas in Bristol Bay, and lower trophic-level organisms in sensitive intertidal and shallow subtidal habitats could experience lethal and sublethal effects. In such cases, local subpopulations of intertidal organisms could be measurably depressed for a year or more, and oil could persist in shoreline sediments for up to a decade.

(3) South Alaska Subregion

Resources associated with seafloor habitats and lower trophic levels (benthic invertebrates, aquatic vegetation, zooplankton, and phytoplankton) in lower Cook Inlet are described in Section III.B.11.c.

Routine Operations

Routine activities that could affect seafloor habitats in the Cook Inlet Planning Area include seismic surveying, drilling of wells, offshore construction activities (e.g., installation of platforms and pipelines), and releases of permitted operational discharges (Table IV-2). It is anticipated that no OCS facilities in Cook Inlet would be decommissioned during the proposed action, but up to 10 exploratory wells and 100 production wells could be drilled, and up to 2 platforms and 125 miles (200 km) of pipeline could be placed in offshore areas.

It is estimated that a site-specific seismic survey would cover an area of approximately 23 km^2 (MMS, 2003b). Because up to 2 new OCS platforms could be placed in Cook Inlet as a result of the proposed action, it is assumed that a total area of 46 km^2 could be subjected to 2 site-specific seismic surveys during the 2007-2012 Leasing Program; this represents approximately 0.15 percent of the total area of the Cook Inlet Planning Area. Each seismic survey would take between 14 and 35 days to complete (not necessarily on concurrent days).

While benthic invertebrates can undoubtedly detect vibrations and pressure changes and do react to such stimuli, available information suggests that seismic surveys are unlikely to discernibly affect benthic organisms (see Thomson and Davis, 2001). Fishes, which are considered more sensitive to injury from seismic pulses than invertebrates due to the presence of gas bladders, are typically not considered to be at risk of serious injuries from airgun blasts unless they are within 1 to 2 m of the source (Thomson and Davis, 2001). Because water depths in Cook Inlet range from 13 m to over 182 m, it is unlikely that airguns would be within 2 m of benthic organisms during surveys. Consequently, it is anticipated that there would be no effects on benthic invertebrates from seismic surveys during the proposed action. Based upon information presented by Thomson and Davis (2001), it appears that effects on zooplankton from seismic surveys would be limited to organisms located very near an airgun. The numbers of planktonic organisms that could be affected in this volume of water would be unlikely to have appreciable effects on zooplankton concentrations in the survey area. Consequently, it is concluded that seismic surveys conducted as result of the proposed action would have no effect on invertebrate populations in the overall Cook Inlet Planning Area.

Exploration in deep water probably would involve semisubmersible or floating drilling rigs, although jackup rigs and bottom-founded rigs could be used in water less than 60 m (200 feet) deep (MMS, 2003b). Because these types of drilling rigs affect only small areas of the bottom and because benthic organisms in Cook Inlet are relatively widespread and dispersed, it is anticipated that there would be little effect on lower trophic-level organism communities from placement of these temporary drilling rigs during exploration. Construction during development operations would involve installing up to 2 offshore platforms and laying up to 125 miles (200 km) of offshore pipeline. These activities could affect benthic organisms in the immediate vicinity. Organisms in soft substrates (e.g., bivalves and polychaetes) could be adversely affected in the immediate footprint of the structure and immediately surrounding the structure due to construction disturbance and sedimentation. It is assumed that placement of two permanent platforms would disturb approximately 3 ha (7.4 acres) of seafloor, and placement of 125 miles of pipeline would disturb approximately 190 ha (470 acres)of seafloor in Cook Inlet. However, platforms would add a hard substrate to the marine environment, providing additional habitat for marine plants and animals (for example, kelp and mussels) that require a hard substrate. Therefore, the overall probable effect of platform and pipeline installation would be to alter species diversity in small areas relative to the overall area of the Cook Inlet Planning Area. At pipeline landfalls, small areas of intertidal habitat could be affected. It is anticipated that these development activities could displace some coastal organisms but would have no measurable effect on local populations. The stipulation on protection of biological resources, which requires nearby surveys and avoidance of special benthic habitats, would help to reduce potential impacts.

Drilling discharges could affect benthic organisms in localized areas surrounding drilling sites although the fluid components of drilling discharges are diluted rapidly following release. It is assumed that approximately 522 tons of drill cuttings would be released to the environment for each exploration well constructed. Up to 10 exploration wells could be placed in Cook Inlet as a consequence of the leasing activities, which could result in the release of up to 5,200 tons of cuttings. Although such releases could result in localized increases in sediment load and deposition, this amount of sediment is small compared to the more than 44 million tons of suspended sediment carried annually into Cook Inlet by runoff from area rivers (Brabets et al., 1999). Cook Inlet waters are naturally high in suspended sediments, and analyses conducted for pipeline construction for previous lease sales indicated that turbidity from pipeline construction was expected to be within the natural range of turbidities from silt-laden rivers of Cook Inlet (MMS, 2003b).

Under the most recent general NPDES permit for Cook Inlet oil and gas discharges (USEPA, 1999b), only drill cuttings with negligible toxicity are allowed to be discharged. It is anticipated that all produced waters, drilling muds, and cuttings that result from development of production wells would be reinjected into existing wells. Consequently, drilling muds and cuttings would not be released from the estimated 100 production wells that could be developed under this alternative.

Section 403(c) of the Federal Water Pollution Control Act (Clean Water Act) requires that initial dilution of discharges in OCS waters must occur within a 100-m radius from the discharge location. Because the waters of Cook Inlet generally are vertically well mixed and strongly influenced by the relatively large tidal range in Cook Inlet, dilution of drilling discharges would be expected to occur over an even shorter distance. While lower trophic-level organisms occurring within the mixing zone could be exposed to concentrations that elicit sublethal effects (e.g., reduced growth rates), the small area affected (compared to the overall area of similar habitat in Cook Inlet) and the intermittent nature of such releases from discharge points would suggest that such effects would be experienced only by small numbers of individuals. A study of sediment quality in depositional areas of Shelikof Strait and Cook Inlet in 1997-1998 found that the concentrations of metals and polyaromatic hydrocarbons in sediments (1) posed no significant risk to benthic biota or fish and (2) were not linked to oil and gas development in upper Cook Inlet or to oil from the 1989 *Exxon Valdez* oil spill (USDOI, MMS 2001). Consequently, effects on populations of benthic organisms in Cook Inlet would not be expected from permitted discharges.

Finally, the routine activities associated with past exploration, development and production in upper Cook Inlet have not had a documented effect on lower trophic-level organisms. It is anticipated that the routine activities associated with the identified exploration and development activities from lease sales in Cook Inlet would be similar. Consequently, no effects on populations of organisms in lower trophic levels are anticipated.

Accidents

Seafloor habitats and organisms in lower trophic levels could become exposed to oil as a consequence of accidental oil spills. Under the proposed action, it is assumed that 1 large oil spill ($\geq$ 1,000 bbl) could occur in Cook Inlet as a result of accidents at either along pipelines (a volume of 4,600 bbl is assumed) or at a platform (a spill volume of 1,500 bbl is assumed). In addition, it is assumed that 2 intermediate-sized spills (50-999 bbl) and 10 small spills (< 50 bbl) could occur (Table IV-4).

Based upon analyses conducted for previous lease sales in Cook Inlet (MMS, 2003b), spills of less than 1,000 bbl would be expected to degrade water quality for up to 10 days in an area less than 50 km^2 in size. The expected concentrations of hydrocarbons at a depth of 5 m or more below a surface spill would be low relative to concentrations found to be toxic to mysid shrimp (MMS, 2003b). Recent laboratory studies indicate that the lethal effects of ultraviolet radiation, which generally penetrates less than a couple of meters into turbid water, such as found in Cook Inlet, is doubled by the presence of hydrocarbons (Duesterloh et al., 2002). Even with a doubling of natural toxicity of oil in the presence of ultraviolet radiation, the effect of these smaller spills on natural plankton populations in pelagicic areas would probably be small and temporary. A few of these smaller spills might be large enough and persist long enough to drift to shore. In contrast to the temporary effect of spills on pelagic organisms, the effect on intertidal and subtidal organisms would probably persist longer. However, it is anticipated that only a small amount of shoreline would be affected by these smaller spills and would not, therefore, present a substantial risk to populations of lower trophic-level organisms.

It is estimated that there is a relatively small chance of a large spill ($\geq$ 1,000 bbl) occurring and entering offshore waters. A oil-spill risk analysis conducted for previous lease sales in the Cook Inlet Planning Area evaluated the risk of contact with specific land segments and environmental resource areas from spills of the same assumed oil volumes (MMS, 2002g). That analysis estimated that the oil slick resulting from a 1,500-bbl or 4,600-bbl spill would probably drift over an area of 31-56 km^2 over 3 days and would cover an area of 77-65 km^2 after 10 days. During this time, toxicity of a surface slick would probably decrease rapidly because of evaporation, dispersion, and dilution. The analysis conducted for the previous lease sales estimated that the resulting concentration of hydrocarbons would be approximately 34-410 ppb in the surface 5 m after 3 days, 10-103 ppb in the surface 10 m after 10 days, and 2-12 ppb in the surface 30 m at the end of 30 days (MMS, 2003b). Based on acute (lethal) and chronic (sublethal) toxicity criteria of 1,500 ppb and 15 ppb, respectively, for effects on sensitive marine organisms from hydrocarbons (MMS, 2003b), the acute effects level would be exceeded for less than 3 days while the chronic effects level would be exceeded for approximately 30 days in pelagic waters. Thus, it is concluded that planktonic organisms in a relatively small area could be killed during the first few days of a spill; after that, the primary effects in oiled areas would be sublethal responses such as reduction in growth or reproductive rates except at the surface boundary of an oil slick. Significant changes in overall plankton populations in Cook Inlet are considered unlikely.

Because the Cook Inlet Planning Area is located within a relatively confined estuary, the likelihood of a large spill contacting part of the shoreline is relatively high. An oil-spill risk analysis conducted for previous lease sales in the Cook Inlet Planning Area estimated that a 1,500-bbl spill would contact 17-23 km of coastline, and that a 4,600-bbl spill would contact approximately 28-38 km of shoreline (MMS, 2002g). In that analysis, three land segments were identified as sensitive because of lower trophic-level organisms: Kalgin Island, Clam Gulch, and Seldovia. It was estimated that a spill at any time during the year from a hypothetical production platform in the lease area being evaluated had less than a 4-percent probability of contact with one of these three specific land segments within 30 days (MMS, 2002g). If a spill occurred along a hypothetical pipeline, the probability of contacting one of these areas within 30 days was found to be less than 6 percent. It should be noted that the probability of contact with a particular shoreline area is a function of assumed spill location, and site-specific evaluations would have to be conducted to fully evaluate potential spill trajectories from future lease sales.

Studies of the *Exxon Valdez* oil spill show that significant hydrocarbon concentrations in intertidal sediments were found at heavily oiled sites followed by an apparent migration of the oil into the shallow subtidal zone in 1991 (Wolfe et al., 1993). Oil in the intertidal and subtidal zones can affect not only lower trophic-level organisms but also higher trophic-level organisms, such as marine and coastal birds (Section IV.B.3.d) and fish (Section IV.B.3.f).

The sublethal effects of oil on marine plants include reduced growth and photosynthetic and reproductive activities. The sublethal effects of oil on marine invertebrates include adverse effects on reproduction, recruitment, physiology, growth, development, and behavior (feeding, mating, and habitat selection). Marine plants and invertebrates in subtidal areas are not likely to be contacted by an oil spill except for floating larval forms, which may be contacted anywhere near the surface. Marine plants and invertebrates in intertidal and shallow subtidal areas are likely to be contacted by an oil spill. Attempts to clean oiled habitats could add to adverse effects and increase recovery time by physically damaging marine plants and disturbing associated fauna.

Oil-spill response plans and dispersant-use guidelines would likely provide some protection to sensitive intertidal and subtidal habitats. Lessees are informed about sensitive habitats that should be protected in the event of an oil spill, and appropriate responses are considered in oil-spill contingency plans. Regardless, oil-spill responses may be unsuccessful in preventing a large spill from contacting some coastline areas. Furthermore, some oil-spill-response activities could adversely affect lower trophic-level organisms. For example, dispersants could temporarily affect subtidal benthic organisms, and cleanup techniques, the presence of large numbers of people, or the use of heavy equipment on shorelines could kill some coastal organisms during cleanup responses.

Conclusion

Routine operations during exploration, development, and production activities under the proposed action probably would not measurably affect local populations of lower trophic-level organisms. In the unlikely event that a large oil spill occurred, it is unlikely that populations of lower trophic-level organisms in pelagic waters would be greatly affected by the spill and associated cleanup activities. However, a large spill would likely contact some shoreline areas in Cook Inlet, and lower trophic-level organisms in sensitive intertidal and shallow subtidal habitats could experience lethal and sublethal effects. In such cases, local populations of intertidal organisms could be measurably depressed for a year or more, and oil could persist in shoreline sediments for a decade.

i. Areas of Special Concern

(1) Arctic Subregions

One national monument (the Cape Krusenstern National Monument) and one national preserve (the Bering Land Bridge National Preserve) are susceptible to potential impacts from OCS oil and gas development in Arctic Alaska under the proposed action (Fig. III-41).

Oil facility development currently is prohibited on the Arctic National Wildlife Refuge (ANWR) and is discretionary on all other national wildlife refuges (NWR’s) within Alaska. Thus, the Alaska Maritime NWR’s Chukchi Sea Unit is the only refuge in Arctic Alaska that could potentially be affected by OCS oil and gas development from adjacent regions under the proposed action (Fig. III-41). This refuge area could potentially be contaminated by oil spilled from offshore projects, or could be subject to negative effects from routine operations associated with the development and from routine operations of onshore oil and gas support facilities. Although numerous refuge lands have been conveyed to private ownership and Native corporations, Section 22(g) of Alaska Native Claims Settlement Act of 1971 (ANCSA) requires that new development on these lands must be in accordance with the purpose for which the refuge was formed. Therefore, development of onshore oil and gas support facilities, though technically possible, is subject to an exhaustive environmental review process.

No national forests occur within the coastal areas of the Arctic Subregion.

Routine Operations

National Parks: Impacts from routine operations assumed under the proposed action would come from onshore facilities developed to support offshore oil drilling and production, and could include effects from pipeline landfalls, dredging, air pollution, and the construction of roads and new facilities.

Onshore oil facilities are permitted only on private landholdings within national park boundaries. Both of the national park units in Arctic Alaska contain private inholdings, but development of onshore oil support facilities is unlikely in either of these. Although oil transport through the Cape Krusenstern National Monument is permitted under the ANCSA and an existing road is present that could be used to access or create support facilities, such development is considered unlikely under the proposed action. Onshore oil and gas development within the boundaries of the Bering Land Bridge National Preserve is also considered to be unrealistic. Consequently, there are likely to be no effects in either of these national parks from the proposed action.

National Wildlife Refuges: The potential effects of routine operations and accidental events on NWR's from the proposed action are similar to those discussed above for the national park system. In addition, subsistence hunting and fishing are permitted on all refuges in Alaska, and could therefore be affected by accidents and routine operations.

The Chukchi Sea Unit of the Alaska Maritime NWR includes 97 ha of land that would be available for development of onshore support facilities in the Chukchi Sea Planning Area under the proposed action. It is currently considered unlikely that onshore oil and gas activities (pipeline landfall, storage and processing facilities) would be developed on refuge lands. For the ANWR, no indirect impacts from onshore routine operations are expected because the refuge is currently closed to oil and gas facility development. Indirect impacts resulting from routine activities in areas adjacent to refuge boundaries, such as noise pollution or emissions associated with transportation of oil from adjacent planning areas, could occur but would be unlikely to have substantial effects on resources within refuge boundaries.

Accidents

National Parks: Impacts from accidents under the proposed action scenario would likely be due to oil spilled from onshore facilities, from offshore drill rigs or production platforms, or from transportation of oil (Table IV-4). Oil spills would have the greatest effect on shoreline habitats and vertebrate communities inhabiting these areas. Impacts would depend primarily on spill location, spill size, and timing of the spill. In general, directly affected coastal fauna would include marine mammals; fishes that reproduce in, inhabit, or migrate through coastal areas; terrestrial mammals that forage on fish; and marsh and seabirds that utilize these habitats for nesting and/or foraging. Spilled oil could also affect subsistence harvests in those parks in which subsistence hunting and fishing are allowed.

A major portion of the Cape Krusenstern National Monument lies directly onshore from the proposed future gas exploration and development areas. However, only oil condensate could be released from the natural gas development activities in Hope Basin. Such a release is unlikely to have adverse effects on coastal fauna or subsistence hunting and fishing within the national monument. The Bering Land Bridge National Preserve contains shoreline on the northeast and northwest edges of the Seward Peninsula adjacent to the Hope Basin Planning Area. However, accidental releases of oil condensate in Hope Basin would be unlikely to affect subsistence hunting and fishing within the preserve.

National Wildlife Refuges: The effects of accidental spills on resources within the NWR's in the Arctic Subregion would depend on individual spill characteristics including spill location, nature of transporting currents, magnitude of the spill, and chemical characteristics of the spilled oil. In addition to potential effects from routine activities associated with offshore and onshore development, the Chukchi Sea Unit of the Alaska Maritime NWR would also be susceptible to oil spilled from tanker traffic and drilling platforms within the Chukchi Sea Planning Area. Arctic NWR would be susceptible to oil spilled from subsea pipelines or drilling platforms in the Beaufort Sea. While small oil spills would likely only have limited influence on potentially affected resources within these refuges, a large spill could result in more drastic effects on coastal habitats and fauna and would probably negatively impact subsistence use.

Conclusion:

Development of national park lands in the Arctic planning areas is considered unlikely under the proposed action, thereby minimizing the potential for impacts from routine operations in these areas. Because ANWR is presently closed to oil development activities, it is assumed that there would be no impacts from routine activities within the refuge and that impacts from routine activities in adjacent areas would be minimal under the proposed action. Development may be possible in the Alaska Maritime National Wildlife Refuge under the proposed action, but it is anticipated that reviews of individual lease sales would minimize the potential for impacts from routine operations.

Impacts from oil spills that occur adjacent to national park or national wildlife refuge boundaries would depend on spill location, spill size, type of product spilled, weather conditions, environmental conditions at the time of the spill, and effectiveness of cleanup operations. It is considered unlikely that accidental spills would adversely impact national park lands within the Arctic Subregion. Large oil spills in areas adjacent to the Chukchi Sea Unit of the Alaska Maritime NWR and ANWR may negatively impact coastal habitats and fauna and also affect subsistence use. There would be no impacts from routine operations or oil spills on national forests under the proposed action because there are no national forest lands within the proposed action area.

(2) Bering Sea Subregion

Descriptions of the areas of potential concern in the South Alaska Subregion are provided in Section III.B.12. The following analyses use exploration, development, and transportation scenario assumptions for the proposed action in the North Aleutian Basin Planning Area. These assumptions are presented in Table IV-2 and in Section IV.B.1. Assumptions used for oil spills are presented in Table IV-4.

There are no National Park Service lands located within the immediate vicinity of the North Aleutian Basin Planning Area.

Routine Operations

National Wildlife Refuges: There are five NWR's located in the vicinity of the North Aleutian Basin Planning Area: the Becharof NWR, Izembek NWR, the Alaska Peninsula NWR, the Togiak NWR, and the Alaska Maritime NWR (Fig. III-42). All are managed by the FWS.

Routine exploration and development activities in offshore areas distant from the NWR areas would have only a limited potential to affect resources on these refuges because they are located relatively distant from shoreline areas. However, there could be a potential for effects on the NWR's from development and operation of facilities to support offshore oil drilling and production. This could include habitat degradation or loss due to nearshore dredging, construction of access roads, construction and operation of processing and waste facilities, construction and operation of shore bases, and construction of onshore pipelines.

It is anticipated that construction of onshore oil facilities would be permissible only on private acreage within the identified refuges. Numerous refuge lands have been conveyed to private owners and Native corporations. Section 22(g) of the ANCSA requires that new development on these lands must be in accordance with the purpose for which the refuge was formed. Therefore, although development of onshore oil and gas support facilities is technically possible within these areas, such projects would be subject to intensive review. However, these refuges could be subject to negative effects, such as habitat degradation from construction and routine operations associated with the development of onshore oil and gas support facilities in adjacent areas. If such facilities are constructed, additional site-specific evaluations would be conducted to assess potential impacts.

Lease sales in the North Aleutian Basin Planning Area could result in construction of 4 to 6 offshore platforms and up to 150 miles of offshore pipeline (Table IV-2). Vessel traffic associated with construction activities in offshore areas could temporarily disturb some wildlife in refuge areas. It is anticipated that noise generated by offshore construction activities would be at low levels, intermittent, and would not occur for longer than a few months. Consequently, no population-level effects on resources within these NWR's are anticipated.

Impacts from accidents associated with the proposed action in the North Aleutian Basin Planning Area could result from oil spilled from onshore facilities, from offshore production platforms, or from pipelines used to transport oil. The magnitude of impacts from oil spills would depend primarily on the spill location, size, and time of year. Large oil spills from offshore platforms or pipelines could potentially affect shoreline habitats and valued biological communities, including marine mammals, invertebrates, fishes, and birds that use coastal or shoreline habitats. Onshore pipeline spills could affect terrestrial or aquatic habitats in the vicinity of leaks or breaks. Subsistence hunting and fishing within these NWR's could also be affected by oil spills, due to contamination or mortality of target resources.

National Forests: Because there are no national forests located within the immediate vicinity of the North Aleutian Basin Planning Area, routine operations or oil spills from offshore platforms or pipelines within the Planning Area would not affect any national forest lands.

Conclusion

There are no national park or national forest lands that would be affected by exploration, development, or production activities within the North Aleutian Basin Planning Area. It is unlikely that any onshore facilities or pipelines would be allowed to be constructed in NWR lands. Although it is unlikely that a large oil spills would contact shoreline areas of NWR's, such an occurrence would likely negatively impact coastal habitats and fauna and could also affect subsistence use within these areas.

(3) South Alaska Subregion

Descriptions of areas of concern in the South Alaska Subregion are provided in Section III.B.12. The following analyses use exploration, development, and transportation scenario assumptions for the proposed action in the Cook Inlet Planning Area. These assumptions are presented in Table IV-2 and in Section IV.B.1.d. Assumptions used for oil spills are presented in Table IV-4.

Two national parks are located in the vicinity of the Cook Inlet Planning Area: the Lake Clark National Park and Preserve and the Katmai National Park and Preserve (Fig. III-43).

There are four refuges (the Alaska Peninsula NWR, the Becharof NWR, the Kodiak NWR,, and the Kenai NWR) in the vicinity of the Cook Inlet Planning Area (Fig. III-43). The Gulf of Alaska Unit of the Alaska Maritime National Wildlife Refuge includes islands and some offshore areas in the vicinity of Lake Clark National Park and Preserve and off the tip of the Kenai Peninsula while the Alaska Peninsula unit of the Alaska Maritime Refuge extends more than 400 miles along the south coast of the Alaska Peninsula from just west of Kodiak Island to the southern tip of the peninsula.

These refuges could be contaminated by oil spilled from offshore projects, or could be subject to negative effects from routine operations associated with the development of onshore oil and gas support facilities. Numerous refuge lands have been conveyed to private owners and Native corporations; Section 22(g) of ANCSA (1971) requires that new development on these lands must be in accordance with the purpose for which the refuge was formed. Therefore, although development of onshore oil and gas support facilities is technically possible, such projects would be subject to intensive review.

The only national forest within the vicinity of the Cook Inlet Planning Area is the Chugach National Forest, which is located mainly on the eastern side of the Kenai Peninsula (Fig. III-43).

Routine Operations

National Parks: Impacts to national parks from routine operations assumed under the proposed action could come from facilities developed to support offshore oil drilling and production, and could include effects from pipeline landfall; dredging and construction; and the construction of roads, processing and waste facilities, and onshore pipelines. Onshore oil facilities are permissible only on private acreage within the national parks identified above. All of the national parks and preserves in the vicinity of the Cook Inlet Planning Area contain privately held acreage. However, development of onshore oil support facilities is considered unnecessary and unlikely in these parks because it is anticipated that oil produced in the Cook Inlet Planning Area during the 2007-20012 leasing period would be piped to existing refineries at Nikiski using new onshore pipelines in the Anchor Point area, well away from the Lake Clark National Park and Preserve and the Katmai National Park and Preserve on the western side of Cook Inlet.

Leasing in Cook Inlet could result in construction of 1 or 2 offshore platforms and up to 125 miles of offshore pipeline. Noise and vessel traffic associated with construction activities in offshore areas adjacent to park boundaries could temporarily disturb some wildlife and could negatively affect recreational values for park users. It is anticipated that noise generated by offshore construction activities would be at low levels, intermittent, and would not occur for more than a few months. Scenic values for some park users could be negatively affected by the presence of platforms visible from park areas (see Section IV.B.3.o).

National Wildlife Refuges: The specific effects and magnitude of routine operations and accidental events from the proposed action are essentially the same as discussed for the national park system, as noted previously. In addition, subsistence hunting and fishing are permitted on all refuges in Alaska and could, therefore, be affected by accidents and routine operations.

The Gulf of Alaska Unit of the Alaska Maritime NWR is open to development of onshore oil support facilities on a case-by-case basis, with acreage available for development near the Cook Inlet Planning Area. However, it is considered unlikely that OCS-related onshore oil or gas pipelines would be routed through the refuge.

No OCS onshore or offshore activity is anticipated in the immediate vicinity of the Alaska Peninsula NWR under the proposed action. Therefore, resources within this wildlife refuge would not be affected by routine exploration, development, or production activities resulting from lease sales in the Cook Inlet Planning Area.

Kodiak NWR lies near the Cook Inlet Planning Area and contains about 191,000 ha of lands that are privately conveyed and possibly available for development of onshore oil support facilities. However, since no routine activity from the proposed action is expected onshore or near this refuge, it is anticipated that refuge resources would not be affected.

The Becharof NWR and the Alaska Peninsula Unit of the Alaska Maritime NWR are closed to oil and gas facility development. Consequently, no direct impacts from onshore routine operations are expected. While there is a potential for routine activities in adjacent offshore areas of the Cook Inlet Planning Area to have effects as a result of noise it is anticipated that such effects would be temporary in duration and small in magnitude.

National Forests: Because there would be no OCS-related development, such as pipelines or other onshore facilities, within the Chugach National Forest itself, it would not be affected by routine OCS activities associated with lease sales in the Cook Inlet Planning Area.

Accidents

National Parks: Impacts from accidents assumed under the proposed action scenario would primarily be from oil spilled from onshore facilities, from offshore production platforms, or from pipelines used to transport oil. It is anticipated that no shoreline facilities would be placed on national parks and that oil produced as a result of leasing activities under the 2007-2012 Leasing Program would be piped to existing facilities at Nikiski. Consequently, there would be no onshore pipelines placed in the immediate vicinity of any of the national parks adjacent to Cook Inlet.

Oil spills from offshore platforms or pipelines could potentially affect shoreline habitats and biological communities of some national parks. The magnitude of impacts would depend primarily on the spill location, size, and time of year. In general, directly affected coastal fauna could include marine mammals; fishes, and birds that reproduce in, inhabit, or migrate through coastal waters or terrestrial mammals that use shoreline areas. Spilled oil that affected coastline areas of a park could also potentially affect subsistence harvests and the number of park visitors.

The Lake Clark National Park and Preserve has approximately 50 km of shoreline along Cook Inlet, including shoreline areas in Tuxedni and Chinitna Bays that are considered to contain sensitive habitats. Katmai National Park and Preserve contains extensive shoreline in proximity to the Cook Inlet Planning Area and the Shelikof Strait region, and is also adjacent to Katmai Bay, which is considered a sensitive resource area. An oil-spill risk analysis conducted for previous lease sales in the Cook Inlet Planning Area estimated that a 1,500-bbl spill would contact 17-23 km of coastline and that a 4,600-bbl spill would contact approximately 28-38 km of shoreline (MMS, 2002g). In that analysis, it was estimated that if a large spill occurred, the probability of contacting Tuxedni or Chinitna Bays within 10 days ranged from less than 1 percent to 69 percent depending on spill location and whether the spill originated from an offshore platform or and offshore pipeline (MMS, 2002g). The same analysis indicated that there was a less than 1-percent to a 6-percent probability that spilled oil would contact shoreline areas in Katmai Bay within 10 days. These probabilities do not take into account the probability of a spill actually occurring, but rather indicate the probability of contact should a spill occur. Site-specific evaluations would be conducted to fully evaluate potential spill trajectories and spill probabilities in a lease sale EIS.

National Wildlife Refuges: All of the NWR areas situated along the shorelines of the Cook Inlet Planning Area or in adjacent areas could be susceptible to oil spilled from offshore drilling platforms or from onshore and offshore pipelines in Cook Inlet. Impacts would depend primarily on the spill location, size, and time of year. In general, directly affected fauna could include marine mammals; fishes that reproduce in, inhabit, or migrate through coastal waters; terrestrial mammals; and marsh birds and seabirds. Spilled oil could also affect subsistence harvests in affected refuges.

National Forests: Because of the forest location, oil spills from offshore platforms or pipelines within the Cook Inlet Planning Area would not be expected to affect shoreline areas or other resources within Chugach National Forest.

Conclusion

Development of onshore facilities within national park lands in the Cook Inlet Planning Area is considered unlikely under the proposed action, thereby making impacts from routine OCS operations unlikely in these areas. However, offshore construction of pipelines and platforms could have temporary and localized effects on wildlife due to noise and activity levels and on scenic values for park visitors. Although occurrence of and contact from large oil spills in areas adjacent to the Gulf of Alaska or Alaska Peninsula Units of the Alaska Maritime NWR is unlikely, spills could negatively impact coastal habitats and fauna and could also affect subsistence use, commercial or recreational fisheries, and tourism. No affects to national forests would be expected to occur because there would be no onshore OCS development within or in the immediate vicinity of national forest lands and because spills within the Cook Inlet Planning Area would not be expected to come in contact with national forest lands.

j. Population, Employment, and Regional Income

Routine Operations

The primary potential direct effect of the proposed action on population, employment, and regional income will be generated by the expected routine OCS oil and gas activity. Most of the workers directly associated with OCS oil and gas activity will work offshore or onshore in worker enclaves separated from local communities. Most OCS workers will likely commute to work sites from Alaska's larger population centers or from outside the immediate area. It is assumed that OCS jobs would be available to the local populations in all areas, but that rural Alaskan employment in the petroleum industry, especially among Native Americans, will remain relatively low.

In addition to direct OCS oil- and gas-related employment, indirect and induced employment will be generated in other sectors of the economy such as construction, transportation, and retail sales. The majority of indirect and induced employment will be located in Anchorage and other regional centers.

As explained in Section IV.B.2.k, MMS has generated forecasts of the potential effects on population, employment, and regional income from exploration and development scenarios for the program proposal. The model generating these forecasts for the Alaska Planning Areas is conceptually consistent with the model used in the Gulf of Mexico Region.

The MMS forecasts that the proposed action would increase Alaska State population by 14,000 residents, employment by 12,600 jobs, and personal income by $192 million each year in an average year.

Table IV-11 shows MMS's forecasts of the potential effects of the program proposal in each of the Alaska Planning areas. The effect forecasts are made at the local level, the rest of Alaska, and the rest of the United States. All the forecasts in the table consist of totals of the direct, indirect, and induced potential effects. However, MMS also calculated the direct, indirect, and induced components for each of the forecasts. For instance, see Table IV-12.

Workers at North Slope sites stay in enclave housing separate from local communities. For the most part, these employees live in south-central Alaska or the Fairbanks area and commute to their homes (or other locations) when not working. (South-central Alaska includes Anchorage, the Kenai Peninsula Borough, and the Matanuska-Susitna Borough.) Thus, the forecasts of local employment and regional income associated with each planning area would occur in the planning area but would apply to employees whose permanent residences lie in other parts of the State or elsewhere outside the State in the rest of the United States. Because the overwhelming majority of workers will live outside the local area, MMS has not included forecasts of population increases associated with each planning area. For this reason, we assume the same pattern of enclave workers for the Arctic and Bering Subregions.

Because most workers live outside the local area, employment in the North Slope petroleum industry has little direct impact on the communities of the North Slope Borough (NSB). However, the NSB receives other benefits from oil development. Revenue from taxation on oil industry facilities forms, by far, the most important component of the NSB tax base and provides the bulk of NSB revenue. The NSB will not be able to tax OCS offshore facilities; however, the NSB will collect some additional tax revenue from new onshore pipelines and other facilities. The NSB will also receive indirect benefits from Native corporation investments in petroleum service companies. Nevertheless, overall effects on the NSB and NSB communities are not likely to be significant, especially when combined with the continued decline in Prudhoe Bay and other North Slope production.

Any potential pipeline traversing of the National Petroleum Preserve-Alaska (NPR-A) from landfall on the Chukchi Sea to the Trans-Alaska Pipeline System would have little direct effect on Chukchi Sea communities due to the NSB's inability to tax most production facilities and little local employment. The NPR-A is in Federal jurisdiction, meaning the NSB would not be able to tax it.

Many workers on oil rigs in the Cook Inlet Planning Area (and onshore oil and gas facilities on the Kenai Peninsula and the North Slope) currently live in Anchorage or on the Kenai Peninsula. The larger populations and more diverse economies of south-central Alaska compared to other Alaskan communities will tend to lessen the potential effect of proposed leasing on their economies. As a result, employment generated by OCS activity in the Cook Inlet Planning Area at its peak is only expected to account for between 1 and 5 percent of the total south-central Alaska employment for 2 to 5 years; furthermore, no sector of the regional labor force will change by more than 10 percent.

Accidents

An oil spill could occur in any of the Alaskan lease sale areas, and cleanup-related employment would likely also occur in the affected area, generally in locations remote from communities. The hiring of cleanup workers would have a regional and State of Alaska emphasis. The regional assessment of the potential effects of OCS oil and gas development is based on the history of petroleum development in Alaska (1970 to the present).

Oil spills will generate only temporary employment (and population) increases during cleanup operations, because such operations are expected to be of short duration. Employment generated by spills will be a function of the size and frequency of spills. "Small spills" are included in the discussion of routine operations, and for the most part would have minor effects. "Large" spills of over 1,000 bbl would generate 250 to 500 jobs for up to 1 month and 15 regional center monitoring jobs for 1 year and would generate moderate local effects. Each Alaskan planning area is assumed to experience one spill of up to 4,600 bbl.

Conclusion

Potential effects on population, employment, and regional income from routine operations and oil spills are expected to be minor, except for moderate local effects from a large oil spill.

k. Sociocultural Systems and Subsistence

Subsistence activities are extremely important in all parts of rural Alaska, and combined with kinship, comprise the fundamental idiom for describing Native social organization and culture. This relationship has been described in Section III.B.14. Diverse subsistence activities take place in all coastal regions potentially affected by the proposed action. Marine mammals and fish are the resources of most concern, as they constitute a major part of the harvest and typically are the resources most likely to be directly affected by OCS activities. Waterfowl are also a resource of potential concern. Land mammals, particularly caribou, are also important subsistence resources, but are potentially affected more indirectly by transportation pipelines and other support infrastructure than by direct OCS oil and gas activities. State Cook Inlet subsistence fisheries are important for the community of Tyonek, on the west shore of Cook Inlet, and Port Graham and Nanwalek located on the southern Kenai Peninsula. Under Federal authority, limited sea mammal harvest and subsistence halibut (and some other non-salmon species) fishing can take place in Cook Inlet. Oil spills have historically resulted in significant effects on subsistence resources and subsistence activities, but routine operations could also potentially result in significant effects. Such potential effects of routine operations will be discussed on a regional basis, followed by the discussion of oil spill (accident) effects.

Routine Operations

Potential "sociocultural systems" impacts are somewhat difficult to discuss in the abstract. At the State level, it is not likely that routine petroleum activities arising from the proposed action would have significant (i.e., major) effects. While activities will contribute to the overall State economy and pattern of slow growth, and the petroleum industry is a primary driver of the State economy, the incremental effects of OCS development resulting from the proposed action would be very difficult to disentangle from other ongoing sociocultural dynamics. Regional and, where appropriate, community-specific discussions are likely to be more fruitful. Because some specific potential effects are the focus of separate sections (e.g., economics and demography, subsistence, fisheries, recreation and tourism), they are only treated in general in this topical analysis, as they relate to more general concerns.

Rural Alaska is quite dependent upon the State of Alaska for providing infrastructure and social services, and especially for funding public education. Even though urban Alaska and the organized rural boroughs support public education through property and other taxes, the State is also a significant supporter of education systems as well. State troopers and Village Public Safety Officers are sometimes the only law enforcement in rural communities. The State also provides important health and other benefits (as does the Federal Government). Thus, OCS activities can be expected to have effects on Alaskan communities, and especially rural communities, through various State programs. These effects would be proportionate to the percentage of the State budget that is composed of revenues from OCS oil and gas production, which for the period of this planning document will be relatively small.

The potential direct and indirect effects of routine OCS operations in the Arctic and Bering Sea Subregions derive from noise, visual, and traffic disturbances as a result of offshore operations, and disturbance from the construction and operation of pipelines and other shore-based facilities. Noise and traffic disturbance may result from seismic activities; the construction, operation, and decommissioning of drilling facilities; supply and tankering operations; and the construction, operation, and decommissioning of production facilities. Visual disturbance (of resources and/or subsistence users) may be perceived to result from the mere presence of offshore rigs or other facilities.

Local residents have consistently indicated that whales and other marine mammals are very sensitive to noise, and that they have been disturbed from their normal patterns of behavior by past seismic and drilling activities. Because of these perturbations, whales can also become less predictable and more dangerous to those who hunt them. That marine mammals are sensitive to noise disturbance is clear, although thresholds in terms of signal characteristics and distance for each species have not been established. Generally, such effects would be localized to the vicinity of the seismic vessel, the construction site, or the drilling/production unit, and to the actual time of operation. Lease stipulations have minimized such problems in the recent past, so that noise and disturbance effects of single actions are expected to be effectively mitigated.

Whalers from Barrow, Nuiqsut and Kaktovik have been especially vocal on this issue, as they are most likely to be directly affected by such activities during the fall open-water season.

> Fenton Rexford (Kaktovik) stated that during exploratory drilling in Canadian offshore waters (to the east of Kaktovik, and where whales come from during their eastward fall migration when Kaktovik whalers hunt them) – We were not successful or had a very hard time in catching our whale when there was activity with the SSDC [single steel drilling caisson], the drilling rig off Canada. And it diverted [bowhead whales] way offshore; made it difficult for our whalers to get our quota (cited in MMS, 1996c).
>
> Herman Aishanna reported that in 1985, the SSDC affected Kaktovik whaling even though it was idle – We got no whales that year (MMS, 2001a).
>
> Burton Rexford related his experience of the effect of seismic activities on whaling in 1979-1981 – There were three of us captains that went out whaling in the fall. In those three years we didn't see one bowhead whale, and we saw no gray whales, no beluga, and no bearded seal (McCartney, 1995, cited in MMS, 1996c).

> Tom Albert, a former non-Inupiat senior scientist for the NSB Department of Wildlife Management – When a captain came in to talk to me, I knew he was going to say that the whales are displaced [by noise] farther than you scientists think they are. But some of them would also talk about "spookiness;" when the whales were displaced out there and when the whaler would get near them, they were harder to approach and harder to catch" (MMS, 1997c).

An entire session devoted to whaling captains' observations on the effects of noise on whales and whaling is also contained in MMS (1997c). That marine mammals are sensitive to noise disturbance is clear although thresholds in terms of signal characteristics and distance for each species have not been established. Generally, such effects would be localized to the vicinity of the seismic vessel, the construction site, or the drilling/production unit, and to the actual time of operation. Lease stipulations for whaler/oil industry conflict resolution and other "non-disturbance" agreements have minimized such problems in the recent past, so that noise and disturbance effects of single actions have been, and are expected to be, effectively mitigated (e.g., Northstar Lease Stipulations, MMS Whale Feeding Study Agreement with the KWCA).

Past industry activities have been effectively limited in specified areas during critical periods of subsistence use through industry/subsistence user cooperation. The potential disturbance effects of production operations may be more difficult to mitigate, as such activities will by definition be longer term and operate year-round. Further, the need to install up to three additional platforms in the Arctic and Bering Sea Subregions (beyond those already in development or planning), over a period of 40 years, could increase the areas and times where either industry or subsistence activities are restricted. This would increase the possibility for significant harvest disruption. This would be further exacerbated if construction and production activities were concentrated in critical subsistence-use areas rather than dispersed. Potential cumulative effects of multiple projects are discussed in a separate section.

Routine petroleum industry activities generally do not interfere with subsistence fishing, which occurs in freshwater or near shore. Effects would be confined to potential reductions in fish populations (or health effects), which have been evaluated in the fishery resources discussion.

Offshore pipeline effects on subsistence will generally be confined to the period of construction and will be mitigated through lease stipulations, which will minimize industry activities during critical subsistence-use periods. Onshore pipeline effects on subsistence would occur during the 1- or 2-year construction period, and for the operational life of the pipeline. The major onshore pipeline constructed for the proposed action would connect Chukchi Sea oil and gas production with the TAPS. It would cross a large area that is currently undeveloped, except for isolated and relatively small airstrips in various conditions. The potential impact of the pipeline on subsistence-resource-use patterns, while unavoidable, can be at least partially mitigated and minimized with proper pipeline design and location/routing. Potential effects of a pipeline on subsistence users (perceptions of areas they wish to avoid, or which are difficult for them to access, for hunting) can be addressed with design considerations (for instance, by elevating or burying segments of the pipeline) and by including subsistence users in the consultation process. The most difficult potential onshore pipeline effects to mitigate would be those related to pipeline servicing and access. If a service road is constructed for this purpose, it would greatly increase impacts to caribou movement and access to subsistence resources on the western part of the North Slope. This effect would be greater if such a road were eventually opened to public access, on the model of the Dalton Highway. Roads are also reported to impose substantial maintenance costs on subsistence equipment (snow machines and sleds) and to present some safety issues (Impact Assessment, Inc., 1990a). Current practices are to minimize the construction of new roads. If pipeline servicing was conducted using aircraft, and perhaps ice roads or other ground transport in winter, such potential access effects would be minimized. Increased aircraft traffic in the summer could have a moderate effect on subsistence uses, but such impacts could be reduced through coordination with subsistence users.

The potential effect of pipelines on subsistence resources themselves (in terms of population and behavior) are discussed in Section IV.B.3.j. Specifically, in regard to caribou, this section concludes that onshore facilities and activities associated with the proposed offshore development program in northern Alaska should have temporary impacts on individual caribou but negligible effects on caribou herds. Negative impacts to caribou can continue to be minimized by mitigation measures, including: (1) construction of pipelines at least 100 m from roads; (2) burial or elevation of the pipelines above the ground in areas that are typically traveled heavily by caribou; (3) maintenance of traffic control in critical areas such as calving grounds, in season; and (4) adherence to minimum altitude levels for service aircraft in flight.

It could be argued that the principal sociocultural-systems impacts of the proposed action in the Arctic Subregion would be in the areas of commercial fishing and subsistence, with implications for health, population, and the economy. All of these topics, except for health, are discussed in other sections. At another level, this analysis would be remiss if it did not again draw attention to the unique combination of benefits and costs that petroleum development has fostered in Arctic Alaska, especially on the North Slope, primarily through the NSB and various Native organizations. The more general agencies of change, of course, are the increased availability of monetary resources, the Alaskan/American political system, and the American/world system of free exchange. In other Arctic Alaskan areas without petroleum development but with other resource development, such as the Northwest Arctic Borough, the same dynamics are present, although with a reduced scope. Potential OCS activity, and the proposed program in particular, would support these established trends. Much of the regional sociocultural effects of OCS activities would be indirect or induced as the result of state programs, as most OCS population and economic effects would not be directly evident at the regional level. Rather, they would be most evident at the State and large-population-center levels.

At the same time, it is critically important to recognize that social systems and cultures are seldom, if ever, in a stable state. Culture is learned from one's teachers (parents, relatives, community, etc.), which tends to be an influence for continuity, and personal experience with an environment that is often different from that of one's teachers, which tends to be an influence for adaptation and change. Thus, many of the items on any list of sociocultural concerns should also be analyzed in the context of adaptive change. Changes in some categories of behavior do not necessarily reflect changes in cultural values. For instance, smaller household size may be a measure of the fragmentation of "traditional" social organization. However, it is more likely a reflection of the increased availability of housing, exposure to the model of the "American nuclear family," increased local wage labor opportunities, better health care and support services for older people living independently, and other factors. What is often perceived as the "erosion of cultural values" is often only a transformation or change in the behavioral expression of that value (modes of sharing, expressions of respects). On the other hand, it must also be recognized that some behavioral changes are more significant indicators of cultural and value change than others. That is perhaps why public testimony on the impacts of petroleum development in Arctic Alaska—especially that of Native Elders—has focused on subsistence resources and practices, the relationship of people to the land and its resources, health, increased social pathologies, and the use (and loss) of Native languages. While OCS activity from the proposed action would only contribute incrementally to these effects, it is vitally important to recognize that these activities would occur within this context.

Some of the vectors of sociocultural change that have been commonly noted in studies of Arctic Alaska (Klausner and Foulks, 1982; Kruse et al., 1983a,b; Galginaitis et al., 1984; Luton, 1985; Worl and Smythe, 1986; Kevin Waring Associates, 1988a; Chance, 1990; Impact Assessment, Inc., 1989a, b; Jorgensen, 1990; Human Relations Area Files, 1992), lease sale documents (MMS, 1990c, 1996a, 1998a, 2001a), or testimony during the lease-sale process (numerous USDOI documents, 1978 to the present time) can be briefly summarized as follows:

- changes in community and family organization (availability of wage-labor opportunities locally or regionally, ethnic composition, factionalism, household size);
- institutional dislocation and continuity (introduction of new institutions, "loss" or de-emphasis of older or more traditional ones, and adaptation of new forms to old content or values, and vice versa);
- changes in the patterns of overall subsistence activities (time allocation, access, effort, equipment and monetary needs) and the potential disruption of subsistence harvest activities by industrial development;
- changes in health measures (a combination of increased access to health care, changes in diet, increased exposure to disease, substance use and abuse, concern over possible exposure to contaminants of various sorts, and other factors);
- perceived erosion of cultural values and accompanying behaviors (increased social pathologies such as substance abuse, suicide, and crime/delinquency in general; decreased fluency in Native languages; decreased respect for Elders; less sharing); and
- cultural "revitalization" efforts such as dance groups, Native language programs, and official and regular traditional celebrations (such as the reestablishment of Kivgiq [the Messenger Feast], for example, in the NSB).

While these are all in some sense generalizations and "analytical constructs," all are also supported by specific testimony of Native residents of the region. These dynamics are not generally viewed as oil and gas development (let alone OCS) specific, but rather as the overall context within which Inupiat, Yup'ik, Athabascan, Aleut, and Alutiqq cultures must continue to exist.

Bering Sea Subregion salmon, halibut, and herring subsistence fisheries are conducted throughout the region. These fisheries will be affected only to the extent that the resource population is. Thus, routine operations under the proposed action should have only negligible to minor effects on these activities. Alaska Natives can hunt marine mammals under the Marine Mammal Protection Act (MMPA). Beluga whales, walrus, and seals are the most significant subsistence marine mammal resources taken in the region, and routine industry activities have not been found to contribute significantly to any population or distribution effects in the region. Routine activities associated with the proposed action that occur on land will take place for the most part on State or private land (Alaska Peninsula). Thus, they would not greatly affect subsistence activities on Federal land, except as they affect resource populations that use both Federal and State lands.

The Bristol Bay region, especially, has already experienced some impacts of oil and gas exploration. It has also seen a recent and drastic decline in the commercial salmon fishery. This region is expected to experience the brunt of any potential positive and negative effects of increased population and employment from the proposed OCS action. With the exception of the Dillingham Census Area, most communities in the Bering Sea Subregion are small, subsistence-based, indigenous Native communities. Native communities tend to be more remote and more difficult to access than non-Native communities, and would be somewhat buffered from the population and employment impacts of the proposed action; the reverse would be true for subsistence resources and subsistence-harvest activities. Overall, impacts from routine operations on subsistence-harvest patterns and sociocultural systems in the Bering Sea Subregion are expected to be minor.

Salmon subsistence fisheries in the South Alaska Subregion are conducted near the Native communities of Tyonek, Port Graham, and Nanwalek. A Federal subsistence fishery for halibut has recently been established, with a bag limit of 20 fish. This fishery will be affected only to the extent that the resource population is. Thus, routine operations under the proposed action would have negligible to minor effects on these activities. Alaska Natives can hunt marine mammals under the MMPA. Beluga whales are the most significant marine mammal subsistence resource taken from Cook Inlet, and this population has experienced a sharp decline in the recent past. Routine industry activities have not been found to contribute significantly to this decline, and the effects of increased routine industry activity on beluga populations are assessed in Section IV.B.3.c. The current subsistence harvest of Cook Inlet beluga is limited to one animal—for the village of Tyonek—per year. Proposed actions should have negligible effects upon this harvest. Routine activities associated with the proposed action that occur on land will take place for the most part on State or private land (western Kenai Peninsula). Thus, they would not greatly affect subsistence activities on Federal land, except as they affect resource populations that use both Federal and State lands.

The South Alaska Subregion, especially the Cook Inlet area, has already experienced the impacts of oil and gas development, and would also experience both the positive and negative effects of increased population and employment from the proposed action of OCS activities. Most communities are ethnically diverse, with Caucasian majority populations. Native communities tend to be more remote and more difficult to access than do non-Native communities, and would be somewhat buffered from the impacts of the proposed action. Overall, impacts of routine operations on sociocultural systems in the South Alaska Subregion are expected to be minor.

Accidents

Oil spills are probably the most significant potential source of adverse effects attributable to the proposed action. Negative effects to specific subsistence species, as well as to the more general patterns of subsistence resource use, persisted in Prince William Sound for several years after the *Exxon Valdez* oil spill and the subsequent cleanup effort. The *Exxon Valdez* oil spill demonstrated that a very large spill could affect Prince William Sound, as well as the east coast of the Kenai Peninsula and the beaches of the Kodiak/Shelikof Strait area. However, the *Exxon Valdez* oil spill was larger than the spills posited as part of the proposed scenario. A pipeline or platform spill in the Bering Sea Subregion could affect subsistence activities in Bristol Bay and on the both sides of the Alaska Peninsula, and a pipeline or platform spill in Cook Inlet could affect subsistence activities on the Kenai Peninsula, Kodiak Island, and the Alaska Peninsula. Such effects would reduce the availability and/or accessibility of subsistence resources typically for a single season or less, but potentially for longer periods. Resources subject to such impacts include those that are most significant for the area–fish and shellfish–as well as marine mammals and, to some extent, terrestrial mammals. Birds and marine plants (seaweed) would also be resources at risk that are used locally.

The impacts of both large and small oil spills are expected to be significant in the Arctic Subregion. An oil spill of more than 1,000 bbl could, depending on the time and location of the spill event, affect the subsistence use of marine mammals in the region where it occurs. Marine mammals are the most important subsistence resource, both conceptually and as food, for these regions. The bowhead whale hunt could be disrupted, as could the beluga harvest and the more general and longer hunt for walrus (west of Barrow). Animals could be directly oiled, or oil could contaminate the ice floes they use on their northern migration. Such animals might be undesirable, and could be more difficult to hunt because of the physical conditions. Animals could be "spooked" and/or wary, either because of the spill itself or of the "hazing" of marine mammals, which is a standard spill-response technique in order to encourage them to leave the area affected by a spill. There has been little experience with under-ice or broken-ice oil spills, and local residents have little confidence in industry's current capability to successfully clean a spill of this type up in a timely manner. While the concern is most typically phrased in terms of the potential effects of oil spills on whales and whaling, it can be generalized to a concern for marine mammals and ocean resources in general. Marine mammals and fish typically comprise 60 percent of a coastal community's diet, and the ocean is frequently referred to in public testimony as "the Inupiat garden." Pipeline and platform spills could also impact migrating anadromous fish in the river deltas, as well as species that use (potentially) oiled coastal and nearshore habitat (nesting birds, breeding caribou, etc.). Overall, the impacts of oil spills on subsistence practices and resources are variable, ranging from minor to major, dependent on the size, location, and timing of a potential spill.

The sociocultural impacts of oil spills are of at least two types. The first is the result of direct effects upon resources that are used in some way by local residents (i.e., subsistence, tourism, recreation, and elements of quality of life). The second is the impact of spill-cleanup efforts, in terms of short-term increases in population and economic opportunities, as well as increased demand on community services and increased stress to local communities. As is evident from the *Exxon Valdez* oil spill event, such cleanup efforts can be quite disruptive socially, psychologically, and economically for an extended period of time. While the magnitude of impacts decline rapidly in the first year or two after a large spill, long-term effects continue to be evident (Palinkas et al., 1993; Picou, 1992, 1996). Such effects can be mitigated, and one important element in such a program is the establishment of, and local participation in, an effective spill-response effort that has been formulated into an explicit spill-response plan. Such local programs can be credited as one effect of spill events, and do have a number of benefits. They provide local employment, a sense of local empowerment, and a means for local resident/oil industry communication.

Conclusion

Potential direct and indirect impacts on sociocultural systems due to noise, visual, and traffic disturbances, as a result of offshore operations for the proposed action, are expected to be limited. Potential direct and indirect impacts on sociocultural systems due to routine operations of offshore pipelines for the proposed action will also be limited because of mitigation and consultation measures. These effects are likely to be confounded by concern over cumulative effects, which are discussed in a later section. Potential impacts on sociocultural systems from routine operations under the proposed action would be limited but variable, with the least significant effects expected in areas already experiencing oil and gas development (i.e., the South Alaska Subregion [Cook Inlet]). Potential impacts on sociocultural systems from accidents under the proposed action could range greatly, depending on the location and timing of a spill.

l. Environmental Justice

Executive Order (EO) 12898 on environmental justice (EJ) for minority and low-income populations was issued in 1994. It specifies that "… each Federal agency shall make achieving EJ part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations" (59 FR 7629). This analysis is to explicitly include effects on patterns of subsistence resource use in its treatment of human health or environmental effects (Council on

Environmental Quality, 1997). Mitigation measures should be developed to address all identified effects. Agencies must incorporate effective public participation and consultation in this process, and provide full access to information. Such measures are to be integrated into the required level of National Environmental Policy Act (NEPA) review required (e.g., Finding of No Significant Impact, Environmental Assessment, EIS), and are to recognize the government-to-government relationship between the U.S. and tribal governments.

The MMS is very sensitive to its responsibilities to evaluate the consequences of its activities in terms of EJ. By definition, OCS activities take place primarily offshore (with onshore support activities) and, thus, most directly affect coastal communities. Most Alaskan coastal communities are rural and predominantly Native (a defined ethnic minority), and many contain at least subpopulations with low incomes. That is, any OCS activity in Alaska is likely to significantly affect a specific local minority (and possibly poor [low-income]) population. The OCS activity in Cook Inlet may be a possible exception, due to the proximity of Anchorage (and about half of the State's total population), but even for Cook Inlet several small communities meet the EO 12898 qualifications for consideration under EJ considerations. Thus, a general case could thus be made that any effect arising from Alaskan OCS activity is liable to have EJ implications.

For these reasons, the MMS socioeconomics studies agenda has emphasized the documentation of subsistence use, and the potential impacts of OCS activities on such uses, along with the more general characterization of rural (Native and non-Native) social organization and the incorporation of local and traditional knowledge. A series of comprehensive studies has focused most heavily on communities on the North Slope (the area of most onshore and offshore oil and gas activity) and in Prince William Sound (the site of the most extensive oil spill and cleanup effort in Alaska). In addition, the MMS has funded projects to synthesize local and traditional knowledge in these two geographical areas, specifically oriented towards the Exxon Valdez oil spill event for Prince William Sound. While this section will not address any specific EJ issues, the sections discussing "sociocultural systems" and "subsistence" are relevant in this regard.

The MMS has especially recognized the extreme importance of whales and whaling on the North Slope, and has conducted a bowhead whale aerial survey annually since 1987. The MMS also funded a Bowhead Whale Feeding Study for the area near Kaktovik in the mid-1980's, as well as currently (1998-2001). A newly-funded study, Quantitative Description of Potential Impacts of OCS Activities on Bowhead Whale Hunting and Subsistence Activities in the Beaufort Sea, is ongoing. The MMS is also funding a study of Cross Island whaling to monitor potential effects of the Northstar development as part of the ongoing Arctic Nearshore Impact Monitoring In the Development Area (ANIMIDA) project. North Slope whalers (and, to a more limited extent, Alaska Eskimo Whaling Commission and NSB staff) have had a role in formulating and implementing this project. The MMS has also funded a large number of biological studies on other marine resources.

Perhaps more importantly, MMS has recognized the importance of local consultation, and the important role that the NSB and other local organizations and institutions can play in the development and evaluation of specific actions. Such a consultation process will be a part of all actions developed under this programmatic EIS. Although MMS has amassed an astounding body of public testimony—much of it from Alaskan Natives—as a result of the public hearing process, the agency's consultation process extends far beyond these formal hearings. For example, for OCS Lease Sale 170 and Beaufort Sea Oil and Gas Lease Sales 186, 195, and 202, scoping and participation included:

- meetings in local Native communities (Nuiqsut, Kaktovik, Barrow) where the issues, alternatives, and mitigation measures identified focused on subsistence whale hunting concerns;

- mailing a Beaufort Focus pamphlet, published in both English and Inupiat, to residents of NSB communities. It outlined the sale planning process, concerns expressed to that point, possible alternatives, possible mitigation measures, and solicited public comments;
- forming an Alaska OCS Region Offshore Advisory Committee as a forum for Alaska stakeholders, including representatives of Native communities;
- conducting a workshop in Barrow in 1997 to elicit observations from subsistence whaling captains on the effects of seismic activities on bowhead whales and whaling (this local and traditional knowledge was synthesized with more formal research and monitoring data on bowhead whale migration);
- holding public hearings in local Native communities for the draft EIS's, with translators to present information in Inupiat as well as in English (comments were accepted in Inupiat as well as in English.); and
- conducting more informal "dialogue" meetings with the NSB to obtain local and traditional knowledge for inclusion in the EIS analysis, especially in regard to potential effects of OCS activities on bowhead whale subsistence hunting.

For the Liberty development EIS, a similar list of meetings was conducted. The MMS solicited the participation of the NSB, the local Native governments of Barrow, Nuiqsut, and Kaktovik, and the regional Native government (the Inupiat Community of the Arctic Slope) in the planning process for the Liberty project under EO responsibilities to consult with the Native community on a government-to-government basis.

Further, the MMS now routinely includes Native representation on the scientific review boards for its major projects, and tries to conduct at least occasional information transfer meetings (discussing the findings of recently concluded and ongoing studies and proposed efforts) near those communities most likely to be affected. The most recent such meeting was held in Barrow on March 28-29, 2000.

Tables III-35 through III-44 provide information sufficient to characterize measurements for the State and Alaska Subregions in terms of ethnic composition and income and poverty. Regional measures are compared with those for the State as a whole to determine whether a region has a disproportionate minority population, or a larger than average population with income below the poverty line. The analysis of potential impacts arising from the proposed action is then examined in view of this information, and conclusions on potential disproportionate adverse effects upon minority populations and populations in poverty are presented.

For Alaska as a State, minority ("non-White") populations constituted about 29 percent of the population in 2000. American Natives made up about 15.5 percent of the total population, African Americans about 3.5 percent, and Asian/Pacific Islanders about 4.6 percent. About 9.4 percent of the 2000 population was below the poverty line, and mean income was $57,171 (median income was $50,746). All of the regions considered in this document, except for southcentral Alaska (Anchorage and the Kenai Peninsula), have significantly larger minority populations than the State as a whole. This is one component of the "urban-rural" divide between the Anchorage area and much of the rest of Alaska. The NSB is 83 percent "minority," with 69 percent of the total population being Native American, 5.9 percent Asian/Pacific Islander, and 0.7 percent African American. Northwest Alaska is 87.7 percent "minority," with 82.5 percent of the total population being Native American. For southcentral Alaska, "minorities" constitute only about 20 percent of the population, and only about 8 percent of the total population is Native American, with the rest split between African Americans and Asian/Pacific Islanders. Because the following communities are predominantly Native communities, the minority populations in the Cook Inlet communities of Tyonek, Port Graham, and

Nanwalek, and the indigenous communities on Kodiak Island, the Upper Alaska Peninsula, and the community of Yakutat would experience any effects discussed above for northwest Alaska and the NSB, as well.

In terms of poverty, of these regions, only northwest Alaska has a disproportionate percentage of its population below the poverty line. However, the community of Tyonek has a very large population in poverty, and Yakutat's is somewhat larger than the State average. In terms of income, northwest Alaska is again the lowest of these regions and significantly below the State median. Southcentral Alaska is somewhat below the State income median, with the community of Tyonek being very much below the State median. Median income for the NSB is actually higher than for the State as a whole, but analysis of the two most recent NSB population surveys demonstrates that non-Inupiat households have significantly higher incomes than do Inupiat households, and that a good number of Inupiat households are living below the poverty line (Harcharek, 1995; Shepro and Maas, 1999). Thus, any effects discussed above for northwest Alaska, the NSB, or Tyonek in southcentral Alaska, will disproportionately affect populations living in poverty.

Many of the effects discussed above contain an EJ component. They will not all be summarized and discussed in detail here. Rather, the central issue of effects on subsistence will be used as a proxy or construct for this potential complex of effects, and will serve as the basis for a discussion of possible mitigation measures. The NSB Municipal Code defines subsistence as "an activity performed in support of the basic beliefs and nutritional needs of the residents of the borough and includes hunting, whaling, fishing, trapping, camping, food gathering, and other traditional and cultural activities" (ADNR, 1997). While this is, at best, a partial view of the significance of these activities to the Inupiat (and more generally to Alaskan Natives) as individuals, culturally it stresses subsistence as a primary cultural and nutritional set of activities upon which Alaskan Natives depend.

Disproportionately adverse effects on Alaskan Natives could result from activities of the proposed action in all regions, although in the South Alaska Subregion such effects would most likely be concentrated in the Native communities of Cook Inlet, Kodiak Island, the upper Alaska Peninsula, and Yakutat. Such impacts could be direct, indirect, and cumulative. Oil spills would add an additional component to such impacts. Such disproportionate, adverse effects could range from minor to major, as is discussed in some detail for the Arctic (NSB) and South Alaska (Cook Inlet) Subregions in MMS (2001a and 2003b, respectively).

Inevitably, "perceptions of risk" exist among local residents concerned about accidents or new development projects in general. They consist of "Not-In-My-Backyard" responses to the proposed action manifest in fear and concern for stakeholder cultural rights and resources. Considering the importance of social networks that are maintained through subsistence cultural patterns, any type of disruption adds to cumulative change. The mere fact that, for example, certain members of the NSB engage in actively opposing offshore development cumulates social change.

This section began with a general discussion of EJ and a list of project-specific actions MMS initiated to help mitigate disproportionately adverse effects on Alaskan Natives. More generally, mitigation of potential effects on subsistence activities will involve the protection of biological resources, the orientation of oil and gas personnel to the environmental and cultural concerns of local residents, and extensive consultation with local residents to avoid disruption of their activities. Again, MMS (2001a) and (2003b) discuss these measures in some detail for the NSB and Cook Inlet, respectively.

Conclusion

Much of the Alaska Native population resides in the coastal areas of Alaska. Any new onshore and offshore infrastructure resulting from this program could be located near these populations or near areas where subsistence hunting occurs. Any adverse environmental impacts to fish and mammal subsistence resources from installation of infrastructure and routine operations of these facilities could have disproportionately higher health or environmental impacts to Alaska Native populations. A large oil spill that contacts subsistence resources could also have disproportionately high impacts to Alaska Native populations if the subsistence resources were diminished or tainted as a result of the spill. Mitigation measures, cooperative agreements between Native and industry groups, and government-to-government consultations are designed to limit the effects from oil spills and routine operations.

m. Archaeological Resources

Archaeological resources in the Alaska Region that may be impacted by the proposed action include historic shipwrecks, aircraft, inundated prehistoric sites offshore, and historic and prehistoric sites onshore. Archaeological sites along the present shoreline, in shallow nearshore waters, and along shallow bathymetric highs have a high likelihood of having already been severely impacted by ice gouging. An exception to this general assumption occurs in the Beaufort Sea, where high-resolution seismic data have shown remarkable preservation of relict landforms (and by extension of any prehistoric archaeological sites that might occur in association with these landforms) just beneath the seafloor (Northern Land Use Research, 2005). The actual age of these landforms has not yet been conclusively determined; however, their stratigraphic position strongly suggests that they date from the last ice age (i.e., the late Wisconsinan) and would, therefore, have potential for containing preserved prehistoric archaeological site deposits. The MMS is currently funding a study to further evaluate the distribution of these landforms and to determine their age. The preservation of these landforms in an area otherwise severely reworked by ice gouging is attributed to their location in shallow coastal waters that are covered with floating shorefast ice during the winter and in areas between the offshore barrier islands and the current shoreline. Within this relatively shallow-water area, shorefast ice and barrier islands prevent the pack ice from severely gouging the seafloor as occurs in the deeper waters, and beyond the barrier islands in the Beaufort Sea. Although there are not sufficient high-resolution survey data to determine whether this same effect favoring prehistoric site preservation occurs in other areas of the Alaska OCS where floating shorefast ice and barrier islands are present, it is very likely that it does. These back-barrier island and shorefast ice areas however, probably does not provide the same degree of protection to shipwrecks and other archaeological sites that are exposed at the seafloor, compared to sites that are completely buried below the seafloor. Shipwrecks in deeper waters beyond the areas of severe ice gouging, such as in the deeper waters off Point Barrow or the Chukchi Sea, have a chance of survival. Likewise, prehistoric archaeological sites that have been buried by a sufficient amount of sediment may be protected from the effects of ice gouging, winter storms, and current scour even in those areas where such destructive processes are pronounced.

Routine Operations

Routine activities associated with the proposal that are likely to affect archaeological resources include well drilling, platform installation, pipeline installation, and onshore facility and pipeline construction projects that involve ground disturbance. While the source of potential impact will vary with the specific location and nature of the routine operation, the goal of archaeological resource management remains the protection and/or retrieval of unique information contained in intact archaeological deposits.

Regulations at 30 CFR 250.194 allow the MMS Regional Director to require that an archaeological report based on geophysical data be prepared if there are indications that a significant archaeological resource may exist within a lease area. For historic resources, this decision is based on whether an historic shipwreck is reported to exist within or adjacent to a lease area. For prehistoric resources, an analysis is completed prior to each lease sale to consider the relative sea-level history, the depth of burial of the late Wisconsinan land surface, the type and thickness of sediments burying the old land surface, and the severity of ice gouging at the present seafloor. Lease areas that are shown by this analysis to have the potential for prehistoric archaeological resources are required to have an archaeological survey prior to initiating exploration and development activities. If the survey finds evidence of a possible archaeological resource within the lease area, the lessee must either move the proposed activity to avoid the possible resource or conduct further investigations to determine if an archaeological resource actually exists at the location. If an archaeological resource is present at the location of proposed activity and cannot be avoided, the MMS procedures require consultation with the State Historic Preservation Office to develop mitigating measures prior to any exploration or development.

Federal, State, and local laws and ordinances, including the National Historic Preservation Act, the Archaeological Resources Protection Act, and the Alaska Historic Preservation Act, protect known sites and also as-yet-unidentified archaeological resources both onshore and offshore. Existing regulations require archaeological surveys to be conducted prior to permitting any activity that might disturb a significant archaeological site. Therefore, most archaeological resources will be located, evaluated, and mitigated prior to any onshore construction project or offshore bottom-disturbing activity. New data related to the human history and prehistory of Alaska likely will be produced from compliance-related archaeological projects associated with the proposal.

Accidents

Oil spills and their subsequent cleanup could impact the archaeological resources of the Alaska Region directly and/or indirectly. The geologic history of specific shorelines generally affects the presence or absence, condition, and age of archaeological sites on or near Alaska Region shorelines. However, some type of archaeological resource is present on or adjacent to nearly all Alaska Region shorelines. Existing data indicate that archaeological resources are particularly abundant along Gulf of Alaska shorelines (Mobley et al., 1990).

Archaeological resource protection during an oil spill requires specific knowledge of the resource's location, condition, nature, and extent prior to impact. However, large portions of the Alaska Region coastline have not been systematically surveyed for archaeological sites. While some response groups have compiled known archaeological site data in a form useful for mitigation during an emergency response (Wooley et al., 1997), these data have not been compiled for all areas of the Alaska Region.

Gross crude oil contamination of shorelines is a potential direct impact that may affect archaeological site recognition. Heavy oiling conditions (Whitney, 1994) could conceal intertidal sites that may not be recognized until they are inadvertently damaged during cleanup. Crude oil may also contaminate organic material used in carbon-14 (^{14}C) dating, and, although there are methods for cleaning contaminated ^{14}C samples, greater expense is incurred (Dekin et al., 1993). However, many other anthropogenic sources of hydrocarbons and other possible contaminants also exist, so caution should always be taken when analyzing radiocarbon samples from coastal Alaska (see Reger et al., 1992). A study examining the effects of the 1989 *Exxon Valdez* oil spill on archaeological deposits revealed that oil in the intertidal zone had not penetrated the subsoil, apparently due to hydrostatic pressure (Dekin et al., 1993).

The major source of potential impact from oil spills resulting from the proposed action (Table IV-4) is the harm that could result from on unmonitored shoreline cleanup activities. Cleanup activities could impact beached shipwrecks, or shipwrecks in shallow waters, and coastal historic and prehistoric archaeological sites. Unmonitored booming, cleanup activities involving vehicle and foot traffic, mechanized cleanup involving heavy equipment, and high pressure washing on or near archaeological sites pose risks to the resource. Unauthorized collecting of artifacts by cleanup crew members is also a concern, albeit one that can be mitigated with effective training and supervision, As Bittner (1996) described in her summary of the 1989 *Exxon Valdez* oil spill: “Damage assessment revealed no contamination of the sites by oil, but considerable damage resulted from vandalism associated with cleanup activities, and lesser amounts were caused by the cleanup process itself."

Interagency and regulatory aspects of oil-spill archaeological site protection have been clarified in a programmatic agreement (Regional Response Team, 1997) that specifies the Federal On-Scene Coordinator's (FOSC's) role in protecting archaeological resources, the type of expertise needed for site protection, and the appropriate process for identifying and protecting archaeological sites during an emergency response. Under the agreement, the FOSC's Historic Properties Specialist coordinates and directs the site identification and protection program, with consultation and cooperation of the Unified Command and other affected and interested parties.

Conclusion

Assuming compliance with existing Federal. State, and local archaeological regulations and policies, most impacts to archaeological resources in the Alaska Region resulting from routine activities under the proposal will be avoided. Some impact may occur to coastal historic and prehistoric archaeological resources from accidental oil spills. Although it is not possible to predict the precise numbers or types of sites that would be affected, contact with archaeological sites would probably be unavoidable, and the resulting loss of information would he irretrievable. The magnitude of the impact would depend on the significance and uniqueness of the information lost. Based on experience gained from the *Exxon Valdez* oil spill, we expect no or very limited impacts from direct contact with oil, but some impacts during cleanup activities.

n. Land Use and Existing Infrastructure

The generic effects of the proposal will be an expanded road system (ice and permanent), additional pipeline emplacement, and higher levels of marine support and support aircraft activity.

(1) Arctic Subregion

Routine Operations

In assessing the effects of the proposed action on the infrastructure and general land use of the Arctic Subregion (Beaufort Sea Coastal Plain), platform location will be the greatest determining factor. To illustrate, platforms scattered among multiple drilling plays and located near the 200-foot depth contour line will require a far greater expenditure of resources (hence infrastructure) than the same number of platforms concentrated in the exploration and/or production of a single play that is located closer to shore and existing infrastructure. The development scenario for this proposed action indicates a potential for 3-10 production platforms, producing from an unknown number of fields. Assuming a range of platform locations, the following notable infrastructure effects may occur: the construction of an additional shore base, the expansion or more intense utilization of existing shore bases, the construction of additional hydrocarbon processing facilities, the construction of up to 160 miles of onshore pipeline and 200 miles of offshore pipeline, a significant expansion of the current ice road system, and a very probable expansion of the existing paved road system to include additional bridges.

A scattered production and exploration pattern will require more helicopter and support boat trips traveling for longer periods of time. Platforms located beyond the landfast ice zone will require substantial helicopter support, especially during the developmental drilling phase, as they will be unreachable by ice-roads. Platforms located in the landfast ice zone could have many of their logistical needs met by vehicles traveling over ice roads. The proposed action may cause a noticeable increase in the region’s boat and aircraft operations, especially during the developmental period. However, given the timeframe of the development scenario (20-50 years), these effects would be moderate, at most, since the area’s developmental drilling may well be scattered over a number of years.

The most important effects of the proposed action will come from a permanent road, should one be built parallel to the proposed onshore pipeline. Depending on the location of the pipeline landfall, the path of an associated road to the TAPS might open up areas not previously reached by permanent roads. Such a road would aid additional future ice road and permanent road construction, but could serve as a means of linking North Slope communities to the permanent road system. Depending on the location of the pipeline landfall, it could significantly shorten the travel time of Barrow or Kaktovik residents to the North American road network. This would be a long-term and major expansion of infrastructure.

Accidents

One anticipated effect of the proposed action in the Arctic is to extend OCS-related infrastructure (e.g., landfalls, platforms) and associated activities westward, beyond their current locations. Should this occur, substantial new areas of Alaska adjacent to the Chukchi Sea would be exposed to the potential effects of crude oil spills, and to the requirement to maintain more extensive crude-oil-spill response equipment in those areas. In both current and new areas, potential impacts to land use and infrastructure resulting from an oil spill would likely include moderate but temporary stresses of the spill response on existing community infrastructure and to direct land-use impacts, temporary increases in boat and air traffic responding to the spill and cleanup operations, and temporary restrictions of access to a particular area while the cleanup is conducted.

Conclusion

The greatest anticipated impact of the proposed action is to expose new areas to the potential effects from routine operations and accidents. Routine operations would impact land use in the vicinity of new facilities and their associated infrastructures. Impacts associated with platform and pipeline construction would be expected to be temporary. An oil spill could notably alter land use, but this also would be expected to be temporary and not likely to result in long-term changes.

(2) Bering Sea Subregion

Routine Operations

The land in the North Aleutian Basin is comprised of rugged terrain that is largely undeveloped. Most of the land is owned by the Federal Government, the State of Alaska, and Native corporations. Much of the State and Federal land along the northern coast is managed for wilderness and wildlife habitat. Some of the larger wilderness areas include the Togiak National Wilderness and the Wood-Tikchik State Wilderness areas. These areas alone cover almost 2.4 million ha (6 million acres). The two primary activities that take place in this region are commercial fishing and tourism associated with the wilderness qualities that are present. There are very few developed communities in the area; the two primary ones are Unalaska/Dutch Harbor (pop. 4,000) and Dillingham (pop. 2,200). Many other population centers in the region are Native Alaskan communities in which development is controlled by Native corporations. Available land for new development is restricted by existing management designations, the willingness of Native Alaskan communities to lease their land, and topographic constraints (e.g., floodplains, mountains).

There is no established oil and gas infrastructure in the North Aleutian Basin. New development, would require some modification to current land use, but such development would be concentrated into a few areas (see Section IV.B.1 for a description of the proposed development). Most of the proposed activities would occur offshore. However, proposed land-based activities include the development of a new shore base with associated dock and causeway, and construction of processing and waste facilities. The construction of these facilities would represent a small modification to existing land use (e.g., undeveloped, commercial, or residential).

Offshore development could temporarily alter land use in some regions. Construction of underwater pipelines to transport oil or gas to onshore facilities could temporarily affect shoreline use in the vicinity of the construction, depending on the location of the onshore facilities (e.g., if the pipeline and associated facilities are located adjacent to a major port or harbor). While an increase is likely in boat traffic between the test wells and platforms and one of the local ports, the low level of expanded traffic would have only a slight effect on overall use of the area.

The addition of this industry in the area could result in the need to expand housing and community infrastructure. This could also result in limited changes to land-use status around the existing communities to accommodate the expansion. Impacts of this nature are dependent on the level of industrialization, the location of the related construction and operation activities, and the housing and infrastructure capacity of the communities closest to the proposed development. Communities such as Unalaska have very little land open for development due to topographic constraints. This particular area is surrounded by floodplain and mountains. In order to make undeveloped land areas in this region suitable for development, some land modification (e.g., grading) would be necessary. Communities such as Cold Bay are completely surrounded by lands managed as wilderness. Amendments to existing land-use designations would be required in order for oil and gas development to occur in these areas.

Accidents

Due to the lack of existing oil and gas exploration infrastructure in the North Aleutian Basin, spill response facilities would need to be established in the area. Potential impacts to land use and existing infrastructure resulting from an oil spill would likely include temporary stresses of the spill response on existing community infrastructure, direct land-use impacts (e.g., impacts of oil contamination to a national wildlife refuge or a recreational port), increased boat and air traffic responding to the spill and cleanup operations, and restrictions of access to a particular area while the cleanup is conducted. These impacts are expected to be limited and temporary but could last for an entire year.

Conclusions

Routine operations would have limited impacts on land use in the vicinity of new processing and transport facilities and their associated infrastructures. Impacts associated with platform and pipeline construction would be expected to be temporary. Impacts could result from an influx of workers to the region, as housing and expanded community infrastructure could be needed. An oil spill could alter land use temporarily but would not likely result in long-term changes.

(3) South Alaska Subregion

Routine Operations

The proposed action will have limited effects on the infrastructure and land use of the South Alaska Subregion. This area’s only offshore oil and gas province is Cook Inlet, an area of Alaska that has been actively producing from offshore State leases for decades. The area is home to active support and processing facilities. The principal one is located at Ninilchik. This region also has an inland network of oil- and gas-gathering distribution pipelines on both the eastern and western sides of the Inlet as well as within the State waters of the Inlet. Given the proposed actions estimated production and the maximum emplacement of two production platforms, it is unlikely that the proposal will have more then a low-to-moderate effect on the land use and infrastructure of the subject area.

Accidents

In the South Alaska Subregion, the potential for accidental effects to land use and infrastructure are limited to Cook Inlet, the Subregion’s only offshore oil and gas province. Cook Inlet has been actively producing oil and gas from offshore State leases for decades. The basic onshore support and processing infrastructure that would be necessary to support the anticipated levels of activity are already in place. Because anticipated activity levels are low, the number of oil spills that are anticipated is also low. Potential impacts to land use and infrastructure resulting from an oil spill would likely include moderate (temporary) stresses of the spill response on existing community infrastructure, direct land-use impacts, increased boat and air traffic to respond to the spill and cleanup operations, and restrictions of access to a particular area while the cleanup is conducted. These impacts are expected to be temporary; their magnitude would depend on location and size.

Conclusion

Routine operations from the proposed action would have a low impact on the land use and infrastructure of the affected areas of the South Alaska Subregion. Accidents from the anticipated low level of activity also are expected to have a low level of impact on land use and infrastructure.

o. Tourism and Recreation

(1) Arctic Subregion

Routine Operations

The Arctic provides some limited recreational opportunities, such as hiking, river rafting, and hunting, primarily near the communities of Barrow, Deadhorse, and Kotzebue. These areas are accessible mostly by air travel, although some road traffic may enter Deadhorse via the Dalton Highway. Barrow has the predominant tourism industry of the three communities; yet, it is seasonal and largely undeveloped. The primary land use in this region is for subsistence activities (see Section III.B.14.b). Commercial fishing opportunities are limited in this area of Alaska (see Section III.B.19).

Currently, there is no oil and gas development on the Alaska OCS in the Chukchi Sea Planning Area, although some oil and gas exploration has occurred previously. The Beaufort Sea Planning Area has a well-developed oil and gas infrastructure. Only a small amount of development is projected in the Arctic over the 5-year period. Oil and gas development activities could result in minor impacts to recreation and tourism in this region.

The main recreation and tourism activities that could be impacted by routine oil and gas operations would be sightseeing, hiking, and rafting. Fishing in this region is primarily a subsistence activity rather than a recreational activity (for impacts on fishing, see Section IV.B.3.k [subsistence]). Impacts on sightseeing might be viewed as being negative, with adverse aesthetic impacts from offshore platforms and possible increases in construction projects for gas-processing facilities and new offshore pipelines to connect to existing onshore pipelines in the Beaufort Sea area. Impacts on these recreational activities would depend on the proximity of the new construction to the recreational use areas (such as whether they are in view of existing parks and refuges; e.g., Cape Krusenstern National Monument or Kobuk Valley National Park). Another impact could be increased amounts of trash and debris washing to shore, which is both an aesthetic issue and a potential health and safety issue.

Accidents

The oil spills that could occur under the proposed action would be responded to primarily by existing response facilities along the coast and existing shore bases according to spill response protocols. Potential impacts to recreation and tourism resulting from an oil spill would likely include direct land-use impacts (e.g., from oil contamination at a coastal area), access restrictions to a particular area (e.g., no fishing or hunting while cleanup is being conducted), and aesthetic impacts (e.g., view of spill and cleanup activities). These impacts are expected to be temporary, and the magnitude of the impacts would depend on the location and size of the spill and the effectiveness of cleanup operations. The greatest potential impacts would occur from large spills in shallow water. The potential for impact would likely decrease with decreasing spill size and increasing water depth.

Conclusion

Routine operations would have limited effects on recreation and tourism, with potential adverse aesthetic impacts to sightseeing, hiking, and rafting activities. Temporary impacts would occur if a spill reached a recreational-use area. The magnitude of these impacts would depend on factors such as the size and location of the spill, and it would likely be greatest if the spill occurred during the recreational season.

(2) Bering Sea Subregion

Routine Operations

The North Aleutian Basin is an undeveloped region consisting primarily of land owned by the State, Native corporations, and the Federal Government. Much of the State and Native corporation land is located along the northern coast of the Aleutians and is managed to protect wildlife resources. The mountainous topography and large floodplains minimize the amount of land available for development. Recreation and tourism in the region is concentrated on observing wildlife, visiting Native communities, and fishing. Access to the region is limited to boats and small aircraft.

Oil and gas development would be a new industry in the North Aleutian Basin. Proposed activities are presented in Section IV.B.1 and include primarily offshore construction (platforms, exploration and production wells, and pipelines). Land-based activities include development of a new shore base with associated dock and causeway and new processing and waste facilities. Because there is little existing infrastructure in the region, a limited amount of new support infrastructure and facilities within the local communities would also be required. The effect of this development on the region's recreation and tourism would be confined to the actual sites chosen, and these areas would be developed in existing harbor areas. The influx of workers and the increased boat and helicopter traffic could cause limited distraction to tourists at some of the locations currently utilized for tourism. During construction of such facilities as pipelines, access to some tourist areas could be temporarily restricted. However, given the concentration of oil and gas development activities to particular areas, alternate tourism routes, wilderness settings, and fishing locations would likely be available.

The North Aleutian Basin has minimal infrastructure at present. Influxes of temporary workers and construction personnel could create temporary pressure on the existing community infrastructure until new facilities are established. Hotel accommodations could be limited until alternative accommodations are made available. Also, flights to the region could be largely monopolized for a short time by the engineers and construction personnel needed for the projects. These impacts are expected to be temporary and their magnitude small.

Accidents

The infrastructure necessary to respond to an oil spill in the North Aleutians region would need to be created since there are currently no facilities or personnel in the region. The materials brought into the area would comply with current requirements and protocols for spill response. Potential impacts to recreation and tourism resulting from an oil spill would likely include direct land-use impacts (e.g., from oil contamination at coastal areas), access restrictions to a particular area (e.g., to fishing or boating traffic), and aesthetic impacts (e.g., view of spill and cleanup operations). Due to limited community size, a large spill could require the temporary importation of spill response personnel. This might limit the facilities available for tourists attempting to use the region if the spill occurred during tourist season. Further, indirect consequences of an oil spill on tourism could result from direct impacts to wildlife populations, wildlife habitat, and fishing populations, and the public perception of those impacts on the quality of recreational experiences in the region. These impacts are expected to be temporary, but could affect more than one tourist season if the spill is large and highly visible to the public (i.e., near popular recreational areas).

Conclusion

Routine operations in the North Aleutian Basin could impact recreation and tourism in limited areas, since the North Aleutian Basin has not been previously developed for the oil and gas industry. The impact would be most noticeable during the short, initial construction periods due to the limited infrastructure to accommodate both tourists and construction workers in the region (with regards to boat and air traffic and overnight accommodations) and to possible restrictions in touring routes and fishing and boating activities. New industrialization would be occur in a few locations, thus minimizing the impact to the overall region. There would be temporary impacts if a spill occurred; these impacts are expected to be limited and temporary, but could affect more than one tourist season if the spill is large and highly visible to the public (i.e., near popular recreational areas).

(3) South Alaska Subregion

Southern Alaska is known for its relatively undisturbed natural beauty, scenic quality, and abundant wildlife. Access to many coastal places is often restricted to small aircraft and boats, and is even more limited for inland areas. The Cook Inlet has a developed tourist industry centered on coastal or water-based activities, such as fishing, boating, sightseeing, and associated land-based activities (e.g., hiking and camping). Coastal communities along Cook Inlet serve as access points for water- and land-based recreational activities.

Routine Operations

Oil and gas development under the proposed action in the South Alaska Subregion would occur near previous development. Proposed development includes one to two new platforms, one to two pipeline landfalls, no new shore bases, and possibly one new waste facility and one new processing facility, although the latter two facilities may not be necessary. Up to 125 miles of new subsea pipeline and up to 75 miles of onshore pipeline could be installed to transport oil from the offshore platforms to common-carrier pipeline systems onshore (Table IV-2). The additional development would not alter the character of the area, as similar infrastructure is already present. Effects on scenic quality would be temporary and localized, and would be most noticeable during heavy periods of industrial activity, such as during drilling or pipelaying. Temporary closure of certain areas to recreation would likely be necessary, but would be limited in size and duration. A small increase in the amount of trash and debris washing ashore may also occur as a result of the development. The frequency of helicopter and vessel traffic to and from the new platforms would be consistent with that of existing platforms, but would contribute marginally to the impact on scenic quality and also add to the industrial noise. The magnitude of these impacts would be small and vary with the distance of these activities from existing parks and wildlife refuges, primary recreational use areas, and cruise line paths. During the short period of construction, the increased workforce could impact lodging accommodations for tourists during peak times; however, impacts would depend on the timing and location of the activities and the availability of a local workforce.

Accidents

The oil spills that could occur in the South Alaska Subregion under the proposed action would be responded to primarily by existing response facilities along the coast and existing shore bases according to spill response protocols. Potential impacts to recreation and tourism resulting from an oil spill would likely include direct land-use impacts (e.g., from oil contamination at a coastal area), access restrictions to a particular area (e.g., no fishing or hunting while cleanup is conducted), and aesthetic impacts of the spill itself and cleanup operations. These impacts are expected to be temporary, but could last an entire season. However, because of public perceptions resulting from the *Exxon Valdez* oil spill in Prince William Sound, tourism in the region may respond more strongly than would tourism in other regions. Nevertheless, under the proposed action, only one large spill is projected over the course of the 5-year period, and the projected size of that spill is not anticipated to exceed 4,600 bbl of oil, which is of significantly less magnitude than that of the *Exxon Valdez* oil spill (i.e., 260,000 bbl [11 million gallons] of crude oil). The magnitude of the impacts would depend on the location and size of the spill and the effectiveness of cleanup operations.

Conclusion

Routine operations would have few effects on recreation and tourism, with potential adverse impacts to sightseeing, boating, fishing, and hiking activities. Temporary impacts would be expected to occur if a spill reached a recreational-use area. The magnitude of these impacts would depend on factors such as the size and location of the spill, and could be felt for an entire tourist season.

p. Fisheries

(1) Arctic Subregion

As described in Section III.B.19, the commercial fisheries in the Arctic Subregion consist primarily of relatively small fisheries for cisco and whitefish in the Colville River Delta and for Chinook salmon in the Chukchi Sea. Potential effects on recreational fishing are discussed in the tourism/recreation section (Section IV.B.3.o), and potential effects on subsistence fisheries are discussed under sociocultural systems (Section IV.B.3.k). Potential effects on fish and fish habitat are described in Section IV.B.3.f. Fisheries in Arctic Alaska may potentially be impacted by the proposed action as a result of the conduct of routine activities, multiple-use conflicts, competition for support services, accidental oil spills, and decommissioning.

Routine Operations

The single commercial fishery in the Beaufort Sea is for cisco and whitefish on the Colville River during the summer and fall months. The potential for negative effects on this fishery would be related to the timing of exploration and development activities and the proximity of those activities to the mouth of the Colville River. Because exploration and development of this area has already occurred, it is considered unlikely that there would be substantial levels of additional development as a result of the proposed action. In addition, impacts would be limited in scope as a result of adherence to mitigation measures and compliance with Federal, State and local requirements. Therefore, impacts to this fishery are also anticipated to be limited in scope.

There are no commercial fisheries in the Chukchi Sea other than a relatively small salmon fishery in Kotzebue Sound. Given the importance of this fishery to local villages, any impacts from the proposed action may directly affect the local economy by causing declines in salmon availability for harvest. Greater declines in the harvest would lead to greater impacts on local communities. However, it is anticipated that impacts from routine operations would be limited in scope as a result of adherence to mitigation measures and compliance with Federal, State and local requirements.

Accidents

The occurrence of an oil spill near commercial fishing areas during the fishing season could have effects on particular fisheries and the local economies that depend on them. Oil spills typically result in the closure of fishing grounds and reduced, or lack of, harvest. Even if harvest continues, the perception of a tainted product could reduce the economic value of fish harvested in the vicinity of an oil spill or could even cause fish to be removed from markets.

Under the proposed action, one large pipeline spill and one large platform spill are assumed to occur (Table IV-4). Such spills could foul fishing gear, result in fish contamination and mortality, and potentially close some fishing grounds or entire fisheries for one or more years. A large spill could also increase competition on alternative fishing areas that remain open, resulting in increased costs and/or reduced harvests for individual fishermen. There is a reduced chance of a spill occurring during pulse fisheries of short duration, such as those for salmon, herring, or whitefish, because of the relatively short period of time that such fisheries are open. However, if a spill were to occur during such a fishery, potential impacts include a total loss of commercial fishing harvest due to the inability to switch to an alternative fishing time or area.

Based on estimates of economic impacts to commercial fisheries from the large 1989 *Exxon Valdez* oil spill in southern Alaska, the overall decrease for ex-vessel revenues for commercial harvests was calculated at 27 percent for 1989 and 12 percent for 1990 (Impact Assessment Inc., 2001). Thus, the *Exxon Valdez* oil spill resulted in a loss of between 12 and 27 percent of ex-vessel value of the harvest for 2 years in an area where multiple and extensive commercial fisheries were located. The largest spill assumed possible in the Arctic Subregion under the proposed action is a 4,600-bbl pipeline spill, which is a small percentage of the size of the *Exxon Valdez* spill. The effects of a 4,600-bbl pipeline spill in Arctic Alaska from the proposed action could be expected to be more limited considering the localized extent of commercial fishing in the area. However, oil spills occurring directly within these localized fisheries would likely result in impacts.

Conclusion

Commercial fisheries in the Arctic Subregion are relatively small and localized. Potential impacts from routine operations are not likely to occur unless the activities occur in the direct vicinity of these localized fisheries. Impacts to these fisheries are unlikely since OCS activities would not occur in the immediate area near these fisheries. Based on the oil-spill scenarios, most accidents assumed under the proposed action could potentially impact commercial fisheries. A large spill has the potential to result in reduced or no harvest that may impact local economies. The occurrence of a large spill that contacts the limited areas that support commercial fisheries is considered unlikely.

(2) Bering Sea Subregion

Bristol Bay supports a large and diverse commercial fishery for groundfish, salmon, herring, and shellfish, as described in Section III.B.19. This section evaluates potential impacts to commercial fisheries from routine exploration and development operations and from accidental spills that could occur as a result of lease sales in the North Aleutian Basin Planning Area of the Bering Sea Subregion.

Bristol Bay supports large recreational fisheries for salmon and halibut and also provides opportunities for recreational clam-gathering along some shoreline areas. This section evaluates potential impacts to recreational fisheries in the vicinity of Bristol Bay from routine exploration and development operations and from accidental spills that could occur as a result of the proposed 2007-2012 Leasing Program.

Routine Operations

Commercial Fisheries: Routine operations could affect commercial fisheries by causing changes in the distribution or abundance of fishery resources, by reducing the catchability of fish or shellfish, by precluding fishers from accessing viable fishing areas, or by causing losses or damage to equipment or vessels. As identified in Section IV.B.3.f(2), it is anticipated that routine operations would not result in detectable effects on overall populations of fishery resources in the North Aleutian Basin Planning Area. Temporary displacement of fishery resources from localized areas could occur as a consequence of noise and activities associated with construction activities during development; however, these resources would be expected to return once construction disturbances have been terminated. Following offshore platform and pipeline construction, there could be some highly localized long-term changes in fish densities and species diversity in the vicinity of platforms and pipelines, due to attraction of some invertebrate and fish species.

Even in cases where dispersal does not occur, seismic surveys could temporarily affect the behavior of some targeted species, thereby affecting catch rates in the immediate area of the survey (see discussion in Thomson and Davis, 2001). While some studies indicate that effects of seismic surveys on fish catch rates are likely to be limited to the time of the survey or for short periods (hours) thereafter (e.g., Skalski et al., 1992), catch rates for some fish species could be affected for longer periods (e.g., Engås et al., 1996). Recent studies indicate that seismic surveys would have no detectable effect on catchability of snow crabs (Christian et al., 2003). Based on this information, it is assumed that catch rates for commercially caught crab species in the North Aleutian Basin Planning Area would not be affected by the relatively few seismic surveys that would occur as a result of the proposed action. As described in Section IV.B.3.f(2), it is estimated that up to 138 km^2 of the North Aleutian Basin Planning Area could be temporarily subjected to seismic surveys as a result of leasing activities under the proposed action.

Some exploration, development, and production activities have a potential to result in space-use conflicts with commercial fishing activities. Commercial fishing vessels could be excluded from normal fishing grounds to avoid the potential for gear loss. Such conflicts can sometimes be avoided by conducting seismic surveys during closed fishing periods or seasons. A potential also exists for loss of gear or access to fishing areas when floating drilling rigs used for exploration are being moved and during other vessel operations.

While compensation for loss or damage of commercial fishing gear attributable to offshore oil and gas operations may be available in some cases, the MMS cannot ensure that such reimbursements would occur. Most space-use conflicts are avoided by following existing navigation rules. In order to further address space-use conflicts, a stipulation for protection of fisheries has been implemented that requires lessees to review planned exploration and development activities with potentially affected fishing organizations and port authorities in order to prevent unreasonable fishing gear conflicts (Appendix C). Under this stipulation, there is also an ability to restrict lease-related uses if deemed necessary to prevent unreasonable conflicts with commercial fishing operations.

Offshore construction of platforms could infringe on commercial fishing activities by excluding commercial fishing from adjacent areas due to safety considerations. It is assumed that up to 6 production platforms could be constructed as a consequence of lease sales in the North Aleutian Basin Planning Area (Table IV-2). If it is assumed that a safety zone of 500 m needs to be maintained by larger vessels around each production platform, some commercial fishing could be excluded from up to 480 ha of surface area within the planning area. Drilling discharges associated with exploration activities would likely affect only a small area near a drilling platform, and are not expected to interfere with commercial fishing. During development and production phases, potential effects of such discharges would cease because all drilling muds, cuttings, and produced waters would be discharged into wells instead of being released to open waters. Potential effects of platform construction and operation are expected to be highly localized. Because only a very small area of the planning area would be affected, interference with commercial fisheries is also expected to be small.

Fishing activities could be temporarily excluded from some areas during construction of offshore pipelines. Once pipelines have been put in place, they could result in entanglement hazards for some types of fishing gear. The presence of an offshore pipeline would not typically interfere with the use of longlines, purse seines, drift nets (MMS, 2004f), or beach seines. However, bottom trawls, such as those employed by the commercial groundfish industry in the North Aleutian Basin Planning Area, have a potential to become snagged on exposed pipelines. The potential for snagging crab traps on pipelines is unknown. It is estimated that up to 150 miles of offshore pipeline would be placed in Bristol Bay as a result of lease sales in the North Aleutian Basin Planning Area, thereby increasing the potential for pipeline snagging by commercial fishing equipment.

It is anticipated that the small increase in vessel activity that could occur as a result of additional lease sales in the North Aleutian Basin Planning Area (up to 18 additional trips per week) would not measurably affect commercial fishing opportunities, catchability of fish and shellfish resources, or navigation by commercial fishing vessels.

Recreational Fisheries: In general, routine operations associated with exploration, development, or production activities could have localized effects on offshore recreational fisheries by causing changes in the distribution or abundance of fishery resources, by reducing the catchability of fish and shellfish, by precluding fishers from accessing viable fishing areas, or by causing losses or damage of equipment or vessels. However, it is anticipated that routine OCS activities would not affect overall levels of recreational fishing in Bristol Bay. As identified in Section IV.B.3.f(2), it is anticipated that routine operations would not result in detectable effects on overall populations of fishery resources in Bristol Bay or surrounding areas. Temporary displacement of fishery resources from localized areas could occur as a consequence of noise and activities associated with construction of platforms and pipelines or due to routine operations. Following platform and pipeline construction, there could be long-term localized changes in fish densities and species diversity due to attraction of some invertebrate and fish species to these structures.

As identified above for commercial fisheries, seismic surveys could temporarily affect the behavior of some targeted species, thereby affecting catch rates in the immediate area of the survey. Some recreational anglers in marine waters could decide to avoid areas during seismic surveys in order to avoid potential loss of fishing gear, due to the increased vessel activity, or because of perceived or actual changes in catchability. It is estimated that up to 138 km^2 of the North Aleutian Basin Planning Area could be subjected to seismic surveys as a result the proposed action. However, given the relatively small proportion of Bristol Bay that would be affected at any particular time, it is not anticipated that seismic surveys would markedly disrupt recreational fishing activities.

It is assumed that up to 6 production platforms and up to 150 miles of offshore pipelines could be constructed in the North Aleutian Basin Planning Area as a result of the proposed action (Table IV-2). Recreational fishing activities could be temporarily excluded from localized areas during construction of these structures. Following construction, recreational fishing boats could be excluded from small areas adjacent to platforms for safety considerations; the area lost to recreational fishing would be limited to the immediate footprint of the platforms plus a small safety zone surrounding each platform. Lease sales in the planning area could result in construction of up to 6 platforms, with a total footprint of approximately 9 ha. Overall, only a very small proportion of available recreational fishing areas in Bristol Bay would be affected. The presence of such platforms could also benefit anglers by aggregating some pelagic or groundfish species.

Vessel traffic to provide support to OCS activities could increase by 1 to 3 trips per week for each platform that is constructed, or up to 18 trips per week if the anticipated maximum number of 6 platforms are constructed. This would constitute a very small increase in overall vessel traffic in Bristol Bay. The potential increase in daily helicopter trips in the Bristol Bay area would not be expected to affect recreational fishing activities.

Accidents

Commercial Fisheries: Fisheries resources could become exposed to oil as a consequence of accidental oil spills. For lease sales resulting from the proposed 2007-2012 Leasing Program, it is assumed that 1 large oil spill could occur as a result of accidents at either pipelines (a volume of 4,600 bbl is assumed) or a platform (a spill volume of 1,500 bbl is assumed). In addition, it is assumed that 2 intermediate-sized spills (50-1,000 bbl in volume) and 10 small spills (< 50 bbl in volume) could occur (Table IV-4).

As identified in Section IV.B.3.f(2), multiple small spills or a single large spill could cause declines in subpopulations of some species inhabiting the North Aleutian Basin Planning Area, although the level of effects would be dependent on a variety of factors. It is anticipated that there would be no long-term effects on overall fish populations in Bristol Bay or the adjacent Bering Sea. However, even localized decreases in stocks of fish could have effects on some commercial fisheries by reducing catches or increasing the amount of effort needed or the distances that must be traveled to obtain adequate catches.

Even if stocks of fishery resources are not reduced as a consequence of a spill, specific fisheries could be closed due to actual or perceived contamination of fish or shellfish tissues. Such closures could result in considerable loss of income. Due to the relatively small amount of oil involved and the limited area likely to be affected, it is anticipated that the assumed small oil spills resulting from this alternative would not result in major closures or reduced market values of catches. A large oil spill (up to 4,600 bbl, as assumed under the proposed action) could result in closures of some area fisheries for at least short periods of time. Fisheries for groundfish and shellfish in deeper waters are less likely to be closed due to an oil spill because oil concentrations to which target organisms are exposed would likely be too low to cause direct effects. Regardless, even fish or shellfish from deeper areas could become commercially unacceptable for market due to actual or perceived contamination and tainting.

The bays and beaches of Bristol Bay have a number of setnet sites where gill nets are anchored to the beach or slightly offshore, and are used to harvest salmon and herring. If an oil spill came in the vicinity of such areas just prior to or during the commercial fishing season, such fisheries would likely be closed to protect both gear and harvest from possible contamination. Such areas would probably remain closed to commercial fishing until cleanup operations or natural processes reduced oil concentrations in fishery areas to levels considered safe. Areas where sediments become oiled could remain closed to commercial setnet fishing for multiple seasons.

Even though pelagic fishes would be less likely to be affected than fishes in shallow subtidal or intertidal areas, oil spills could contaminate gear used for commercial fishing, such as purse seines and/or drift nets. A large oil spill before or during the season when such fishing gears are in use could result in closures of some short-period, high-value commercial fisheries in order to protect gear or harvests from potential contamination.

Lines from longline fisheries for halibut, Pacific cod, and other fish species could also be affected by oil. Some lines and buoys fouled with small amounts of oil could be deemed unfit for future use.

Although it is unlikely that a trawler would be operating in an oiled area, the trawl catches could be contaminated by oil and rendered unfit for consumption and unprofitable if passed through such an area.

When the motor vessel *Selendang Ayu* ran aground along the northern shore of Unalaska Island in the Aleutian Island chain in December 2004, approximately 8,000 bbl of fuel oil and diesel were released into marine waters. This prompted closure of approximately 500 km^2 of State waters in the vicinity of the spill to all commercial fishing for a 9-month period until it was demonstrated that the threat of contaminating gear or fishery resources had subsided (ADFG, 2004b, 2005). Fisheries within the closure area that were affected included those for tanner crab, Pacific cod, black rockfish, and other groundfish species. Similar closures could be expected to occur in portions of Bristol Bay in the event of a large spill due to OCS activities in the North Aleutian Basin Planning Area. Depending on the magnitude, timing, and location of a spill, it is possible that affected fishery areas could be closed for a one or more seasons, resulting in economic losses.

Recreational Fisheries: As identified in Section IV.B.3.f(2), fisheries resources could be exposed to oil as a consequence of accidental oil spills. For this analysis, it is assumed that 1 large oil spill could occur as a result of accidents at either pipelines (a volume of 4,600 bbl is assumed) or a platform (a spill volume of 1,500 bbl is assumed). In addition it is assumed that 2 intermediate-sized spills (50-1,000 bbl in volume) and 10 small spills (< 50 bbl in volume) could occur (Table IV-4). While it is anticipated that these spills would not affect overall populations of fishes in Bristol Bay, some fish stocks in localized areas could be affected. The magnitude of such effects would depend upon many factors, including the volume of oil spilled, weather conditions, prevailing currents, locations, oil spill response actions, and whether the oil reached sensitive habitats for fishery resources. Declines in localized fish stocks could affect recreational fishing success and businesses associated with providing offshore recreational and sportfishing opportunities.

An oil spill could result in closure of some ports in an effort to protect ports and vessels from being oiled. Oil spills could potentially cause economic losses to boat owners and anglers by contaminating vessels and fishing gear. Oiled vessels would need to be cleaned, and oiled gear either cleaned or replaced; potential individual costs are expected to be relatively small. Charter operators could be inclined to temporarily avoid going out of port into Bristol Bay to avoid fouling their gear and vessels with oil. Public perception of oil-spill damage could temporarily reduce the number of anglers. If so, anglers would likely target alternate fishing areas until they deemed that the quality of the fishing experience in the oil-spill area had returned to previous conditions. Oil spills that reach waters near the mouths of freshwater tributaries during salmon spawning runs could result in loss of fishing opportunities in those tributaries due to concerns about contamination or tainting of fish that pass through oiled waters.

Populations of intertidal organisms could be depressed measurably for a year or more in intertidal areas contacted by spilled oil. Oil contacting specific beaches could affect clam gathering by depressing clam populations or tainting tissues of clams.

Conclusions

Although routine operations in the North Aleutian Basin Planning Area could have localized and temporary effects on some fishery resources, overall effects on populations of commercial fishery resources in Bristol Bay and surrounding waters from routine operations are not anticipated. Seismic surveys and construction of platforms and pipelines could result in space-use conflicts with commercial fishing activities, although these effects would be localized and, in the case of seismic surveys, temporary.

The level of effects from accidental spills would depend on the location, timing, and volume of spills; spill response activities; and other environmental factors. Small spills that could occur under the proposed action are unlikely to have a substantial effect on commercial fishing before dilution and weathering reduced concentrations of oil in the water; consequently, it is anticipated that small spills would not have substantial or long-term effects on commercial fisheries in Bristol Bay. It is anticipated that a single large spill as assumed under this alternative (up to 4,600 bbl) would affect only a small proportion of a given fish population within Bristol Bay, although substantial temporary effects on populations could occur if important habitat areas were contaminated. However, depending on specific conditions during a spill, there could be substantial economic losses for commercial fisheries as a consequence of reduced catch, loss of gear, or loss of fishing opportunities during cleanup and recovery periods.

Although there could be some localized, temporary effects on fishery resources, overall populations of biological resources that serve as the basis for recreational fisheries in Bristol Bay are not expected to be affected by activities associated with routine operations. The magnitude of effects from accidental spills would depend on the location, timing, and volume of spills, in addition to other environmental factors. Small spills that could occur under the proposed action are unlikely to affect a large number of fish or have a substantial effect on recreational fishing before dilution and weathering reduced concentrations of oil in the water; consequently, it is anticipated that small spills would not have long-term effects on recreational fishing in Bristol Bay. A large spill within the North Aleutian Basin Planning Area would likely affect only a small proportion of a given fish population, and it is unlikely that overall fish populations in Bristol Bay would be measurably affected. However, spills could have localized effects on recreational fishing as a consequence of contamination of fish tissues, damage to fishing gear, degradation of aesthetic values that attract anglers, or temporary closure of fishing areas.

(3) South Alaska Subregion

The central Gulf of Alaska, including Cook Inlet supports a large and diverse commercial fishery for groundfish, salmon, herring, and shellfish as described in Section III.B.19.c. This section evaluates potential impacts to commercial fisheries in the vicinity of Cook Inlet from routine exploration and development operations and from accidental spills that could occur as a result of lease sales in the Cook Inlet Planning Area.

The central Gulf of Alaska, including Cook Inlet supports, a large and diverse sportfishery as described in Section III.B.19.c. In this section, potential impacts to recreational fisheries in the vicinity of Cook Inlet from routine exploration and development operations and from accidental spills that could occur as a result of lease sales in the Cook Inlet Planning Area are evaluated

Routine Operations

Commercial Fisheries: Routine operations could affect commercial fisheries by causing changes in the distribution or abundance of fishery resources; by reducing the catchability of fish or shellfish; by precluding fishers from accessing viable fishing areas; or by causing losses or damage to equipment or vessels. It is anticipated that routine operations would not result in detectable effects on overall populations of fishery resources in Cook Inlet or the surrounding areas of the Gulf of Alaska. Temporary displacement of fishery resources from localized areas could occur as a consequence of noise and activities associated with construction activities during development; however, these resources would be expected to return once construction disturbances have been terminated. Following platform construction, there could be some highly localized long-term changes in fish densities and species diversity in the vicinity of platforms due to attraction of some invertebrate and fish species (Section IV.B.3.f).

Even in cases where dispersal does not occur, seismic surveys could temporarily affect the behavior of some targeted species, thereby affecting catch rates in the immediate area of the survey (see discussion in Thomson and Davis, 2001). While some studies indicate that effects of seismic surveys on catch rates are likely to be limited to the time of the survey or for short periods (hours) thereafter (e.g., Skalski et al., 1992), catch rates for some species could be affected for longer periods (e.g., Engås et al., 1996). It is anticipated that typical seismic survey would take between 14 to 35 days to complete and would encompass approximately 23 km^2 of surface area (MMS, 2003b); thus, it is estimated that up to 46 km^2 of the Cook Inlet Planning Area could be subjected to seismic surveys during the 2007-2012 Leasing Program.

Some exploration, development, and production activities have a potential to result in space-use conflicts with commercial fishing activities. Seismic-exploration vessels towing long cables have had a history of conflicts with the commercial fishing industry in Cook Inlet (MMS, 2003b), including losses of crab pots, longlines, or other gear. In some cases, commercial fishing vessels could be excluded from normal fishing grounds to avoid the potential for gear loss. Such conflicts can sometimes be avoided by conducting seismic surveys during closed fishing periods or closed seasons. A potential also exists for loss of gear or access to fishing areas when floating drill rigs used for exploration are being moved and during other vessel operations.

While compensation for loss or damage of commercial fishing gear attributable to offshore oil and gas operations may be available in some cases, the MMS cannot ensure that such reimbursements would occur. Most space-use conflicts are avoided by following existing navigation rules. In order to further address space-use conflicts, a stipulation for protection of fisheries has been implemented that requires lessees to review planned exploration and development activities with potentially affected fishing organizations and port authorities in order to prevent unreasonable fishing gear conflicts (Appendix C). Under this stipulation, there is also an ability to restrict lease-related uses if deemed necessary to prevent unreasonable conflicts with commercial fishing operations.

Offshore construction of platforms could infringe on commercial fishing activities by excluding commercial fishing from adjacent areas due to safety considerations. It is assumed that up to 2 production platforms could be constructed as a consequence of leasing in the Cook Inlet Planning Area (Table IV-2). If it is assumed that a safety zone of 500 m is maintained by larger vessels around each production platform, commercial fishing could be excluded from up to 160 ha of surface area within the planning area. Drilling discharges associated with exploration activities would likely affect only a small area near a drilling platform, and are not expected to interfere with commercial fishing. During development and production phases, potential effects of such discharges would cease because all muds, cuttings, and produced waters would be discharged into wells instead of being released to open waters. Potential effects of platform construction and operations is expected to be highly localized. Because only a very small area of the Cook Inlet would be affected, interference with commercial fisheries is also expected to be small.

Construction of pipelines can result in entanglement hazards for some types of fishing gear. The presence of an offshore pipeline would not typically interfere with the use of longlines, purse seines, drift nets (MMS, 2004b), or beach seines. However, a bottom trawl, such as those employed by the commercial groundfish industry in the Cook Inlet, has a potential to become snagged on exposed pipelines. It is estimated that up to 125 miles of additional offshore pipeline could result from lease sales in the Cook Inlet Planning area (Table IV-2), thereby increasing the potential for pipeline snagging by bottom trawling equipment.

It is anticipated that the small increase in vessel activity that could occur as a result of additional lease sales in Cook Inlet under the proposed action (up to 6 additional trips per week) would not measurably affect commercial fishing opportunities, catchability of fish and shellfish resources, or navigation by commercial fishing vessels.

Recreational Fisheries: In general, routine operations associated with exploration, development, or production activities could affect recreational fisheries by causing changes in the distribution or abundance of fishery resources, by reducing the catchability of fish and shellfish, by precluding fishers from accessing viable fishing areas, or by causing losses or damage to equipment or vessels. As identified in Section IV.B.3.f, it is anticipated that routine operations would not result in detectable effects on overall populations of fishery resources in Cook Inlet or the surrounding areas of the Gulf of Alaska. Temporary displacement of fishery resources from localized areas could occur as a consequence of noise and activities associated with routine operations. Following platform construction, there could be long-term localized changes in fish densities and species diversity due to attraction of some invertebrate and fish species to platforms.

As identified above for commercial fisheries, seismic surveys could temporarily affect the behavior of some targeted species, thereby affecting catch rates in the immediate area of the survey. Some recreational anglers could decide to avoid areas during seismic surveys due to the potential for loss of fishing gear, due to the increased vessel activity, or because of perceived or actual changes in catchability. It is estimated that up to 46 km^2 of the Cook Inlet Planning Area could be subjected to seismic surveys during the 2007-2012 Leasing Program. However, given the relatively small proportion of the available Cook Inlet area that would be affected at any particular time, it is not anticipated that seismic surveys would greatly disrupt recreational fishing activities.

Offshore construction of platforms could infringe on some recreational fishing activities by excluding recreational fishing boats from adjacent areas for safety considerations. It is assumed that up to 2 production platforms could be constructed as a consequence of lease sales in the Cook Inlet Planning Area (Table IV-2). However, the area lost to recreational fishing would be limited to the immediate footprint of the platforms plus a small safety zone surrounding each platform; thus, lease sales in the Cook Inlet Planning Area could result in construction of up to 2 platforms, with a total footprint of approximately 3 ha. Only a very small proportion of available recreational fishing areas in Cook Inlet would be affected. The presence of such platforms could also benefit anglers by aggregating some pelagic or groundfish species.

Vessel traffic to provide support to OCS activities could increase by 1 to 3 trips per week for each platform constructed or up to 6 trips per week if 2 platforms are constructed (Table IV-2). This would constitute a very small increase in overall vessel traffic in Cook Inlet. The potential increase in daily helicopter trips in the Cook Inlet area would not be expected to affect recreational fishing activities. Disturbance of recreational fishing opportunities from other activities associated with routine operations (e.g., pipeline construction) are also expected to be relatively minor.

Accidents

Commercial Fisheries: Fisheries resources could become exposed to oil as a consequence of accidental oil spills. For lease sales in the Cook Inlet Planning area under the proposed action, it is assumed that 1 large oil spill (a spill volume $\geq$ 1,000 bbl is assumed) could occur as a result of accidents at either pipelines (a spill volume of 4,600 bbl is assumed) or at a platform (a spill volume of 1,500 bbl is assumed). In addition it is assumed that 2 intermediate-sized spills (50-999 bbl in volume) and 10 small spills (< 50 bbl in volume) could occur (Table IV-4).

As identified in Section IV.B.3.f, multiple small spills or a single large spill could cause declines in subpopulations of some species inhabiting the Cook Inlet Planning Area, although the level of effects would be dependent on a variety of factors. It is anticipated that there would be no long-term effects on overall fish populations in the central Gulf of Alaska. However, even localized decreases in stocks of fish could have effects on some commercial fisheries by reducing catch or increasing the amount of effort or the distances that must be traveled to obtain adequate catches.

Even if fish stocks are not reduced as a consequence of a spill, specific fisheries could be closed due to actual or perceived contamination of fish or shellfish tissues. Such closures could result in considerable loss of income. Due to the relatively small amount of oil involved and the limited area likely to be affected, it is anticipated that the assumed small oil spills would not result in closures or reduced market values of catch over the life of the 2007-2012 Leasing Program.

A large oil spill could result in closures of some fisheries for at least short periods of time. The Cook Inlet commercial shellfish industry is likely to be affected by closures because such a spill would be likely to affect shellfish in nearshore subtidal and intertidal areas. Fisheries for shellfish that occur in deeper waters, where oil residues seldom reach, are less likely to be closed. For example, weathervane scallop beds that are commercially harvested off Augustine Island in 38-115 m of water are unlikely to be damaged by an oil spill that passes through the area because oil concentrations at those depths would likely be too low to cause direct effects. Regardless, even shellfish from deeper areas could become commercially unacceptable for market due to actual or perceived contamination and tainting.

The bays and beaches of Cook Inlet have a number of setnet sites where gillnets are anchored to the beach or slightly offshore, and are used to harvest salmon and herring. Oil spills could damage setnet fisheries, as evidenced by the *Exxon Valdez* oil spill of 1989. While only a relatively small volume of weathered oil entered the lower Cook Inlet region as a result of that spill, the commercial salmon fishery was closed to protect both gear and harvest from possible contamination. Under the proposed action, a spill the size of the assumed largest spill (4,600 bbl) in Cook Inlet would, by itself, probably also result in the area being temporarily closed to commercial fishing until cleanup operations or natural processes reduced oil concentrations in fishery areas to levels considered safe.

Although pelagic fishes would be less likely to be affected than fishes in shallow subtidal or intertidal areas, oil spills could contaminate gear used for commercial fishing, such as purse seines and or drift nets. A large oil spill before or during the season when such fishing gears are in use could result in closures of some short-period, high-value commercial fisheries in order to protect gear or harvests from potential contamination.

Lines from longline fisheries for halibut, Pacific cod, black cod, and other fish species could be also be affected by oil. Some lines and buoys fouled with small amounts of oil could be unfit for future use. Although it is unlikely that a trawler would be operating in an oiled area, the trawl catches could be contaminated by oil and rendered unfit for consumption if the trawler did pass through such an area. For an assumed 4,600-bbl spill in Cook Inlet, it is estimated that the affected area could range from 265-1,100 km^2 (MMS, 2002g).

Based on analyses conducted by MMS for Cook Inlet oil spills of the same sizes assumed for large spills in this analysis and assumptions about the value of commercial fisheries in Cook Inlet, it was estimated that the occurrence of a 4,600-bbl oil spill in lower Cook Inlet could result in an economic loss to commercial fisheries of about 22-37 percent per year for 2 years (MMS, 2003b). Depending on the timing and location of a spill, it was also considered possible that the fishery could be closed for a whole season, resulting in a 100-percent loss for a given year.

Recreational Fisheries: As identified in Section IV.B.3.f, fisheries resources could be exposed to oil as a consequence of accidental oil spills. For this analysis, it is assumed 1 large oil spill (≥ 1,000 bbl) could occur as a result of accidents at either a pipeline (4,600-bbl volume is assumed) or a platform (a s 1,500-bbl volume is assumed). In addition it is assumed that 2 intermediate-sized spills (50-999 bbl in volume) and 10 small spills (< 50 bbl in volume) could occur (Table IV-4). While it is anticipated that these spills would not affect the overall populations of fishes in the central Gulf of Alaska, some fish stocks in localized areas of Cook Inlet could be affected. The magnitude of such effects would depend upon many factors, including the volume of oil spilled, weather conditions, prevailing currents, locations, oil-spill response actions, and whether the oil reached sensitive habitats for fishery resources. Declines in localized fish stocks could affect recreational fishing success and businesses associated with providing recreational and sport fishing opportunities.

An oil spill could result in a closure of ports in an effort to protect the port and vessels from being oiled. Oil spills could potentially cause economic losses to boat owners and anglers by contaminating vessels and fishing gear. Oiled vessels would need to be cleaned, and oiled gear either cleaned or replaced; potential individual costs are expected to be relatively small. It is anticipated that many anglers would choose to fish in alternate areas in the event of port closures. Charter operators could be inclined to temporarily avoid going out of port into Cook Inlet to avoid fouling their gear and vessels with oil. Public perception of oil-spill damage, real or perceived, could temporarily reduce the number of anglers. If so, anglers would likely target alternate fishing areas until they deemed that the quality of the fishing experience in the oil-spill area had returned to the previous conditions.

While, charter operators could lose business in the event of a large spill, a report on the July 2, 1987, *Glacier Bay* tanker oil spill found “no measurable impacts” on sportfishing from that spill (Northern Economics, 1990). The *Glacier Bay* was in transit from Valdez to the Kenai pipeline facilities when it is assumed to have hit an uncharted rock approximately 20 miles west of the Kasilof River. It is estimated that 3,100 bbl of oil were spilled (Northern Economics, 1990). Although several popular sportfishing runs had already ended when the spill occurred, the busiest season was beginning for the halibut charter-boat fishery, and the second-run Kenai salmon sport fishing season was just opening for the year. Northern Economics (1990) did not find evidence of losses in these sportfisheries due to oil-fouled boats or gear, loss of fishing opportunity, or harvest of oil-fouled fish that had to be discarded (with only one exception). In addition, the numbers of fish caught did not appear to be affected, and customers did not cancel reservations because of concerns about the spill (Northern Economics, 1990).

Populations of intertidal organisms could be depressed measurably for a year or more in intertidal areas contacted by spilled oil. Oil contacting beaches could affect clam gathering by depressing clam populations or tainting tissues of clams.

Conclusion

Overall populations of biological resources that serve as the basis for commercial fisheries in the Cook Inlet are not expected to be altered by routine exploration, development, or production activities conducted as a result of lease sales under the proposed action. The level of effects from accidental spills would depend on the location, timing, and volume of spills; spill response activities; and other environmental factors. Small spills that may occur under the proposed action are unlikely to have a substantial effect on commercial fishing before dilution and weathering reduced concentrations of oil in the water; consequently, it is anticipated that small spills would not have substantial or long-term effects on commercial fisheries in the Cook Inlet. It is anticipated that any single large spill (up to 4,600 bbl) would affect only a small proportion of a given fish population within the Cook Inlet, although substantial temporary effects on populations could occur if important habitat areas were contaminated. However, there could be effects on commercial fishing as a consequence of reduced catch, loss of gear, or loss of fishing opportunities during cleanup and recovery periods.

The populations of biological resources that serve as the basis for recreational fisheries in the Cook Inlet are not expected to experience population-level impacts as a result of activities associated with routine operations. The magnitude of effects from accidental spills would depend on the location, timing, and volume of spills, in addition to other environmental factors. Small spills that could occur under the proposed action are unlikely to affect a large number of fish or have a substantial effect on recreational fishing before dilution and weathering reduced concentrations of oil in the water. Consequently, it is anticipated that small spills would not have long-term effects on recreational fishing in the Cook Inlet. A large spill would likely affect only a small proportion of a given fish population within the Cook Inlet, and it is unlikely that overall fish populations in the central Gulf of Alaska would be measurably affected. However, spills could have localized effects on recreational fishing as a consequence of contamination of fish tissues, damage to fishing gear, degradation of aesthetic values that attract fishers, or temporary closure of fishing areas.

4. Atlantic Region

a. Air Quality

Routine Operations

Projected emissions for the proposed 2007-2012 Leasing Program were made using emission factors derived from an emissions inventory constructed by Wilson et al. (2004). The results are shown in Table IV-13. The emissions from platform production, support vessels, and helicopters are averaged over the projected 40-year duration of activities. Emissions from exploratory drilling, platform construction, and pipeline installation were averaged over a period of 1-5 years.

The mid-Atlantic OCS facilities located within 25 miles from the State seaward boundary would be subject to the same requirements as would be applicable if the facility were located in the nearest onshore area. The applicable regulations are those that were promulgated by the Virginia Department of Environmental Quality. The Norfolk-Virginia Beach-Newport Beach-Hampton Roads area is designated marginal nonattainment for ozone (O_3). Therefore, facilities with emissions greater than 100 tons per year of nitrogen oxide (NO_x) or volatile organic compounds (VOC) would need to obtain emission offsets (9 VAC 5-80-2120). If the projected emissions are greater than 250 tons per year, an air quality modeling analysis is required to determine compliance with the national ambient air quality standards (NAAQS) and the Prevention of Significant Deterioration (PSD) increments. Facilities would have to apply best available control technology, but for sources located within 25 miles from the State seaward boundary, more stringent requirements may apply. The OCS facilities located more than 25 miles from the State seaward boundary would not be subject to offset requirements.

Exploration drilling, construction activities, and production platforms are expected to result in only a small increase in levels of nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and particulate matter less than 10 microns in diameter (PM_{10}) in the nearest onshore areas. Concentrations are expected to be within the NAAQS and PSD increments. The potential effects on O_3 concentrations in the region should be minimal due to the relatively low emissions from the proposed action, and emission sources within 25 miles from the State seaward boundary would be offset.

Accidents

Small accidental oil spills would cause limited, localized increases in concentrations of VOC due to evaporation of the spill. Most of the emissions would be expected to occur within a few hours of the spill and would decrease drastically after that period. Large spills could result in emissions over a broader area and a longer period of time. In situ burning of a spill results in emissions of NO_x, SO_2, carbon monoxide (CO), and PM_{10}, and would generate a plume of black smoke. For a more complete discussion, see Section IV.B.2.a. Based on the discussions in this section, any air quality impacts from oil spills should be localized and of short duration and should not pose a significant risk to human health. Any impacts from in situ burning should also be limited. Pollutant concentrations would not be expected to be within the NAAQS. The air quality impacts from oil spills and in situ burning would, therefore, be short term.

Conclusion

Concentrations of NO_2, SO_2, and PM_{10} from any routine activities associated with the proposed action in the mid-Atlantic are expected to be within the applicable maximum allowable increases. The concentrations of NO_2, SO_2, PM_{10}, and CO are expected to remain well within the NAAQS. Impacts from oil spills would be localized and short-term.

b. Water Quality

This section analyzes impacts to water quality from exploration and development and production activities associated with one proposed lease sale in the Mid-Atlantic Planning Area. Coastal waters, as defined here, include the bays, estuaries, and coastal wetlands along the mid-Atlantic coast and State waters extending out to 3 nautical miles offshore of the coastline. Marine waters extend from this boundary out to the Exclusive Economic Zone or, from 3 nautical miles offshore of the coastline to approximately 200 miles from the coastline.

Water quality in the mid-Atlantic coastal region is primarily controlled by the land uses, including numerous urbanized centers and large expanses of agricultural lands, of the mid-Atlantic watersheds. Due to the influence of the Gulf Stream and other ocean and shelf currents, water quality in marine waters in the mid-Atlantic is not measurably influenced by pollutants generated on land. That said, the majority of ocean pollution, regardless of its location, originates from land-based sources. Only 20 percent of all anthropogenic sources of pollution found in the ocean are estimated to originate from activities occurring in ocean waters (U.S. Commission on Ocean Policy, 2004).

(1) Coastal Waters

Coastal waters in the Mid-Atlantic Planning Area are characterized by elevated concentrations of dissolved inorganic nitrogen, dissolved inorganic phosphorus, chlorophyll a, and decreased dissolved oxygen (DO) concentrations. These conditions are particularly prominent in the Chesapeake and Delaware Bays, where hypoxic conditions facilitate highly eutrophic conditions, evidenced by the prolonged algae blooms in the area.

In addition to the large input of nutrients into the estuaries of the mid-Atlantic, high bacterial loads and potentially toxic organic chemicals and metals from both point source and nonpoint source runoff are prevalent in the mid-Atlantic coastal areas.

Exploration

The factors that may contribute to water quality degradation from exploration activities related to the lease sale in the mid-Atlantic are the installation and operation of one or more drilling rigs, the drilling of 10-15 exploration wells, 1-5 service vessel trips per week, 5-10 helicopter trips per week, and the use of support bases in the Hampton Roads area for vessel and helicopter service and support (Table IV-3). No large oil spills would be assumed to occur during exploration activities, and small spills < 1000 bbl) are possible but would be considered unlikely.

The installation and operation of any and all drilling rigs, as well as the drilling of all exploratory wells, would be located offshore in marine waters. The effects of these activities would only pose an impact to coastal waters in so far as sediment and other contaminants associated with these activities would be able to travel into coastal areas. Because of the prevailing current regime in the area and the rapid dissipation rate of drill muds and cuttings associated with exploration wells, and of sanitary and domestic wastes associated with drilling rigs, it is highly unlikely that these contaminants will impact coastal waters.

Vessel and helicopter trips to and from the drilling rigs to a port in the Hampton Roads area would generate routine discharges that could impact coastal water quality. These discharges would include atmospheric deposition of fuel and direct discharges of sanitary wastes and bilge water. The atmospheric deposition of fuel from both vessels and helicopters would be minimal, but would nonetheless contribute an incremental amount of petroleum into coastal waters. Bilge water discharges from support vessels could also contain petroleum and metals from machinery. Routine operational petroleum deposition and discharge, bilge water, and sanitary discharges in larger coastal water channels would produce minor localized effects that would not approach significant proportions because of the large volume of water available to dilute the discharges and the presence of currents that would promote mixing. However, if these discharges were to enter the Chesapeake Bay, due to its proximity to the Hampton Roads area, there might be insufficient water volume or currents for mixing and dilution that could exacerbate the Bay's hypoxic conditions, as these wastes would incrementally consume DO in the water. In this scenario, water quality could be degraded. Compliance with applicable NPDES permits and USCG regulations would prevent or minimize most impacts on receiving waters, and water quality would quickly recover to background conditions

The use of existing support bases in the Hampton Roads area, and the onshore disposal of offshore solid wastes, may affect coastal water quality by contributing a minimal increase over background levels of onshore point and non-point discharges into mid-Atlantic waters. In so far as vessel traffic associated with exploration activities would require the use of maintained shipping channels for safe operation, some sediment disturbance is likely due to routine channel dredging activities in the Hampton Roads area.

Though no large oil spills would be assumed to occur during exploration activities, some small spills are possible. Small oil spills, though unlikely, would produce small, but measurable, impacts on water quality. Assuming that all small spills would not occur at the same time and place, water quality would only be temporarily degraded and would rapidly recover because of mixing, dilution, and weathering. Weathering processes that transform the oil include volatilization, emulsification, dissolution, chemical oxidation, photo-oxidation, and microbial oxidation (NRC, 2003a; NOAA, 2005b). Oil is insoluble in water and partitions into both lighter and heavier density fractions when released into water. Lighter oil fractions (such as benzene, toluene, ethylbenzene, and xylene) often comprise the majority of the initial volume of an oil spill, and are especially susceptible to weathering processes, including evaporation.

The impacts of an oil spill could increase in magnitude with increasing proximity to shore. If an oil spill were to occur adjacent to the coastline, the oil would not be easily dispersed, and weathering could be slower than it would be offshore. Effects on water quality could persist if oil reached coastal wetlands and was deposited in fine sediments, becoming a long-term source of pollution because of remobilization. In such locations, spill cleanup might be necessary for the recovery of the affected areas. Shoreline cleanup operations could consist of washing or excavation activities involving crews working with sorbents, hand tools, and heavy equipment.

Conclusion

The impacts associated with exploration activities on coastal water quality are expected to be localized and short term, and should not result in long-term degradation in the background water quality in the area. Because of the distance of coastal areas from rig installation and drilling activities, the impacts with a potential to affect coastal waters are limited to the discharges from support vessels and helicopters operating nearshore, onshore point and nonpoint source discharges into mid-Atlantic waters from support facilities, and small accidental oil spills. Small spills would result in short term, temporary impacts to coastal water quality.

Development and Production

If development and production activities from the lease sale were to occur in the mid-Atlantic, the factors that may contribute to water quality degradation are the drilling of 8-12 development and production wells, the installation and operation of one platform, 1-5 service vessel trips per week and 5-10 helicopter trips per week to and from the platform, the transportation of oil from the platform to the Hampton Roads area by tanker, and the construction and operation of a pipeline (25 to 75 miles long [40-120 km]) to transport natural gas from the platform to an onshore processing facility (Table IV-3).

Existing support bases would be used in the Hampton Roads area for vessel and helicopter service and support. Similarly, an existing oil storage and/or processing facility would be used for any oil produced. A new gas processing facility would be constructed in the event that gas is produced. One large oil spill of 1,500 bbl from a tanker is assumed to occur during development and production activities for the purpose of analysis, in addition to 1-2 small spills (50-999 bbl) and 5-10 very small spills (< 50 bbl).

The installation and operation of the platform, and all development and production wells, would be located offshore in marine waters. The effects of these activities would only pose an impact to coastal waters in so far as sediment and other contaminants associated with these activities would be able to travel into coastal areas. Because of the prevailing current regime in the area and the rapid dissipation rate of drill muds and cuttings associated with the development and production wells, and of sanitary and domestic wastes associated with the platform, it is highly unlikely that these contaminants will impact coastal waters.

Vessel and helicopter trips to and from the platform to a port in the Hampton Roads area would generate routine discharges that could impact coastal water quality, as discussed above under the exploration phase of the project.

The use of existing support bases and the construction of a new gas processing facility in the Hampton Roads area, may affect coastal water quality by contributing a minimal increase over background levels of onshore point and nonpoint source discharges into mid-Atlantic waters. In so far as vessel traffic associated with exploration activities would require the use of maintained shipping channels for safe operation, some sediment disturbance is likely due to routine channel dredging activities in the Hampton Roads area.

Under the proposed action scenario, a natural gas pipeline extending across coastal waters into the Hampton Roads area would be constructed and operated. Trenching operations to bury the pipeline would suspend sediments, causing short-term increases in turbidity in the coastal waters along the pipeline corridor. Though the amount of sediment disturbed by the pipeline trenching would be highly dependent on the technique of trenching and type of bottom sediment encountered, the disturbance of bottom sediments caused by these operations would be unavoidable. Trenching may be accomplished by jetting, or excavating by rotary or plow techniques. Trenching in firm bottom sediments, such as clay, disturbs less than half of the amount of sediment than trenching in soft bottom sediments, such as loose sand bottoms.

The impacts of turbidity from the suspended sediment plume associated with trenching activities would include decreased light attenuation in the water column, direct smothering of aquatic habitats and species, and resuspension of contaminated sediments. These impacts are discussed in depth under the marine waters section, found below. Although pipeline trenching has a substantive effect on bottom water quality, this activity entails a one-time disturbance. The impacts associated with turbidity from the construction of the pipeline would be temporary and would be confined to a localized area of disturbance in the immediate vicinity of the pipeline. Water quality would return to background concentrations once construction activities were completed because of settling and mixing.

The transportation of oil by tanker, from the platform to the Hampton Roads area, would increase the risk of oil spills in coastal waters. One large oil spill of 1,500 bbl from a tanker is assumed to occur during development and production activities for the purpose of analysis (Table IV-4), in addition to 1-2 small spills (50-999 bbl) and 5-10 very small spills (< 50 bbl). Water quality would be temporarily degraded from any oil spill, but would most likely rapidly recover because of mixing, dilution, and weathering factors.

The volatile (lighter density) fraction of crude oil contains the most toxic components of the oil. Due to weathering, these volatile components are generally removed before a spill reaches the shore, greatly reducing the acute toxicity of the spill. However, if a large oil spill were to occur adjacent to the coastline and enter an estuary, in particular the Chesapeake Bay, the effects on water quality could be immediate and severe. Actual impacts would depend on currents, turbulence, water temperature, and volatility of the crude oil. Turbulence in estuaries is usually less than in nearshore or offshore environs, causing a slower rate of oil dissipation and, therefore, resulting in a more prolonged effect on water quality. Other factors peculiar to estuaries are the large area of shallow, low energy, intertidal zones where oil may become stranded and weather relatively slowly, as well as the high content of suspended sediments that are expected to cause oil to aggregate and sink. Once oil particles settle out, their weathering would slow, causing an extended period of poor water quality as oil seeps slowly from the bottom. Secondary effects, associated with the slow breakdown of oil, would result in the consumption of DO in bottom waters. Oil-saturated sediments in estuaries may also periodically resuspend and affect water quality for extended periods of time. After evaporation, dissolution, emulsification, photo-oxidation, and biodegradation have taken place, the remaining oil residue would form into tar balls. The persistence of tar balls can be traced to the relatively small surface area, and to their incorporation into bottom sediment where processes of biochemical and chemical degradation are reduced (MMS, 1992b).

Conclusion

The impacts associated with development and production activities on coastal water quality are expected to be localized, short to medium term, and would most likely not result in long-term degradation to the background water quality conditions in the area. Because of the distance of coastal areas from platform installation and drilling activities, these activities are not anticipated to impact coastal waters. The impacts with a potential to affect coastal waters are associated with the discharges from support vessels and helicopters operating nearshore, onshore point and nonpoint source discharges into mid-Atlantic waters from support facilities, the installation of a natural gas pipeline, and accidental oil spills, including the risk of one large spill from tanker transport of oil.

Small spills would result in short term, temporary impacts to coastal water quality. A large spill would have temporary impacts to water quality, however, clean-up efforts and evaporation, dilution, and dispersion would minimize the possibility of persistent impacts.

Oil spills in coastal waters in and near the Chesapeake Bay could reduce or impair water quality. The magnitude of the impacts would depend on the specific location affected and the nature and magnitude of the accident. Spilled oil entering the Bay would aggregate with suspended sediment, sink, and cause an extended period of locally poor water quality. Tar, the final product, could remain for a number of months in the marine environment but would have little additional effect on water quality (MMS, 1992b). There are not expected to be any long-term, widespread impacts on water quality.

(2) Marine Waters

Water quality in the marine waters in the Mid-Atlantic Planning Area is generally good. There are, however, some major local variations; due primarily to the influence of estuarine ebb flow plumes and ocean dumping sites (MMS, 1998). Concentrations of most trace metals, except lead, in deepwater sediments have been found to be at or below the average composition for shale in other parts of the world. Additionally, concentrations of suspended matter (turbidity) are typically low in mid-Atlantic marine waters, though they increase naturally during storm events and vary locally between surface and bottom waters, different seasons, and in different areas due to differing sources and grain sizes.

Exploration

Marine waters could experience water quality degradation from exploration activities related to the lease sale in the mid-Atlantic from the installation and operation of one or more drilling rigs, the drilling of 10-15 exploration wells, and the 1-5 service vessel trips per week and 5-10 helicopter trips per week anticipated to occur between the shore and the rigs (Table IV-3). The use of support bases in the Hampton Roads area for vessel and helicopter service and support would not significantly affect marine waters due to the distance of the bases; any pollutants that enter coastal waters in the course of operating the support bases would dissipate and disperse prior to entering marine waters, thereby becoming negligible impacts on marine water quality. No large oil spills would be assumed to occur during exploration activities, and small spills (< 1000 bbl) are possible but would be considered unlikely.

The effects of drilling muds and drill cuttings on water quality are anticipated to be short-term and limited to an area in the immediate vicinity of the discharge site. The principal effects on water quality from the discharge of drilling muds and cuttings include decreases in DO, and increases in turbidity, heavy metals, hydrocarbons, and nutrients.

Exploration wells produce about 7,860 bbl of drill muds per well and 2,680 bbl of drill cuttings per well (Table IV-3). Thus, the drilling of 10-15 exploration wells which would produce a total of 78,600 to 117,900 bbl of drill muds and 26,800 to 40,200 bbl of drill cuttings. Discharges of drilling muds and cuttings during normal operations are regulated by NPDES general permits issued by the USEPA. In areas where disposal of drilling muds and cuttings at sea is permitted under an NPDES general permit and MMS regulations, their environmental effects would be localized and reversible because of settling, mixing, and dilution factors.

The dilution of discharged drilling muds has been previously studied in the mid-Atlantic. Normally, drilling muds do not reach the bottom at the discharge site due to currents and turbulence on the OCS. In addition to current and turbulence, the amount of mud dispersed in the water column and its associated impacts depend on the location of the discharge point in the water column and density stratification of the water column. Conservative estimates predict that increased turbidity and other impacts associated with suspended sediments are expected to be measurable only within 800-1,000 m (2,600-3,280 feet) of the discharge point (MMS, 1992b).

However, within the localized zone of impacts from the discharge of muds, turbidity and suspension of sediment contaminants will increase. While increased turbidity generally decreases light attenuation in the water column, at the depths the drilling will take place this would be considered a negligible impact. Turbidity may also directly affect the biological ecosystem. In high concentrations, suspended sediments may affect the gills of fish and impair photosynthetic processes. Mobile organisms may temporarily migrate out of the zone of turbidity. Upon settling, the sediment can blanket or smother benthic organisms and block filter mechanisms (MMS, 1999b). Overall, studies from the mid-Atlantic and other oil and gas exploration regions indicate that effects on water quality from the discharge of drilling muds and cuttings are not expected to last more than a few hours and are limited to the general vicinity of the discharge point (MMS, 1992b).

Potential causes of decreased water quality from turbidity other than drilling muds and drill cuttings include bottom disturbance associated with the installation and operation of one or more drilling rigs, and from the discharge of domestic and sanitary waste from drilling and support vessels. These impacts are all expected to have effects on water quality that last no more than a few hours and then only in the immediate vicinity of the discharge point.

Drilling and service vessels, in addition to helicopter trips to and from the drilling rigs, would generate routine discharges that could impact marine water quality. These discharges would include atmospheric deposition of fuel and direct discharges of sanitary wastes and bilge water. The atmospheric deposition of fuel from both vessels and helicopters would be minimal, but would, nonetheless, contribute an incremental amount of petroleum into coastal and marine waters. Bilge water discharges from support vessels could also contain petroleum and metals from machinery. Sanitary and domestic waste and deck drainage would be expected to occur from drilling and service vessels as part of normal operations and could contribute to water-quality degradation. However, sanitary and domestic wastes would be routinely processed through onsite waste treatment facilities before being discharged overboard. Discharging of domestic and sanitary wastes from drillships must comply with USEPA NPDES permit requirements. These requirements include a requirement for a total residual chlorine concentration (minimum of 1.0 milligrams per liter) in order to control fecal coliform in the discharge, and a prohibition on floating solids and foams. The principal impact from these wastes is expected to be an increase in nutrients (phosphates and nitrates) and organic compounds resulting in an increase in biological oxygen demand and chemical oxygen demand. Due to ocean turbulence and the large volume of receiving waters, however, the DO concentration is not expected to decrease measurably.

Routine discharges associated with deck drainage and the release of ballast and bilge waters are subject to NPDES permit requirements of the “no visible oil or sheen” standard. The NPDES regulations also require a static sheen test for drilling muds during each discharge. Sand and sludge recovered from the treatment processes would be containerized and shipped to shore for disposal. Impacts to water quality from such discharges would require no mitigation because of the treated nature of the wastes, the small quantities of discharges involved, and the mixing and dilution of the wastes with large volumes of water.

As in the case of coastal waters, accidental oil releases in the Mid-Atlantic Planning Area could affect the quality of marine waters. Though no large oil spills would be assumed to occur during exploration activities, some small spills (< 1,000 bbl) are possible (Table IV-4). The magnitude of these impacts, and the rate of recovery, would depend on the location and size of the spill, type of product spilled, weather conditions, and environmental conditions at the time of the spill. Generally, oil spilled below the surface rises rapidly as droplets, which coalesce to form a slick on the water surface, enabling rapid and standard cleanup measurements to occur. During times of oceanic turbulence, however, the slick will break up into two components, a surface slick and a subsurface plume that, in part, will form an emulsion of oil in water. The stability of the subsurface plume will depend on turbulence and the proportion of volatile components in the oil. A large, subsurface plume component will extend the period of poor water quality since it would reduce the rate of dissipation. In the absence of other types of weathering, subsurface plumes may ultimately weather to tar to a greater extent than surface slicks. Tar is denser than the surrounding water and may remain from several months to years in the marine environment before it is broken down (MMS, 1992b).

Conclusion

Impacts to marine waters resulting from exploration activities under the proposed action could reduce or impair water quality. These impacts would primarily be generated from drilling activities, including the installation and operation of a drilling rig(s), and the discharges from support vessels and helicopters. The impacts are expected to be localized and short-term. No impacts to marine waters are anticipated from support bases located on land.

Compliance with NPDES permit requirements would minimize or prevent most impacts to receiving waters caused by discharges from routine exploration activities. Water quality would recover when discharges ceased because of dilution, settling, and mixing. Small oil spills would have temporary and localized impacts to water quality.

Development and Production

Development and production activities from one lease sale in the Mid-Atlantic Planning Area would include the installation and operation of one platform, the drilling of 8-12 development and production wells, 1-5 service vessel trips per week and 5-10 helicopter trips per week to and from the platform, the transportation of oil from the platform to the Hampton Roads area by tanker, and the construction and operation of a pipeline (25-75 miles long) to transport natural gas from the platform to an onshore processing facility (Table IV-3). For the purpose of analysis, 1 large oil spill of 1,500 bbl from a tanker, in addition to 1-2 small spills (50-999 bbl) and 5-10 very small spills (< 50 bbl), would be assumed to occur during development and production activities.

Development and production wells produce about 5,800 bbl of drilling muds per well and 1,630 bbl of drill cuttings per well (Table IV-3). Thus, the drilling of 8-12 development and production wells would produce a total of total of 46,400-69,600 bbl of drilling muds and 13,040-19,560 bbl of drill cuttings. Discharges of drilling muds and cuttings during normal operations would be regulated by NPDES general permits issued by the USEPA, and impacts from the discharge of drilling muds and cuttings would be the same as those discussed above during the exploration well phase. In areas where disposal of drilling muds and cuttings at sea is permitted under an NPDES general permit and MMS regulations, their environmental effects would be localized and reversible because of settling, mixing, and dilution factors.

In addition to drilling muds and cuttings, produced water will be generated during operation of development and production wells. Produced water is water that is brought to the surface from an oil-bearing formation during oil and gas extraction. Production tests are initially anticipated to result in average discharges of 68 bbl of formation water from each well. Generally, the amount of produced water is low when production begins but increases over time near the end of the field life. Produced water may contain specialty chemicals added to the well for process purposes (e.g., biocides and corrosion inhibitors) and chemicals added during treatment of the produced water before its release to the environment (e.g., water clarifiers). Produced water may also have elevated concentrations of salts, petroleum hydrocarbons, some metals, and naturally occurring radioactive material.

The discharge of produced water into the sea may degrade water quality in the immediate vicinity of the discharge point because of its potential constituents. The USEPA modeling performed in conjunction with laboratory tests indicates that produced water discharges reach nontoxic levels within about 100 m of the discharge point, assuming discharge rates up to 25,000 barrels per day because of dilution, dispersion, and settling (Avanti Corporation, 1993). Because discharge points are typically much farther apart than 100 m, no interactions that would measurably affect water quality are expected between them, and background concentrations are expected to exist away from the immediate area of the discharge location.

Formation water, domestic and sanitary waste, and deck drainage, are all regulated by NPDES permit requirements issued by the USEPA, and are expected to have effects on water quality that last no more than a few hours, and then only in the immediate vicinity of the discharge point. Sanitary and domestic wastes would be routinely processed through onsite waste treatment facilities before being discharged overboard, and deck drainage would be treated onsite to remove oil and then discharged, as described above during the exploration phase of the proposed project.

Under the proposed action scenario, a natural gas pipeline extending from marine waters into the Hampton Roads area would be constructed and operated. Entrenched pipelines may disturb bottom sediments in an area 20 m wide along their axis. However, pipeline trenching is not necessary if the water depth is greater than 60 m (200 feet). Wherever trenching is required in marine waters, it would suspend sediments causing short-term increases in turbidity along the pipeline corridor. The impacts associated with turbidity from the construction of the pipeline would be temporary, and would be confined to a localized area of disturbance in the immediate vicinity of the pipeline. Water quality would return to background concentrations once construction activities were completed because of settling and mixing. Additional causes of short-term decreased water quality from turbidity include the preparation of the foundation for the production platform. Total bottom area disturbance for installation of the platform would be 2 to 5 ha (5-12 acres).

The transportation of oil by tanker, from the platform to the Hampton Roads area, would increase the risk of oil spills in coastal waters, including the risk of one large spill. Oil spilled in the offshore environment will, in all likelihood, have dissipated its lighter-weight hydrocarbons before reaching shallow water. The processes active on spilled oil in shallow water are confined primarily to further emulsification, sedimentation, biodegradation, and tar ball production. It is assumed that, because the volatiles are the most toxic components of the crude oil and are largely removed before the spill reaches the shore, the acute toxicity of the spill is greatly reduced. The impact of an oil spill on marine waters would be substantive but short term, as a consequence of the highly turbulent nature of the marine environment and the rapid rate of dispersion and evaporation of the spill. Tar, the final product of the weathering of oil in the oceanic environment, would remain for a number of months but would have little additional effect on water quality (MMS, 1992b).

Conclusion

The impacts to marine waters associated with development and production activities under the proposed action could reduce or impair water quality, but such impacts are expected to be localized, short to medium term, and would most likely not result in long-term degradation to local water-quality conditions. These impacts would be primarily generated from drilling activities, platform installation and operation, and the routine discharges from support vessels and helicopters.

Compliance with NPDES permit requirements would minimize or prevent most impacts to receiving waters caused by discharges from routine activities. Water quality would recover when discharges ceased because of dilution, settling, and mixing. Oil spills would have temporary and localized impacts to water quality. Spill cleanup efforts and evaporation, dilution, and dispersion would minimize the long-term impacts.

c. Marine Mammals

The Mid-Atlantic Planning Areas supports a diverse community of marine mammals including 27 species of cetaceans, 4 species of pinnipeds, and 1 sirenian as described in Section III.C.6. Because of differences in their distribution and ecology, not all species of marine mammals reported from the mid-Atlantic would be expected to be equally exposed to or affected by exploration, development, and production activities. The majority of the nonendangered and nonthreatened marine mammals on the Atlantic OCS are small cetaceans. With the exception of the minke whale and Bryde's whales, the nonendangered cetaceans occurring on the Atlantic OCS are species of dolphin, porpoise, and beaked whales. These cetaceans are widely distributed on the Atlantic OCS and occur year round within the potential lease area (Fig. III-47). Many species are adapted to the shelf/slope habitat where most of the leasing activities would be expected to occur. Pinnipeds occurring in this area may also be vulnerable to adverse effects of oil exploration, development, and production.

Although six endangered cetacean species are listed for the mid-Atlantic, they do not all occur routinely on the Atlantic OCS. Fin whales could be exposed to OCS impacts year round; however, they concentrate in more northern waters around Cape Cod from May to September to feed, but are found at high concentrations in winter and early spring around the Delmarva Peninsula. Sperm whales can be encountered most frequently along the 1,000-m contour year round, but they also enter shallow shelf waters in the fall to feed. Humpback and right whales occur in greater concentrations further north around Cape Cod and most likely migrate through the mid-Atlantic on a route east of the highest petroleum interest. However, they would be susceptible to OCS impacts, particularly a large spreading oil spill. The sei whale generally prefers deeper shelf and slope waters, and since this species is uncommon in the sale area, serious impacts to it are unlikely. The blue whale is generally found in the Gulf of St. Lawrence and more northern waters. Although it occasionally strays further south, it is highly unlikely that it will be affected by sale-related activities.

The endangered West Indian manatee is considered extralimital in the mid-Atlantic, and the northernmost area occupied seasonally on a regular basis is coastal North Carolina. Although manatees would not occur directly in the lease area, and a very limited number of animals occasionally migrate as far north as North Carolina and Virginia, a low potential exists for them to be subject to impacts from lease activities, particularly a large spreading oil spill.

Harbor, gray, harp and hooded seals can be found in the mid-Atlantic area and may possibly occur in coastal areas adjacent to any leased areas. These animals may use areas potentially selected for onshore facilities or pipeline landings. Depending on the time of the year and seal presence, this may result in loss of haulout or pupping areas for these animals. In addition, noise generated from OCS-related activities may result in the disturbance of seals in the area and, if long-term, potentially result in the animals leaving the area. Oil spills may also impacts seals or their prey with larger or more coastal spills of greater concern. However, as none of the seals are listed under the ESA or depleted under the MMPA, potential impacts are not likely to rise to population level effects. In addition, the implementation of appropriate mitigation and monitoring measures would lessen the potential for these impacts to occur.

Special protections in the form of lease stipulations, which are assumed to be part of the proposal, provide a safeguarding mechanism for endangered and threatened marine mammals as well as those species not listed under the ESA. In addition, impacts to any critical, unusual, rare, important or uncommon habitat, or other resource which may be identified as essential to the preservation, recovery, natural distribution, and behavior of these species would also be lessened through appropriate mitigation and monitoring measures. Should specific concerns involving endangered and threatened marine mammals or their habitats be identified by MMS, the lessee may be required to modify operations to ensure that these significant biological populations and habitats deserving protection are not adversely affected. These modifications could include shifts in operational sites, modifications in drilling procedures, and increased consideration of the areas during oil-spill contingency planning.

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Exploration

Activities associated with exploration (Table IV-3) include drilling 10-15 exploration and delineation wells, 1-5 service vessel trips and 5-10 helicopter trips per week to the drilling rigs, and discharges of drilling muds (7,860 bbl/well) and cuttings (2,680 bbl/well). Infrastructure and facilities associated with exploration include one or more drilling rigs operating in the lease area and a support base for service vessels at the Hampton Roads area in Norfolk, Virginia. Vessels and helicopters servicing the offshore drilling rigs would operate out of the same area. No oil spills are likely to occur during exploration. Aspects of exploration activities which may affect marine mammals include underwater noise, vessel and aircraft traffic, discharge of drilling muds and cuttings, and waste generation.

Noise From Exploration Activities: Sources of airborne and underwater noises associated with routine OCS operations have been discussed in Section III.C.6. Acoustic sensitivity is the most highly evolved cetacean sensory process; therefore, sound is likely to have a large impact-producing potential. Investigations of possible acoustic impacts on marine mammals have included studies of the potential of underwater noise to cause physical discomfort or injury, hearing loss, signal masking, startle reactions, and noise-induced displacement (Gales, 1982; Richardson et al., 1995). Startle reactions, avoidance or flight from the sound source, disruption of feeding behavior, interruption of vocal activity, and modification of vocal patterns are likely responses to noise impacts. The biological importance of such responses (e.g., effects on energetics, survival, reproduction, population status) is unknown. Sources of underwater noise discussed here are seismic surveys, drilling activities, and vessel and aircraft activity.

Seismic Survey Noise—Noise generated by seismic surveys may have physical and/or behavioral effects on marine mammals, such as (1) hearing loss, discomfort, and injury; (2) masking of important sound signals; and (3) behavioral responses such as fright, avoidance, and changes in physical or vocal behavior (Richardson et al., 1995; Gordon et al., 1998). However, death or physical injuries on marine mammals from seismic surveys are unlikely. Marine mammals most likely to be exposed to and affected by routine seismic surveys are baleen whales.

Physical impacts of anthropogenic noise on marine mammals may range from temporary hearing impairment to permanent hearing loss to gross physical injury (Richardson et al., 1995). Airguns, however, are unlikely to produce gross physical damage (in the form of organ injury) unless the marine mammal is very near the airgun (where highest energy levels would occur) and especially if the airgun started up immediately next to an animal. In most cases, marine mammals would not be expected to be present so close to an array because survey vessels are required to conduct visual monitoring and maintain clearance within a 500-m (radial distance) or other exclusion zone around an array and in the immediate vicinity of the survey vessel. Monitoring begins 30 minutes prior to survey activity and continues until seismic operations cease or until environmental conditions (e.g., rain, fog, darkness) hinder observation of the sea surface. Airgun use for surveys is gradually started so as to introduce noise into the environment first at lower levels. If a marine mammal is observed within or traveling towards the exclusion zone, an immediate shutdown of the seismic array is required. These requirements help further reduce the potential for marine mammals to be exposed to sound levels that could affect hearing or behavior.

The sound frequencies generated by seismic surveys are known or inferred to be within the hearing frequencies of some marine mammals (Gales, 1982). As higher frequency specialists, toothed whales and seals are likely to have some overlap in their hearing range with seismic activity, but the more intense seismic sounds are not expected to occur within these species' primary hearing frequencies. Baleen whales, as low frequency specialists, are more likely to be affected as their primary hearing ranges overlap with seismic noise and are, thus, more likely to be affected by seismic noise. Baleen whales are considered to possess good hearing sensitivity at low frequencies down to approximately 10 Hz, and many of their vocalizations occur in the low tens to a few hundred hertz (Richardson et al., 1995; Ketten, 1998; Stafford et al., 1999). Seismic survey airgun arrays are configured to output maximal energy in the region of a few tens of hertz, which overlaps with the expected hearing sensitivity of these baleen whales. There is also the potential for all species to be susceptible to auditory masking (Richardson et al., 1995; Gordon et al., 1998). Auditory masking occurs when a sound signal that is important to a marine mammal (e.g., communication calls, echolocation, environmental sound cues) is rendered undetectable due to the high noise-to-signal ratio in a relevant frequency band. In the case of seismic surveys, where potential masking noise takes a pulsed form with a low duty cycle (about 10%, or a 1-second disturbance in the sound field in every 10 seconds of ambient noise), the potential for auditory masking may be low relative to a continuous sound, such as ship noise.

While a seismic survey may affect more than one individual, routine surveys are not expected to result in population-level effects. Individuals disturbed by or experiencing masking due to a survey would likely return to normal behavioral patterns after the survey has ceased (or after the animal has left the survey area). Because cetaceans are highly mobile species, they may be expected to quickly leave an area when a seismic survey is initiated, thereby greatly reducing their exposure to maximal sound levels and, to a lesser extent, masking frequencies. However, the potential for increased impacts occurs if repeated seismic surveys occur in areas important to marine mammals, such as breeding, feeding, pupping, or haulout areas. The implementation of appropriate mitigation and monitoring measures for seismic surveys in these important habitats would likely reduce the potential for impacts.

Currently, MMS has implemented numerous mitigation measures for the conduct of seismic surveys in the Gulf of Mexico and off California and Alaska. These measures are meant to reduce the potential for impacts to occur, especially those at the population level. MMS would also analyze and determine appropriate similar measures for seismic surveys taking place in the Atlantic to ensure any potential effects do not rise to the population level impacts. For more information on potential effects to marine mammals from seismic exploration and mitigation and monitoring measures currently imposed in the Gulf of Mexico and Alaska, see the MMS Programmatic Environmental Assessment for Arctic Ocean Outer Continental Shelf Seismic Surveys (MMS, 2006b) and the MMS Environmental Assessment on Geological and Geophysical Exploration for Mineral Resources on the Gulf of Mexico Outer Continental Shelf (MMS, 2004b).

Drilling Noise—Noise associated with OCS drilling is of relatively low frequency, typically between 4.5 and 30 Hz. (Richardson et al., 1995). Because hearing sensitivity among endangered baleen whales is greatest at low frequencies (between 18 Hz and 2 kHz), they would most likely be affected by sounds within these ranges. Odontocetes and seals use sounds at frequencies that are generally higher than the dominant sounds generated by offshore drilling, and thus are expected to be impacted to a lesser degree by these sounds. However, some species (such as the pilot whale and the endangered sperm whale) may have good low-frequency hearing and, thus, could be affected by drilling noise. Effects would include behavioral disruption, avoidance or displacement from the immediate vicinity of the operating facility, and interference with communication or echolocation. However, neither behavioral disturbance nor the displacement of individuals by normal operations at offshore facilities would be expected to result in long-term effects to marine mammals unless the activities regularly occurred in important feeding or breeding areas

Vessel and Aircraft Noise— Marine mammals may be affected by the noise generated by OCS-related surface vessels and aircraft. The degree of reaction is largely dependent on the frequency and location of disturbance, the species, and the behavior the animal is engaged in at the time of disturbance. For example, harbor seals are considered to easily flush from a haul out site upon close approach of an aircraft or vessel. Repeated flushes could result in a higher energy expenditure, animals leaving a preferred haul out site or even injury or mortality to pups when adults quickly flush from an area. For all marine mammals, aircraft flights to and from offshore platforms could result in startle reactions depending on the aircraft altitude. These impacts would be minimized by adherence to the Notice to Lessee operator guidelines or other mitigation measures meant to reduce the potential for disturbance to occur.. Disturbance of marine mammals by ships and boats may be considered a more prominent source of potential impact because of the substantially greater underwater noise levels and relatively large numbers as compared to aircraft. Reactions of marine mammals may include apparent indifference, cessation of vocalizations or feeding activity, and evasive behavior (e.g., turns, diving, etc.) to avoid approaching vessels (Richardson et al., 1995). Impacts can be short-term in nature or longer-term if repeated disturbance occurs.

Vessel and Aircraft Traffic: In addition to impacts from vessel and aircraft noise, there is the potential for ship collisions with marine mammals. The degree of impact is dependent on the species or population and the life history stage of the individual animal(s). At least 11 species of cetaceans have been documented as being hit by ships in the Atlantic Ocean (including the U.S. and European waters and the Gulf of Mexico) (Laist et al., 2001). In most cases, the whales were not seen beforehand or were seen too late to avoid collision. Most lethal or severe injuries involved ships traveling 14 knots or faster and collisions with vessels greater than 80 m in length (Laist et al., 2001). In addition, a majority of ship strikes seemed to occur over or near the continental shelf. The most frequently struck species in the Atlantic have been the endangered fin whale; in addition, the endangered humpback, right, and sperm whales are commonly hit (Laist et al., 2001). Collisions with manatees from vessel traffic related to the proposed action are not considered likely.

Ship strikes are responsible for the majority of human-caused right whale mortalities (Jensen and Silber, 2003; Marine Mammal Commission, 2005). Right whales are particularly susceptible because they either are unable to detect approaching vessels or ignore them if they are involved in important behaviors, such as feeding, nursing, or mating. Also, right whales are slow swimmers and are buoyant, which may make it difficult for them to avoid oncoming vessels even if they are aware of the vessel's approach (NMFS, 2005d). Given the highly endangered status of these animals, any mortality could result in population level impacts.

Some dolphins and porpoise are commonly found with moving vessels and appear capable of avoiding collisions with oncoming vessels. However, some may be injured by contacting propellers. Such injuries may or may not be lethal. Other species such as the beaked whales actively evade ships and are rarely observed at sea.

To reach the location of the lease area under the proposed scenario, support vessels would cross the migratory pathway or habitat of many marine mammals Notices to Lessees provide mandatory guidelines to OCS operators designed to reduce the potential for collisions between vessels and whales (MMS, 2003d). Only 1-5 service vessel trips per week are assumed to occur under the proposal. This amount of traffic results in a negligible increase to collision impact risks to endangered whales, largely because of the limited seasonal occurrence of these species within the prospective lease area. The potential for collisions may be greater with species regularly occuring in the prospective lease area, but these species are not considered as threatened or endangered and any mortality would likely not rise to population level effects.

Operational Discharges and Wastes: Produced water, drilling muds, and drill cuttings are routinely discharged into offshore marine waters in compliance with applicable regulations and permits, and would continue under the proposed action. The discharge of production wastes into open water is prohibited in coastal waters, but permitted in marine waters under the NPDES program. Marine mammals could be affected directly through exposure to operational discharges or ingestion of contaminated prey, or indirectly as a result of discharge impacts on prey species (NRC, 1983). However, while these materials may contain a variety of constituents (e.g., trace metals, hydrocarbons) that may be toxic to marine mammals, these discharges would be rapidly diluted to background levels and dispersed in the open water, which substantially reduces their potential for contact with marine mammals. Furthermore, marine mammals may avoid facilities where permitted discharges are occurring, thereby greatly reducing the likelihood for their direct exposure. Thus, it is unlikely that marine mammals would be directly exposed to operational discharges at concentrations sufficient to result in direct lethal or sublethal effects.

Operational discharges from OCS service vessels, when permitted, would be released into the open ocean where they would be rapidly diluted and dispersed. Sanitary and domestic wastes are routinely processed through onsite waste treatment facilities before being discharged overboard. Deck drainage is processed on site to remove oil and is then discharged. Thus, permitted waste discharges from OCS service vessels would not be expected to directly affect marine mammals.

Some contaminants present in permitted discharges may biomagnify or bioaccumulate in the food chain, resulting in a higher exposure than might be incurred through direct contact. Permitted discharges may also result in a reduction of prey in the immediate vicinity of the discharges. Localized reduction in prey would not be expected to affect individuals or populations, nor would their diet be expected to consist solely or primarily of prey that may have accumulated toxic materials from a permitted discharge. While the bioaccumulation of toxic materials is documented in cetaceans (Trent University, 1997; BIOCET, 2004), the source of the accumulated materials is poorly understood. Contaminants are introduced throughout the Atlantic from a variety of national and international sources, and the principal sources and levels of contaminants to which marine mammals in the Atlantic OCS are exposed are unknown.

Ingestion of, or entanglement with, solid debris can adversely impact marine mammals (Marine Mammal Commission, 2005). Mammals that have ingested debris, such as plastic, may experience intestinal blockage, which in turn may lead to starvation, while toxic substances present in the ingested materials (especially in plastics) could lead to a variety of lethal and sublethal toxic effects. Entanglement in plastic debris can result in reduced mobility, starvation, exhaustion, drowning, and constriction of, and subsequent damage to, limbs caused by tightening of the entangling material. The discharge or disposal of solid debris into offshore waters from OCS structures and vessels is prohibited by the MMS (30 CFR 250.40) and the USCG (International Convention for the Prevention of Pollution from Ships [MARPOL], Annex V, P.L. 100-220 [101 Statute 1458]). Thus, entanglement in or ingestion of OCS-related trash and debris by marine mammals would not be expected under the proposed action during normal operations.

Conclusion

Under the proposed action, some exploration activities could affect marine mammals in the Mid-Atlantic Planning Area. The potential for population level impacts would be expected to be greater on ESA-listed species and less with nonlisted species. Noise generated during exploration, development, and production activities, and from OCS-related vessels and helicopters, may temporarily disturb some individuals. The impact of disturbance is largely dependent on the frequency and location of the activity, species involved, and the life history stage of the individual animal(s). Collisions with OCS-related vessels may injure or kill some individuals. Mud and cuttings discharges would release toxic chemicals into the water and possible contaminate marine mammals directly or through ingestion of contaminated prey species. Ingestion of or entanglement with discarded waste could lead to intestinal blocking, reduced mobility, and other lethal and sublethal effects. Many of the effects associated with noise and the presence of OCS-related vessels or structures would likely be short term and not result in population-level effects. Others may involve repeated disturbances to individuals causing them to leave preferred habitat. The degree of effect at the population level is largely dependent on the population status of the animal. Existing permit requirements, regulatory stipulations, and MMS guidelines targeting many of the routine operations would greatly limit the impact of any potential effects on marine mammals. With appropriate mitigation and monitoring, no changes in distribution, population size, patterns of migration, or behaviors of marine mammals are expected.

Development and Production

Activities associated with development and production include all the parameters described above for exploration plus the following: (1) drilling 8-12 development and production wells, (2) placement of one platform off the Virginia coast, (3) 1-5 service vessel trips and 5-10 helicopter trips per week to the production platform, (4) discharges of drilling muds (5,800 bbl/well) and cuttings (1,630 bbl/well), (5) construction of a pipeline (25-75 miles long) from the platform to a gas facility on shore, (6) transport of natural gas via a pipeline to shore, (7) transport of liquid hydrocarbons (oil and gas condensate) via tankers to shore, and (8) processing of gas at an onshore facility (Table IV-3).

Infrastructure and facilities associated with exploration include those described for exploration plus a single platform in the lease area, a single pipeline with landfall in the Virginia Beach area, a support base for service vessels in the Hampton Roads area in Norfolk, and a processing facility and pipe coating yard onshore. Vessels and helicopters servicing the offshore drilling rigs would operate out of the same area. All onshore facilities would be located at existing industrial sites. Forty years of development and production are expected from the proposed action.

Aspects of development and productions activities which may affect marine mammals include all those discussed above for exploration (underwater noise, vessel and aircraft traffic—including tankers, discharge of drilling muds and cuttings, and waste generation) plus installation and operation of offshore structures and the possibility of oil spills.

Installation and Operation of Offshore Structures: Noises generated during the drilling of exploration and delineation wells and development and production wells are expected to be the most substantive and prolonged source of underwater noise which could affect marine mammals that may be present in the area. Construction and operation activities could disturb normal behaviors (e.g., feeding, social interactions), mask calls from conspecifics, disrupt echolocation capabilities, and mask sounds generated by predators. Portions of the Atlantic that would be disturbed by the construction of new platforms and pipelines would be largely limited to the immediate footprint of the new structure and its surroundings. Animals may either temporarily or permanently leave the vicinity of a platform where there is a combination of drilling activities, maneuvering support vessels, and arriving and departing helicopters. In cases where the specific habitat is not essential to the animal, animals would be expected to avoid the platform and locate to other suitable habitat nearby. These effects would be considered short-term and sublethal. In cases where animal have a strong affinity for the habitat within the construction area (i.e., prime habitat for mating, feeding, calving—but not for any of the listed species), the impacts are unknown. If other suitable habitat is available in the area with little energetic costs to the animal, then the impacts would be expected to be short-term and sublethal. However, the potential exists for greater impacts if additional suitable habitat is not available.

As discussed above for effects from exploration activities, oil and gas operations produce underwater noise over a wide range of frequencies. The ability of a marine mammal to detect these sounds is dependent on the hearing capabilities of their species with some marine mammals able to detect certain low-frequency sounds from considerable distances. Other marine mammals hear and communicate at much higher frequencies. Construction and operation of platforms, depending on activity levels, would not be expected to result in measurable changes in the population size, general or seasonal movements, distribution, or behavior of marine mammals.

The installation of pipelines is not expected to measurably affect marine mammals which occupy the offshore areas of the Atlantic OCS. Potential impact-producing factors would include machinery noises, and noises from vessels and possibly helicopters. In waters less than 61 m (< 200 feet), dredging activities would be required to bury the pipelines below the sediment. This activity would produce site-specific increases in turbidity of limited duration. Such localized and minor disturbances are not expected to measurably affect inshore species of cetaceans and seals which are adapted to the often turbid waters of rivers and estuaries. The anticipated landfall would have no expected impact on most of the marine mammals, other than possibly seals, because they do not occupy shore-water habitats. Seals may be forced to leave preferred habitat if pipelines are constructed there. Although marine mammals might encounter vessels, barges, or other equipment supporting pipeline construction offshore, the expected impacts are likely to be equivalent to, or less than, those anticipated from platform noise and associated offshore oil and gas activities. Due to the very low numbers of manatees likely to occur at the potential pipeline landfall area, contact between this activity and manatees is considered very remote. Therefore, pipeline construction is not expected to measurably affect marine mammal populations.

Oil Spills: It is assumed that up to 12 small oil spills (1 to 999 bbl) would occur with uniform frequency over the life of the proposed action (Table IV-4). Platform spills are assumed to occur in the area proposed for consideration for lease. Tanker or barge spills are assumed to occur along the tanker and barge routes. Although a large spill is not likely, for purposes of analysis it is assumed that one large spill (1,500 bbl) from a tanker would occur. While small spills are more numerous, they are also more easily contained and cleaned up and usually have less damage potential than large spills. The potential severity of oil spills on marine mammals depends on a number of factors. These include the size of the spill, type of oil, rate of weathering, location and trajectory (e.g., offshore, coastal waters, beaches, estuarine areas), and time of year. Marine mammals may be exposed to spilled oil by direct contact, inhalation, and ingestion (directly or indirectly through the consumption of oiled prey species), and such exposures may result in a variety of lethal and sublethal effects.

For cetaceans, manatees, and seals, direct contact of oil may irritate, inflame, or damage skin and sensitive tissues (such as eyes and other mucous membranes) (Geraci and St. Aubin, 1988). This is particularly true with light, refined products such as gasoline (Geraci and St. Aubin, 1988). Prolonged contact to petroleum products may reduce food intake; elicit agitated behavior; alter blood parameters, respiration rates, and gas exchange; and depress nervous functions. Under less extreme exposures (lower concentrations or shorter durations), oil does not appear to readily adhere to or be absorbed through cetacean skin (Geraci and St. Aubin, 1988).

Fresh crude oil releases toxic vapors that when inhaled may irritate or damage respiratory membranes, congest lungs, and cause pneumonia. Following inhalation, volatile hydrocarbons may be absorbed into the bloodstream and accumulate in the brain and liver, leading to neurological disorders and liver damage (Geraci and St. Aubin, 1988). Toxic vapor concentrations may occur just above the surface of an oil spill and, thus, may be present for inhalation by surfacing cetaceans.

Marine mammals may incidentally ingest floating or submerged oil or tar and may consume oil-contaminated prey (Geraci and St. Aubin, 1988). Spilled oil may also foul the baleen fibers of mysticete whales, temporarily impairing food-gathering efficiency or resulting in the ingestion of oil or oil-contaminated prey (Geraci and St. Aubin, 1988). Ingested oil can remain within the gastrointestinal tract and be absorbed into the bloodstream and, thus, could irritate and/or destroy epithelial cells in the stomach and intestine. Certain constituents of oil, such as aromatic hydrocarbons and polyaromatic hydrocarbons (PAH's), include some well-known carcinogens. These substances, however, do not show significant biomagnification in food chains and are readily metabolized by many organisms. Since the endangered baleen species occurring on the Atlantic OCS are not known to feed within the area covered by the proposed action, neither ingestion of oil nor baleen fouling are anticipated.

An accidental oil spill may result in the localized reduction, extirpation, or contamination of prey species. Invertebrate and vertebrate species (such as zooplankton, crustaceans, mollusks, and fishes) may become contaminated and subsequently expose marine mammals that feed on these species. Any marine mammal feeding in the vicinity of an oil spill could either ingest oil by feeding on contaminated prey or be forced to search for food sources beyond the vicinity of the spill.

Depending on their habitat preferences, feeding styles and population status, some species may be more vulnerable than others to exposure from a spill. For example, spills that occur in or reach coastal areas, and especially sheltered coastal habitats such as bays and estuaries, would be more likely to affect coastal dolphins, porpoise, manatees and seals than marine mammals inhabiting more open and deep waters. Because benthic organisms (such as crustaceans and mollusks) accumulate oil compounds more readily and to higher levels than pelagic biota, the potential for ingesting oil-contaminated prey is highest for benthic feeding whales, reduced for plankton-feeding whales, and least for fish-eating whales (Geraci and St. Aubin, 1988). Species with a dependence on or preference for offshore areas or habitats for feeding, shelter, or reproduction (e.g., surface-feeding baleen whales) would be more likely to be affected by a deepwater spill than would other marine mammals (Geraci and St. Aubin, 1988).

An oil spill reaching coastal waters may affect manatees. Because the distribution of manatees is largely limited to coastal waters along the Florida peninsula, with some individuals venturing as far north as North Carolina and occasionally further north, the West Indian manatee would be most vulnerable to a spill reaching the preferred river systems and canals where it congregates. Oiling of manatee habitat could have serious effects. Oiling of aquatic plants, the primary food of these herbivorous mammals, could affect food supplies and possibly lead to accumulation of hydrocarbon fractions with unknown physiological effects. However, since the majority of the manatee population occurs within the State of Florida in habitat not directly accessed by ocean water (e.g., Banana, Crystal, and Indian Rivers), the impacts of a coastal oil spill would probably be minimal. An offshore oil spill would have no measurable impact on the manatee population. Unless the oil spill is large and under conditions that would reach far enough to the south, there is a low likelihood that an oil spill would affect the coastal habitats used by the manatee. Thus, the endangered West Indian manatee would not be expected to be affected by an oil spill under the proposed action.

In the event of a small or large oil spill, delphinids would be able to detect surface oil both visually and acoustically (Geraci and St. Aubin, 1988). The cooperative behavior these animals demonstrate enhances the ability of these animals to avoid contact with spilled hydrocarbons. Potential impacts such as inhalation, ingestion, or measurable bioaccumulation of oil are, therefore, not expected. Whether a major oil spill would result in temporary abandonment of affected habitat is not certain. Seals may temporarily or permanently lose preferred onshore resting or pupping habitat, and dolphins and seals may lose access to coastal feeding areas. However, with appropriate response, it is not expected that measurable effects on marine mammals would occur.

Oil-spill response activities may affect marine mammals, either through exposure to response chemicals (e.g., dispersants or coagulants) applied to control or break down spilled surface oil, or through disturbance by or collision with spill response vehicles. The chemicals used during a spill response are toxic, but are considered much less so than the constituents of spilled oil (MMS, 1989d). The presence of, and noise generated by, oil-spill response equipment and support vessels could temporarily disturb marine mammals in the vicinity of the response action, with affected individuals likely leaving the area. Oil-spill response support vessels may also increase the risk of collisions with marine mammals in the vicinity of the spill response. Under the proposed action, response actions in open water would be expected to be localized, infrequent, and of relatively short term, thus reducing the potential for affecting marine mammals. In the event of a large spill contacting the shore or moving into coastal and inland wetlands, longer-term response activities would be likely.

Small oil spills are not expected to affect marine mammal populations. This is due to the limited susceptibility of marine mammals found in the mid-Atlantic to impacts from oiling and because of the limited quantities of oil involved, area disturbed, and the tendency of these materials to evaporate and disperse rapidly. Although marine mammals could contact such a spill, the likely impacts resulting from contact with this volume of material are expected to be sublethal and nondebilitating. There is potential for sublethal impacts such as disruption of migratory and social behavior or localized reduction or loss of a food source resulting from a large oil spill. There is, however, little expectation that more than a very few individuals of any marine mammal population would contact crude oil spilled from a disabled tanker or other source. Small and large oil spills are not expected to measurably affect the population size or distribution of Atlantic OCS marine mammals.

Conclusion

Under the proposed action, some development and production activities could affect marine mammals in the Mid-Atlantic Planning Area. Underwater noise is expected to be the most prevalent potential impact associated with development and production. However, all acoustic impacts are expected to be sublethal and non-debilitating. Vessel and aircraft traffic are expected to result in occasional startle reactions and avoidance responses. A limited number of probable lethal collisions between vessels and marine mammals could occur, with any mortality having a greater population-level effect on endangered baleen whales. Mud and cuttings discharges could release toxic chemicals into the water and possibly contaminate marine mammals directly or through ingestion of contaminated prey species. Ingestion of or entanglement with discarded waste could lead to intestinal blocking, reduced mobility, and other lethal or sublethal effects. Installation and operation of offshore facilities could disturb normal behaviors and could lead to avoidance or displacement from the area. The potential for impacts related to oil spills could lead to skin, respiratory, and digestive problems but are expected to be sublethal and nondebilitating. Other than measurable impacts to the extremely endangered right whale population if any individual is injured or killed, such as in the event of a vessel collision, no changes in population size, distribution, or behavior are expected for the proposed action.

d. Marine and Coastal Birds

Exploration

The main activities associated with oil and gas exploration that could affect marine and coastal birds in the Mid-Atlantic Planning Area are support vessel trips and helicopter trips to drilling rigs (Table IV-3). Oil spills are not likely to occur during exploration.

Coastal birds are those species such as terns, gulls, sea ducks, and cormorants, which occur over shore waters and the inner portions of the OCS. These birds may roost onshore or raft on the water. The susceptibility of coastal birds to oil- and gas-related activity is largely dependent on their feeding behavior, whether they are social or solitary, and how much time they spend in contact with the water. During the winter, large numbers of birds such as sea ducks, cormorants, and pelicans may be concentrated in relatively small geographical areas offshore of the mid-Atlantic States. The only activities associated with exploration that could impact most coastal species would be related to vessel and aircraft traffic. No more than 5 vessel trips and no more than 10 helicopter trips to drilling rigs are assumed to occur each week under the proposed action. Noise from vessel and aircraft traffic is not expected to cause more than startle responses or temporary avoidance behavior among birds in affected onshore, coastal, and pelagic habitats. Such impacts are not expected to measurably affect bird populations. Impacts due to the discharge of drilling muds and cuttings are expected to be restricted to the offshore environment.

Onshore and nearshore activities related to exploratory drilling are not expected to measurably affect any coastal or marine bird populations because these activities will be located at existing airport and marine facilities that are already avoided, for the most part, by these bird species.

Migratory pelagic species present unique problems for impact assessment. For example, some species have a low presence or are absent from the Atlantic OCS for most of the year. However, during late autumn, huge flocks may gather in staging areas along the mid-Atlantic OCS, and vessel and helicopter traffic associated with oil and gas exploration could have a transient impact on these groups. However, since the birds that form these huge flocks are often nonbreeders, and the amount of oil and gas support vessel and helicopter traffic would be minimal, the actual level of impact to the population should be small.

Threatened and Endangered Species and Species of Concern: Endangered peregrine falcons have been found as far as 300 miles offshore and could be adversely affected during their spring and fall migrations through the mid-Atlantic region. Although not expected during exploration, any minor oil spill in the lease area that does not approach shore could affect peregrines indirectly by affecting offshore prey species.

One species in particular, the red phalarope, migrates through the Middle Atlantic Bight during April-May in large numbers. Because the continental slope is believed to be the central migratory corridor for the entire eastern North American population, this species would be especially vulnerable to oil and gas activity in the vicinity of the slope during April-May. However, exploratory drilling activities will be minimal and are not likely to affect the stability of healthy populations.

Conclusion

Federally listed, coastal-oriented endangered species and species of concern are not likely to be adversely affected by exploratory drilling in the proposed lease area. Disturbance from the low level of vessel and helicopter traffic expected in the mid-Atlantic is likely to cause only a minimal impact on marine and coastal birds.

Development and Production

Coastal and marine birds, in general, could be exposed to adverse or lethal impacts from OCS oil and gas development and production in the Mid-Atlantic Planning Area (Table IV-3). The main activities that could adversly affect birds or their habitat are support vessel and helicopter traffic. Accidental oil spills at the platform or from tankers transporting oil to shore could adversely affect birds or their habitat.

Noise from platforms, aircraft overflights, support vessel traffic, and geophysical survey activities may cause occasional avoidance behavior and sublethal startle reactions. Such impacts would be unlikely to alter the behavior, distribution, or migrations of the affected populations. Because of the low level of oil and gas activity projected for the area, offshore structures and artificial lighting are not expected to measurably impact pelagic species or migratory birds.

The severity of impacts from oil, which could affect nonendangered and nonthreatened marine and coastal bird populations, depends on such variables as spill location, quantity and type of spilled oil, time of year, and weathered state of the spilled hydrocarbon. Direct effects are caused by actual contact with a spill, and they include matting of plumage that can reduce flying and swimming ability, loss of buoyancy that prevents resting and sleeping on the water, and loss of insulation resulting in death by exhaustion. It is thought that some species are actually attracted to oil slicks because they appear to be calm water areas or suggest concentrations of prey species. Oil ingestion and accumulation of toxic petroleum hydrocarbons can lead to reproduction failure and increased physiological stress that can reduce an animal's ability to survive. During nesting season, oiled adults can transfer oil from their plumage to unhatched eggs or chicks, thereby reducing hatching and fledging success respectively (Biderman and Drury, 1978). Indirect effects are adverse impacts that could alter a species habitat or prey availability, or could cause a disruption of essential activities. The incorporation of crude oil into the sediments of a shallow bay, estuary, or wetland could contaminate that habitat and depress populations of prey species (primarily shellfish) for several years.

A 1,500-bbl oil spill may kill or debilitate small numbers of birds, and if the spill occurs at certain times and locations, thousands of birds could be affected (Ford et al., 1982). However, even a spill which impacts large numbers of a particular species may not result in measurable damage to the affected population because of its potential for postspill immigration, recruitment, and replacement from the nonbreeding segment of the population (Ford et al., 1982).

(1) Coastal Birds

Shorebirds occur year-round throughout the mid-Atlantic OCS. Areas of sandy beaches, tidal flats, and wetlands may support large populations of these birds, and depending on the season, substantial portions of populations may occur within the proposed lease area. Typical shorebird species include sandpipers, plovers, turnstones, and oystercatchers. Shorebirds considered typical of marshes in the mid-Atlantic include rails, willets, and dunlins. Wading birds are usually found in areas of quiet, shallow water. Herons and egrets are very common throughout the mid-Atlantic. Service vessel and helicopter traffic, and onshore support facilities, are not expected to affect shorebirds or wading birds as no new filling of wetland or coastal habitats will be required to accommodate OCS service vessels or support facilities. Support vessel and helicopter traffic could disrupt normal waterfowl activities, but should not have a serious adverse effect.

Shorebirds and wading birds would be vulnerable to oil spills that contact intertidal and other coastal habitats, including sandy beaches. Nearshore and transportation-related spills pose a greater risk of contacting and adversely affecting important coastal avian habitats than oil spills from offshore production.

Different species exhibit variable susceptibility to oiling (King and Sanger, 1979; Clapp et al., 1983). Most vulnerable are those birds that spend a large portion of their time feeding or resting on the water such as grebes, loons, and sea ducks (Simmons, 1985). A small spill could result in substantive local mortalities among highly gregarious species. Conversely, solitary species with low seasonal densities, and behaviors that involve infrequent or limited water contact, would likely have the lowest potential for impacts. Age may also affect an individual's susceptibility to oiling impacts (Nero and Associates, 1983).

Freshly spilled oil contacting inshore waters and shoreline habitats (e.g., beaches, tidal flats, and wetlands) could result in indirect impacts including nest contamination and subsequent loss of young, loss of food organisms, bioaccumulation of hydrocarbon fractions through food web contamination, and habitat loss or damage. Even if birds are absent when a spill contacts a specific area, impacts on food resources could result in subsequent impacts on arriving birds.

Waterfowl would be particularly vulnerable to oil-spill impacts during their spring and fall migrations through the mid-Atlantic region. The most susceptible waterfowl are the sea ducks that migrate and winter off the coast. The probability of an offshore oil-spill impacting sea duck wintering areas or the major bays and sounds where they concentrate is small. Because sea ducks congregate in nearshore areas, the transporting of oil poses a greater threat to sea ducks than does exploration or development activity. An oil spill in prime waterfowl habitat could affect large numbers of birds regardless of the season. For example, a spill occurring in an estuary during the winter could affect large numbers of waterfowl. During the summer, though substantially fewer birds are about, oil impacts to that habitat could result in indirect impacts to birds returning in the fall.

In general, shorebirds and wading species are not considered highly susceptible to spilled oil. Because of their adaptation to a more terrestrial than aquatic lifestyle, shorebirds and waders may become stained by beached oil. However, these birds are not likely to experience lethal stresses caused by lost insulation and buoyancy to the extent that more aquatic species are affected. However, while light to moderate oiling may not be fatal among this group of birds, during the nesting season the transfer of oil to developing embryos and chicks could result in reproductive failure.

(2) Marine Birds

Impacts due to the discharge of drilling muds and cuttings are expected to be restricted to the offshore environment. Therefore, only pelagic species could be affected. Cuttings sink to the seafloor, and mud components are diluted by ocean currents to background levels within a few kilometers or less of the discharge point. Because the USEPA regulates drilling discharges with NPDES permits, mud constituents are not considered to be toxic at levels assumed for the proposed action, and, therefore, present no risk to pelagic birds. The rapid dilution of drilling muds also eliminates the risk of bioaccumulation in birds. It is not expected that drilling discharges will measurably impact nonendangered and nonthreatened pelagic birds.

Many of the pelagic species that occur along the mid-Atlantic OCS are not considered to be susceptible to oiling impacts (Clapp et al., 1982 a, b; 1983). Species in this category include the petrels and albatrosses, birds highly adapted to continuous soaring flight. Most of these birds are solitary and occur at relatively low densities, though certain oceanographic phenomena such as upwelling and current convergences may concentrate birds in relatively small geographical areas. However, there are also pelagic birds that are probably highly susceptible to oiling. Examples include phalaropes, fulmars, cormorants, and sea ducks. These birds spend considerable time on the water, often in very large aggregations.

The low reproductive capacity of many pelagic birds is a factor that must be considered in assessing potential impacts that may result from a large offshore oil spill. Most pelagic seabirds (e.g., petrels, shearwaters, and albatross) take several years to reach reproductive age. Although long-lived, reproductive capacity is quite low. Breeding pairs do not reproduce every year and generally produce only one chick during active nesting seasons. Population levels among species that follow such reproductive strategies could be seriously affected if any sizable portion, or even in some cases a small percentage, of the adult breeding population were affected (Ford et al., 1982). For most pelagic species, in particular those which breed on remote mid-oceanic islands, it is unlikely that direct or indirect impacts (e.g., nesting success or bioaccumulation of hydrocarbon fractions) would be quantifiable. However, it is these populations with low reproductive recruitment that are expected to require the longest period for recovery from exposure to spilled oil. Small, chronic discharges of crude oil contained in formation waters may pose an additional long-term threat to pelagic species.

Among the marine birds, diving species and species that spend most of the time on the water's surface (e.g. murres, puffins, and cormorants) have a much greater risk of contacting oil. Because populations of these birds are very slow to replace lost numbers due to their low reproduction rates, oil spill mortalities could result in both short- and long-term adverse effects. Some investigators (Samuels and Lanfear, 1982; Wiens et. at., 1979) have predicted, using population growth models for seabirds, that the loss of a significant number of breeding adults could result in a recovery time ranging from 5-10 years to 100 years depending upon the severity of the spill and the resiliency of the population.

Threatened and Endangered Species and Species of Concern: The bald eagle is an endangered species that occurs within the coastal zone of the Mid-Atlantic Planning Area. If an eagle contacted or ingested oil-contaminated food, several impacts could result: the eagle could be poisoned by the oil; it could develop sublethal physiological abnormalities; egg-laying could be inhibited; plumage could become oiled; or oil could be transferred to eggs, thereby reducing hatchability. These impacts are considered unlikely unless crude oil or oiled fish or birds wash up on the shore in the eagle's territory.

Oil spills reaching breeding areas of the endangered peregrin falcon would not only pose a threat to adult birds but to their eggs and young as well since the adults could transfer oil to their nest. However, should a spill occur at an offshore platform, the probability is very small that oil would affect peregrine migratory stopover or nesting areas. A nearshore spill has a somewhat greater probability of contacting peregrine migratory stopover areas, primarily along the coast of Virginia.

The osprey is a species of concern that could be affected by an oil spill. The osprey is a fish-eating bird that swoops down and captures fish near the water's surface. It is also known to cover its eggs with seaweed to regulate humidity. These two characteristics make it vulnerable to an oil spill by oil ingestion, fouling, or reproductive impairment. Ospreys, however, are rarely found more than five miles from their nests, so the areas of concern for osprey safety are in the immediate vicinity of the nests. The greatest concentration of osprey nests near the proposed lease area is along the Chesapeake Bay. It is unlikely that osprey-nesting areas will be exposed to an oil spill from drilling sites offshore. However, nearshore spills from tanker activity or the proposed pipeline do pose a small risk to the species.

Conclusion

Marine and coastal bird populations on the Mid-Atlantic Planning Area are not expected to be measurably affected by the routine activities assumed for the proposal.

Because of the relatively low, estimated number of oil spills, there is a low risk of impact resulting in some losses of marine birds, particularly for pelagic birds and sea birds. The long-term effect could be a small reduction in population sizes for a few species. Small spills are expected to result in very few deaths among susceptible species, but it is not expected that these losses would be measurable against natural fluctuations within affected populations. In the unlikely event that a large spill occurred, it is not expected that marine or coastal bird species would experience measurable impacts at the population level. However, local impacts could, under certain circumstances, be high depending on the location and time of year in which the spill occurred.

e. Fish Resources and Essential Fish Habitat

(1) Fish Resources

The Mid-Atlantic Planning Area is one of transition and seasonal migration for a number of species, with numerous species of fish dependent upon the estuaries of the mid-Atlantic region either during developmental stages or as passageways going to and from freshwater spawning areas. These species include winter and summer flounder, striped bass, shad, smelt, black sea bass, bluefish, American eel, weakfish, and others. Because of the complexity of the mid-Atlantic ecosystem, fish species distribution, abundance, and community composition vary greatly during the year.

Exploration

Impacts from oil and gas exploration can occur from three general exploration activities: lights from drilling vessels can impact fish movements; noise from exploration activities can have temporary effects on fish locations; and in some circumstances, drilling muds and cuttings may be lethal to some resident species.

Lights on drilling rigs could deter some mesopelagic fishes (those species living in depths of about 600-1,000 feet) from normal upward feeding migrations in the area next to the platform or drilling rig immediately under the light. The intensity of transmitted light in the water column further away would be greatly reduced because of high reflection from the water surface due to the acute angle at which the light would strike the surface, and because of increased distance from the light source. The feeding of several fish species would actually be aided by the attraction of forage species to light sources. Sound and light from the relatively low level of activity assumed for the proposal are only expected to affect individuals or small groups of fish; hence, impacts are not expected on whole populations of pelagic fish eggs, larvae, juveniles, or adults of species of shelf, shelf-spawning, estuarine-dependent, or open-ocean epipelagic fish resources.

Airguns towed behind ships in geophysical surveys are expected to affect fish at short range. In general, no substantive effects on survival, developmental rates, or behavioral responses of crab larvae have been noted. Eventual death after swimbladder damage in finfish may result from airguns at close range (within 1.5 m [5 feet]). Airguns may physically damage or kill fish embryos at close range; effects on yolk-sac larvae may also occur, but older larvae may be less susceptible. Dispersal and migration also have been observed with seismic surveying in recent years. The distance traversed during geophysical surveys could be considerable, but impacts are expected to be confined to individuals near airguns (Laychak and Pieper, 1990).

Noise also would result from the operation of the drillship, from support vessel traffic, and from drilling itself. It is difficult to evaluate what effect the additional sounds from drilling operations would have on fish in the area, in part because the effects of noise on fish are not well documented. Adult fish are expected to avoid any uncomfortable noise levels. Generally, field studies indicate that it is a sudden change in sound that causes the greatest response in fish (Wardle, 1983). These sounds potentially could cause fish to avoid the area of activity (Schwartz and Greer, 1984). Conversely, some fish, particularly sharks, could be attracted to the area by the low-frequency sounds (Myrberg, 1978).

Sound of high intensity may damage sensory hair cells in the inner ear of fish (Cox et al., 1986). The sense of sound is important for some fish behavior. Broadband sound from semisubmersible vessels may blend into background levels within 1 km (0.6 miles) from the source. At a range of 100 m (328 feet) from a semisubmersible source, sound at low frequencies (125-315 Hz) has been reported at up to 42 dB above the upper limit of prevailing ambient noise (Richardson et al., 1991b). Drillships are somewhat louder than semisubmersibles. Sound levels may decline by 20 dB at a range of 1 km (0.6 miles) and by another 20 dB at a range of 10 km (6.2 miles) (Richardson et al., 1991b). Thus, sound originating from oil and gas operations is expected to result only in extremely localized effects on fish behavior, and to not affect whole fish stocks.

The discharge plumes for drilling muds would be diluted in the water column. The discharge plume would probably contact planktonic eggs and larvae of open-ocean epipelagic or shelf-spawning species, including those species whose juveniles use estuaries as nurseries (estuarine-dependent species). Sublethal or lethal effects on such eggs and larvae are not expected because of the relatively nontoxic nature of most water-based fluids. Significant bioaccumulation of heavy metals in adult fish is not expected because of the high mobility of fish and the nature and duration of drilling muds and cuttings discharges. Laboratory studies on the effects of drilling muds on marine organisms have demonstrated that most water-based fluids (those permitted under NPDES regulations) are relatively nontoxic (National Research Council [NRC], 1983). In most cases, sublethal effects occur at concentrations of muds only slightly lower than those that are lethal. Especially sensitive species include reef corals and the larvae of American lobster and sea scallop. The NRC stated further that the effects of drilling muds released from multiple-well programs are probably less than additive, and that the known impacts from exploratory drilling are probably indicative of impacts from longer-term, multiple-well programs. The exception may be found in populations of fish that are attracted to and remain in the vicinity of the drilling vessel for a period of several weeks or months. These fish may browse or otherwise feed on rig-fouling organisms that may contain elevated levels of some metals. Some food resources may be lost to demersal feeding fish due to changes in sediment characteristics, but this would be expected to be of a minor nature and localized around drilling rigs.

Turbidity in a drilling mud plume at an exploratory well site may actually increase the ability of ichthyoplankton to detect transparent zooplankton prey items by scattering light and increasing illumination of prey or by providing contrasting background (Boehlert and Morgan, 1985). However, adaptation to suspended sediments, which may exist in estuarine and shelf species in relatively turbid waters, is probably rare or nonexistent in the epipelagic, clearwater, open-ocean species.

The most noticeable impacts of drilling discharges would be due to smothering of benthos by cuttings. For example, during the initial drilling phase, cuttings may be deposited in a layer up to 50 cm thick within 10 m (33 feet) of the wellhead (Brandsma and Sauer, 1983). However, the thickness of the layer at greater distances would decline to a few centimeters and then a few millimeters, with the thickness at a given distance from the wellhead being determined by local water currents (Brandsma and Sauer, 1983). It is not expected, therefore, that the sedimentation by drilling discharges surrounding each wellhead would seriously impact productivity of the benthos or the overlying waters. As an example, the drilling of eight exploratory wells on Georges Bank, a highly productive region with important fisheries, did not appear to have a measurable effect on production of the epibenthos or demersal fish upon which that commercial fishery is based (Collie and Curran, 1985). Individual demersal shelf or upper slope fish that feed on benthos could experience a local food shortage. Localized impacts on benthic fish and shellfish such as ocean quahog (*Arctica islandica*), sea scallop, and Atlantic surfclam (*Spisula solidissima*) in the mid-Atlantic could occur. However, the area of -affected benthos, relative to the total area supporting bottom-dwelling organisms, is so small that shellfish or demersal fish populations as a whole are not expected to be affected.

Discharge of deck drainage and treated sanitary and domestic wastewaters is assumed to occur, but the total volume would be small relative to the receiving waters. Effects on organisms would be limited to the upper water column near the point of discharge. Sublethal effects to phytoplankton and zooplankton that provide nutrition for commercially important finfish and shellfish would be expected.

Conclusion

Because fishery resources are widespread through the Mid-Atlantic Planning Area and the level of exploratory activity is projected to be minimal, impacts in the proposed lease sale area are expected to affect a small portion of the population. No impacts to fish population distribution and abundance are expected to occur.

Development and Production

A variety of fish communities are found on the continental slope area. They include species abundant in the shelf areas but whose reproductive products move onto the slope, away from more desirable areas. The area of highest geological interest is found in the continental slope, away from the most important spawning areas.

Gas pipeline emplacement constitutes the main source of mechanical disturbance assumed under the proposal. Burial of individual shellfish and other benthos, including prey organisms of demersal fish, is expected to occur during trenching or jetting for pipeline emplacement. Trenching or jetting for emplacement of the proposed pipeline, which would be buried where water is less than 60 m (197 feet) deep, would temporarily suspend sediment in the water column, possibly resulting locally in altered behavior of some marine species (Olla et al., 1982). With backfilling of the pipeline trench, a volume of sediment equal to the volume of the pipe would be deposited up to a distance of several meters on either side of the axis of the pipeline. In contrast, the total area occupied by bottom dwelling organisms (such as surf clams and ocean quahogs in the Mid-Atlantic Bight) is very large. Recolonization is expected to begin soon after cessation of pipeline construction. In waters depths greater than 60 m (197 feet), laying the pipeline on the seafloor is expected to bury benthic organisms. Exposed pipelines would serve as attachment substrate for benthic organisms or as protective habitat. However, concentrations of predators at the site could repel mobile prey. No impacts on whole populations of shellfish or demersal predatory fish are anticipated.

A production platform would serve as attachment substrate for benthos and as protective habitat, but aggregations of predators could repel mobile prey. Platforms would probably act as artificial reefs that could actually improve fishing in the mid-Atlantic by concentrating hard-ground fish in the snapper-grouper complex. Artificial reefs may elevate total fish production, merely redistribute and concentrate the populations, or create a combination of the two processes (Bohnsack, 1989). The importance of each process may depend on local circumstances and the ecology of the affected species, but connection between artificial reefs and either or both processes is difficult to detect and, hence, has seldom been demonstrated (Bohnsack, 1989). Artificial reef effects could also be anticipated along the deeper, unburied portion of a pipeline. Some pelagic fishes such as dolphin (*Coryphaena hippurus*), cobia (*Rachycentron canadum*), and some tunas are attracted to surface structures such as anchor markers and mooring buoys. Platform emplacement would disturb fish resources associated with the bottom. Therefore, only impacts to individuals of demersal or benthic fish species and not to whole populations are expected.

Formation water may be taken from a well with muds and cuttings or at the end of drilling if the well is tested. Similarly, produced water could be extracted along with produced oil or gas. Produced water discharge rates of 118-36,500 bbl/day per production platform have been recorded (Neff et al., 1989). Abernathy (1989) compiled information on the characteristics and substances which may be associated with produced waters, such as trace metals, radioactive isotopes, hydrocarbons, inorganic salts, and low dissolved oxygen concentrations. The NPDES permit restrictions allow discharge of such waters only if significant environmental harm will not occur. Alternatively, formation or produced waters could be reinjected into deep rock strata. In either case, no deleterious effects on fish or ichthyoplankton are expected. Although any hypersaline produced waters would be quickly diluted, discharged volumes are expected to be sufficient to produce minor osmotic stress to fishes, especially ichthyoplankton, a few meters from the point of discharge where little dilution would occur.

Studies have shown that a number of chemical contaminants including heavy metals, pesticides, and petroleum hydrocarbons can cause damage and death to fish embryos during early development stages. This makes pelagic fish eggs vulnerable to oil spills because these eggs float at of near the surface and can easily come in contact with water surface film. At least 14 species of commercially important finfish and shellfish spawn or have eggs that are transported into the mid-Atlantic. These are surf clams, menhaden, yellowtail flounder, sea scallop, lobster, summer flounder, silver hake, scup, white hake, ocean quahog, black sea bass, tilefish, bluefish, and Atlantic mackerel.

Transport of larvae is more complex because they are more widely distributed and their development time is much longer. In many species, as larvae develop they begin to make vertical movements, and some descend to the bottom rather quickly. This would be advantageous to species that utilize the onshore flow near the bottom to get ashore. Among species that spawn offshore whose larvae use estuaries for nursery grounds are summer flounder, black sea bass, spot, croaker, and others.

Eggs and larvae may die in spawning or nursery areas due to coating or direct toxic effects of oil. Sensitivity to oil generally diminishes from eggs, to larvae, to fry, to adults. Spawning areas offshore to the Mid-Atlantic are widespread along the continental shelf and poorly defined. A possible spill should have little effect to the overall year-classes because the populations are not highly concentrated.

Studies indicate that adult fish may be less vulnerable to spills than are other groups of aquatic organisms because of their mobility and avoidance reactions. It has been suggested that actively swimming species avoid contamination since significant fish kills have not been observed following offshore oil spills. Based on these avoidance reactions, mortality to adult finfish is not expected to be significant. Some adults may be killed from direct toxic effects or indirectly as a result of maladaptive behavior. Behavioral changes could include loss of equilibrium, inability to school, and reduced swimming activity. The reproductive output of adults may also be affected.

Deep-sea fish such as macrourids (grenadiers and rattails) reproduce primarily in the waters of the continental slope. Mesopelagic fish, such as myctophids (lanternfish) are abundant in the deeper slope waters. These, and possibly the products of bathyal fishes commonly below 2,000 m that drift into the slope zone, all contribute to the fish populations of the slope area. An oil spill on the slope could affect the eggs of the deepwater species that have pelagic eggs, but to what extent is unknown.

The magnitude of the effect of an oil spill depends on the time of year of the spill, the sensitivity of the species affected, the complex chemical composition of the oil, the physical oceanographic characteristics of the receiving water, the amount of oil spilled, and the previous exposure of the biota to stress. Interacting biological, chemical, and physical forces vary in importance over time in weathering spilled oil (NRC, 1985).

Under the proposed action, 10 small oil spills (<50 bbl), 2 medium spills (50-999 bbl), and 1 large spill (1,500 bbl) are assumed to occur (Table IV-4). A small oil spill from support vessels, drilling rigs, platforms, or tankers may occur anywhere between a lease block and marine terminal in the Hampton Roads area. Open-ocean epipelagic, estuarine, and shelf species could be affected by such a spill. Most of the fish that support major fisheries in the Mid-Atlantic Bight have planktonic rather than benthic eggs and larvae. Some fish spawn in the estuaries; individual eggs and larvae of such fish could die from an oil spill. Many of the species contributing to major fisheries spawn on the continental shelf; these species include those that are estuarine-dependent. A small spill on the shelf could contact passively moving eggs and larvae of such species and cause mortality to individuals, but a slick from a spill in an estuary or on the continental shelf would probably be avoided by juveniles and adults. However, commercial shellfish beds, in water less than 60 m (197 feet), could exhibit death of individuals since bivalves, except possibly scallops, cannot avoid oiled sediments. Large epipelagic fishes such as tunas and billfishes occur in approximately the upper 200 m (656 feet) of the water column above the continental slope and further seaward. These fish generally have buoyant eggs and epipelagic larvae; the eggs and smaller larvae move relatively passively and could be contacted by an oil slick, resulting in death of individuals. Juveniles, adults, and larger larvae (which may be of sufficient size to move actively) could avoid the slick.

After spreading, oil slicks would be expected to have little or no toxic effect on organisms in the water column beneath the floating oil, before the oil had weathered to a nontoxic state (McAuliffe, 1987). However, two exceptions have been reported. Oiling from the *Amoco Cadiz* spill killed phytoplankton and caused mortality and persistent depressed function of the digestive system in some species of pelagic zooplankton. Oiling from the *Argo Merchant* spill caused elevated mortality of pelagic fish eggs (NRC, 1985). The reason for these exceptions is not clearly understood, but they may be the result of higher concentrations of soluble volatiles when the spills first occurred. The time that these volatiles are present in water is very limited, and impacts would be expected to affect only a small area in the immediate vicinity of the spill. Recovery of fish in shoreline habitats with contaminated sediments is expected to take 2-12 years (Teal and Howarth, 1984). However, the length of shoreline that could potentially be contacted is expected to be relatively small; therefore, no impact on whole fish populations is expected.

In general, individual eggs and larvae of estuarine species, estuarine-dependent species that spawn on the shelf, shelf species, and open-ocean epipelagic species may experience sublethal effects or death from a small oil spill. The younger life stages are often the most sensitive to pollution. However, due to the small size of the slick from such a spill and rapid weathering, no sublethal or lethal impacts on whole populations of eggs and larvae are anticipated. Juveniles and adults may avoid oil slicks completely. Thus, it is expected that few or no individual juveniles and adults will be affected by an oil spill.

In the case of a 1,500-bbl spill, juveniles of estuarine-dependent species that use marshes and seagrass beds as nurseries could experience some habitat loss. Such loss could result in displacement to other habitat that could be overcrowded or marginal in quality, resulting in sublethal or lethal effects. Groups of juveniles and adults could ingest or absorb oil, possibly resulting in tainting and sublethal effects at low oil concentrations or death at high concentrations. However, due to the small area of an oil slick relative to the total area of spawning, nursery, and adult habitat for estuarine-dependent and shelf species, no measurable impacts on whole populations of fish resources are expected. Concentrations of oil beneath both experimentally created oil slicks and accidental spills greater than or equal to 1,000 bbl were within the range causing sublethal effects on marine organisms. Based on information gained from accidental oil spills, recovery of impacted fish resources within the affected area would be expected within 1-3 years, except for fish in shoreline habitat with contaminated sediment, which could take about 2-12 years to recover (Teal and Howarth, 1984).

In summary, sublethal effects on food organisms for fish are expected in the immediate vicinity of the point of discharge for treated wastewater. In the first phase of drilling, burial of bottom-dwelling organisms is expected near the wellhead within a range on the order of tens of meters. Trenching for pipeline emplacement in water less than 60 m deep is expected to disturb benthic organisms on the order of several meters on either side of the axis of the pipeline. The installation of a platform or drilling rig is expected to destroy some habitat for bottom-dwelling animals in the immediate vicinity of the structure. Lights and man-made sounds other than airguns may interfere with fish behavior in the immediate vicinity of a drilling rig or platform. Sounds may be diminished by 20 dB at a range of

1 km (0.62 miles) from the source. Lights are not expected to have an effect on mesopelagic fishes on the order of tens to hundreds of meters from the platform or drilling vessel. Formation or produced waters could cause minor osmotic stress to fishes, especially ichthyoplankton, within a few meters of the point of discharge, before dilution in receiving waters occurs.

Threatened and Endangered Species and Species of Concern: Atlantic calico scallop beds could be disturbed by activities resulting from the proposal if protective measures are not in place. Typical beds on the east coast are only about 8-16 km (5-10 miles) long and a few hundred meters (0.5 miles) to 16 km (10 miles) wide (South Atlantic Fishery Management Council, 1982). Therefore, depending on the location of a scallop bed and the pipeline route, a significant portion of a bed could be buried during pipelaying (the major source of mechanical disturbance from the projected oil and gas activities). Similarly, a bed could be damaged by discharge of muds and cuttings at the seafloor during initial drilling operations, emplacement of drillship anchors, or platform emplacement. Such impacts can occur on attached epiflora and epifauna of a live bottom area that may occur in a restricted zone; thus, impacts could indirectly affect resident reef fishes. Surveys would be conducted prior to pipelaying to avoid sensitive bottom areas, and lease stipulations would be adopted to minimize impacts from drilling discharges and the placement of rigs and platforms.

The shortnose sturgeon is an endangered anadromous fish that spawns in the middle and upper portions of the Connecticut, Hudson, and Delaware Rivers. It is highly unlikely that an oil spill or any sale-related activities would adversely affect the shortnose sturgeon because of the downstream and coastal location of support facilities and the areas under consideration for this sale. Because little is known about the life history of this fish when it enters the potential lease area, it is difficult to assess impacts when it is in its marine environment. However, the threat of a serious adverse impact would seem remote due to the demersal habits of this species and its need to spawn in freshwater areas that will receive no expected impact from the proposed action.

Conclusion

Impacts on fish resources may result from the discharge of operational effluents, muds, and cuttings; platform and pipeline emplacement; structure removal; lights on offshore rigs; noise associated with routine drilling operations or geophysical surveys; and discharge of formation or produced waters. Based on the assumptions for the proposed action, individual finfish or shellfish are expected to experience sublethal impacts such as reduced biogenic activity, reduced metabolic functions, or disease. Deaths of a few individuals are also expected. However, no measurable decline in whole populations is expected. The anticipated duration of impacts is less than one generation or 1-3 years for most activities and events. Recovery of fish in localized inshore habitats contaminated by an oil spill could require 2-12 years. No measurable impact to species of concern is expected as a result of the proposed activity.

(2) Essential Fish Habitat (EFH)

The Magnuson-Stevens Fishery Conservation and Management Act, which was reauthorized and amended by the Sustainable Fisheries Act (1996), requires a fishery management council to: (1) describe and identify EFH in its respective region, (2) specify actions to conserve and enhance that EFH, and (3) minimize the adverse effects of fishing in EFH. The Act requires Federal Agencies to consult on activities that may adversely affect EFH's designated in fishery management plans.

An EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity." In the mid-Atlantic, EFH descriptions have been prepared for summer flounder

(*Paralichthys dentatus)*, scup (*Stenotomus chrysops)*, black sea bass (*Centropristis striata)*, bluefish (*Pomatomus saltatrix)*, Atlantic surfclam (*Spisula solidissima)*, ocean quahog (*Mercenaria mercenaria)*, Atlantic mackerel (*Scomber scombrus)*, Loligo squid (***Loligo*** *pealei*), Illex squid (***Illex*** *illecebrosus*), butterfish (*Peprilus triacanthus*), and dogfish (*Squalus acanthias*). The five most important threats to these species in terms of their EFH impacts are coastal development; non-point source pollution; dredging and dredge spoil placement; port development, utilization, and shipping; and marinas and recreational boating. The description of EFH for each of the listed species varies with the season and age class of the species of concern.

Exploration

Impacts from oil and gas exploration can occur from three general activities: lights from drilling vessels can impact fish movements, noise from exploration activities can have temporary effects on fish locations, and in some circumstances drilling muds and cuttings may be lethal to some resident species.

As explained above, the location of EFH for each of the listed species varies with the season and age class of the species of concern. Because fishery resources are widespread through the Mid-Atlantic Planning Area and the level of exploratory activity is projected to be minimal, impacts in the proposed sale area would only affect a very small portion of the total fish habitat (including EFH). Impacts to EFH from exploration would be the same as exploration impacts to fishery resources discussed above in this section.

Development and Production

The impacts of routine operations to EFH may result from the same factors that could impact other fish resources. These include discharge of operational effluents, muds, and cuttings; platform and pipeline emplacement; structure removal; lights on offshore rigs; noise associated with routine drilling operations or geophysical surveys; and discharge of formation or produced waters. Hard-bottom EFH areas of topographic features should not be affected by the deposition of drilling muds and cuttings because of lease stipulations preventing discharges in areas containing substrates of high habitat value and diversity such as coral and other hard-bottom areas.

The EFH for many migratory fish species includes surface water habitat for the egg and larval stages of development. Oil spills would have an impact on EFH in surface water for planktonic eggs and larvae by trapping and killing eggs and larvae in the affected area. Wave and wind action, weathering, and biological degradation would dissipate oil in the surface water, and EFH would be reestablished. The period of time needed to reestablish appropriate EFH conditions following a spill would depend upon the characteristics of the individual spill and would be related to many factors, including the location of the spill, the nature of transporting currents, the magnitude of the spill, and the chemical characteristics of the spilled oil.

Impacts to EFH from development and production would be the same as development and production impacts to fishery resources discussed above in this section. Some localized and short-term degradation and impacts could occur, but no long-term impacts to EFH are expected.

f. Sea Turtles

Five federally listed species of marine turtles are known to occur on the Atlantic OCS. The three endangered species of sea turtles found in the Mid-Atlantic Planning Area are the leatherback, hawksbill, and Kemp's ridley. The two threatened species are the loggerhead and the green. Only the loggerhead and leatherback are known to occur in the proposed lease area in relatively high numbers and could be adversely affected by exploration and development and production activities in early summer and late fall when they migrate through the area. The green turtle and loggerhead turtle occur in nearshore and offshore waters of the Mid Atlantic during the warm months. Additionally, the loggerhead nests regularly in the mid-Atlantic—up to 10 loggerhead nests are found each year on the Virginia coast; thus, this species is also vulnerable to impacts during nesting season. Bays, lagoons, and estuaries along the mid-Atlantic coast are developmental areas for juvenile Kemp's ridley turtles. Leatherback turtles occupy coastal and pelagic waters. The hawksbill turtle, while occasionally has been reported within the area covered by the proposed action, is primarily a tropical species and is not expected to incur significant adverse impacts from exploration, development, and production activities.

Special protections in the form of lease stipulations, which are assumed to be part of the proposal, provide a safeguarding mechanism for endangered and threatened marine turtle species and any critical, unusual, rare, or uncommon habitat or other resource which may be identified as essential to the preservation, recovery, natural distribution, and behavior of these species. Should specific concerns involving endangered and threatened marine turtles or their habitats be identified, the MMS may require the lessee to modify operations to ensure that these significant biological populations and habitats deserving protection are not adversely affected. These modifications could include shifts in operational sites, modifications in drilling procedures, and increased consideration of the areas during oil-spill contingency planning.

Exploration

Activities associated with exploration include drilling 10-15 exploration and delineation wells, 1-5 service vessel trips and 5-10 helicopter trips per week to the drilling rigs, and discharges of drilling muds (7,860 bbl/well) and cuttings (2,680 bbl/well), as shown in Table IV-3. Infrastructure and facilities associated with exploration include one or more drilling rigs operating in the lease area and a support base for service vessels at the Hampton Roads area in Norfolk. Vessels and helicopters servicing the offshore drilling rigs would operate out of the same area. No oil spills are likely to occur during exploration. Aspects of exploration activities which may affect marine turtles include underwater noise, vessel and aircraft traffic, discharge of drilling muds and cuttings, and waste generation.

Studies involving sea turtle hearing sensitivity or noise-induced stress are limited (McCauley et al., 2000; Bartol et al., 1999); therefore, a full understanding of the physical and behavioral effects of noise impacts on sea turtles is not well known. Sources of airborne and underwater noises associated with routine OCS operations include seismic surveys, drilling activities, and vessel and aircraft activity (see Section III.C.9). Impacts from these sources are analyzed below.

Sounds produced during seismic surveys possess both high- and low-frequency energy that is expected to be detectable by sea turtles. These sounds have much greater energy than other nonexplosive OCS-related sounds. Impacts could include physical damage resulting from noise as well as pressure effects. A study by McCauley et al. (2000) found that sea turtles displayed a general "alarm" response (increased and erratic swimming) at an estimated 2-km range from an operating seismic vessel and behavior indicative of avoidance within an estimated 1-km range. This suggests that sea turtles would attempt to avoid surveying vessels and that they may be temporarily displaced from the vicinity of a seismic survey.

Offshore drilling structures produce significant underwater noise over a wide range of frequencies and intensities that may be detected by sea turtles within the area of the installation (Geraci and St. Aubin, 1987). Potential impacts on sea turtles may include behavioral disruption and temporary displacement from the area near the sound source. One or more drilling rigs would operate in the lease area for exploration. Certain sea turtles, especially loggerheads, may be attracted to OCS structures and, thus, may be more susceptible to impacts from sounds produced during routine operations.

Helicopters and service vessels may affect sea turtles due to machinery noise and/or visual disturbances (NRC, 1990). Sounds from helicopters and vessels would originate from coastal ports and travel through broad areas of the continental shelf and slope. Therefore, the effects of sound generated from these activities could affect any species and life stage of sea turtles known to occur in the mid-Atlantic. The most likely impacts would be short-term behavioral changes such as diving and evasive swimming, disruption of activities, or departure from the area of disturbance. Areas with heavy vessel traffic may be avoided by sea turtles, although generally most species appear to exhibit considerable tolerance to ship and aircraft noise. Noise related to OCS helicopter and vessel traffic in the mid-Atlantic would be transient and generally not at levels that would prevent rapid recovery of sea turtles once the source (i.e., passing aircraft or vessel) was eliminated.

Sea turtles can be killed or injured by collision with ships. Increased ship traffic (service vessels) would increase the risk of turtles colliding with ships. The risk would vary depending upon location, vessel speed, and visibility. Most sea turtles in the mid-Atlantic are distributed within nearshore waters and waters of the continental shelf, and only the loggerhead turtle has been known to nest in this region. During the hatching season, it is believed that hatchling turtles leave their nesting beaches and swim offshore to areas of water mass convergence. Hatchlings and juvenile turtles, even in relatively high concentrations, would be very difficult to spot from a moving vessel because of their small size and generally cryptic coloration patterns. Adult turtles are generally visible at the surface during periods of daylight and clear visibility. However, they may also be very difficult to spot from a moving vessel when resting below the water surface, and during nighttime and periods of inclement weather. Although adult, and perhaps juvenile, turtles are capable of avoiding moving vessels, it is possible that collisions between OCS service vessels and sea turtles may occur under certain circumstances. Mitigation measures (such as NTL 2003-G10) include adhering to MMS strike avoidance guidelines (MMS, 2003d) stating that vessel operators should maintain a vigilant watch for sea turtles and slow down or stop their vessel to avoid striking protected species. When sea turtles are sighted, attempts should be made to maintain a distance of 45 meters or greater whenever possible.

Drilling muds are generally considered to be nontoxic except at high concentrations. Discharges are regulated through the NPDES permit process issued by the USEPA, which places limitations on concentrations of toxic constituents to protect marine resources. Discharges are rapidly diluted to background levels in the high-energy current environment of the potential offshore lease sites. It is unlikely that prey species consumed by turtles when offshore would accumulate measurable levels of drilling mud components due to their limited potential for exposure to the discharge plumes. Similarly, discharges of waste fluids from OCS service and construction vessels would be diluted and dispersed rapidly in the open-ocean environment. Therefore, no measurable bioaccumulation of drilling mud components, which could subsequently be identified in marine turtles is expected.

Ingestion of, or entanglement with, accidentally discarded solid debris may adversely impact sea turtles. Reports of the ingestion of plastic and other nonbiodegradable debris exist for almost all sea turtle species and life stages (NOAA, no date). Ingestion of plastic debris can affect the alimentary canal or remain within the stomach. Sublethal quantities of ingested plastic debris can result in various effects, including positive buoyancy, in certain turtles, making them more susceptible to collisions with vessels or increasing predation risk (Lutcavage et al., 1997). Certain species of adult sea turtles, such as loggerheads and leatherbacks, appear to readily ingest certain plastic debris. In oceanic waters, floating or subsurface translucent plastic material and sheeting may be mistaken for gelatinous prey items such as jellyfish. Entanglement in plastic debris can result in reduced mobility, drowning, and constriction of and subsequent damage to limbs (Lutcavage et al., 1997). Currently, the discharge or disposal of solid debris from both OCS structures and vessels is prohibited by the MMS (30 CFR 250.40) and the USCG (MARPOL, Annex V, Public Law 100-220 [101 Statute 1458]). Assuming that operators comply with these regulations and laws, most impacts on sea turtles resulting from solid debris would be avoided. Individual turtles may be injured or killed, but impacts to whole populations would not be measurable.

Conclusion

It is not expected that exploratory activities would affect populations of marine turtles known to occur on the Atlantic OCS. A small number of turtle mortalities could result from exploration related activities, but should not pose a serious threat to any of the turtle populations. Other than collisions with vessels, potential impacts are expected to be sublethal. No changes in distribution, population size, patterns of migration, or behaviors of marine turtles are expected.

Development and Production

Activities associated with development and production include all the parameters described above for exploration plus drilling 8-12 development and production wells, placement of one platform off the Virginia coast, 1-5 service vessel trips and 5-10 helicopter trips per week to the production platform, discharges of drilling muds (5,800 bbl/well) and cuttings (1,630 bbl/well), construction of a pipeline (25-75 miles long) from the platform to a gas facility on shore, transport of natural gas via a pipeline to shore, transport of liquid hydrocarbons (oil and gas condensate) via tankers to shore, and processing of gas at an onshore facility. Vessels and helicopters servicing the offshore drilling rigs would operate out of the same area. All onshore facilities would be located at existing industrial sites. Forty years of development and production are expected. Several small oil spills (5-10 spills less than 50 bbl, 1-2 spills of 50-999 bbl) could occur, and it is assumed that one large oil spill (1,500 bbl) would occur from a tanker transporting oil to a marine terminal (Table IV-4).

Aspects of development and productions activities which may affect marine turtles include all those discussed above for exploration (underwater noise, vessel and aircraft traffic, discharge of drill muds and cuttings, and waste generation) plus installation and operation of offshore structures, artificial light sources, and the possibility of oil spills.

Pipeline trenching and construction of a pipeline landfall may affect sea turtles. In water deeper than 200 feet, which does not require burying the pipeline below the seafloor, no measurable impacts on turtle populations are expected. Pipeline installation here could confer a minor benefit to some turtles in the form of shelter and substrate for food species. In waters less than 200 feet, the pipeline would be buried. There is some chance of direct impacts during trenching, because turtles have been known to be killed or injured during such operations (Dickerson et al., 1992). In addition, there may be indirect impacts due to disruption of small corridors of nearshore and coastal habitats. It is assumed that habitats such as seagrass beds and live-bottom areas commonly used by turtles for feeding or resting would be avoided during pipeline routing. It is also assumed that disruption or damage to nesting beaches would be avoided. Pipeline construction is not expected to measurably affect marine turtle populations.

Offshore platforms act as artificial reefs, causing a large increase in biomass in their immediate vicinity, which could attract feeding turtles. Associations between turtles and offshore platforms may be the result of specific attributes of platform location and characteristics of platforms which sea turtles find attractive, such as shelter and food. While the installation of one production platform could benefit turtles, adverse impacts could also occur. If an oil spill occurs at a platform, turtles could be in close proximity to it and be more likely affected. Also, if the organisms living under the platform accumulate toxic materials and trace metals discharged from the platform, turtles could ingest these toxins by feeding on these organisms, with probable results of physiological disorders or death. Furthermore, if platforms attract turtles, an increase in vessel traffic occurring in areas where turtles congregate, would increase the chances of vessel strikes. However, most lease sites are likely to be located offshore in water depths on or near the continental shelf-slope break. Other than juvenile loggerhead and green turtles, and the pelagic leatherback, the primary habitat of marine turtles on the Atlantic OCS is located primarily within inshore shelf waters.

Vessel and aircraft traffic can cause startle reactions among turtles. These are short-term, sublethal flight responses. A very low number of turtles may be struck by tankers or support vessels, resulting in death or serious debilitation over the 40-year expected duration of the lease. Vessel traffic levels call for 1-5 trips per week. At this low level of vessel traffic, no changes in distribution, population size, patterns of migration, or behaviors of marine turtles are expected.

The potential for artificial illumination in the offshore environment to attract turtles to fixed platforms is uncertain. Brightly lit, offshore drilling facilities present a potential danger to hatchlings. Hatchlings are known to be attracted to light (Raymond, 1984; Witherington and Martin, 1996; Witherington, 1997) and may orient toward lighted offshore structures (Chan and Liew, 1988). If this occurs, hatchling predation might increase dramatically since large birds and predatory fishes also congregate around structures (Witherington and Martin, 1996). Whether brightly lit offshore structures would attract juvenile turtles passively migrating in mats of seagrass is unknown. Most adult and subadult turtles occupy relatively shallow water nearshore and most likely would remain unaffected by the presence of platforms offshore.

It is assumed that up to 12 small oil spills (1-999 bbl) would occur with uniform frequency over the life of the proposed action (Table IV-4). Platform spills are assumed to occur in the area proposed for consideration for lease. Tanker or barge spills are assumed to occur along the tanker or barge routes. Although a large spill is not likely, for purposes of analysis it is assumed that one large spill (1,500 bbl) from a tanker would occur. While small spills are more numerous, they are also more easily contained and cleaned up and usually are of less damage potential than large spills. The potential severity of oil spills on marine turtles depends on a number of factors. These include the size of the spill, type of oil, rate of weathering, location and trajectory (e.g., offshore, coastal waters, beaches, estuarine areas), and time of year.

Sea turtles are vulnerable to the effects of oil at all life stages—eggs, hatchlings, juveniles, and adults. Oil effects on turtles include increased egg mortality and developmental defects; direct mortality due to oiling in hatchlings, juveniles, and adults; and negative impacts to the skin, blood, digestive and immune systems, and salt glands (Milton et al., 2003). Spilled oil may affect sea turtles through various pathways: direct contact, inhalation of oil or related volatile distillates, ingestion of oil (directly, or indirectly through the consumption of oiled prey species), and ingestion of floating tar. Direct contact of oil with sensitive tissues such as eyes and other mucous membranes produces irritation and inflammation. Oil can adhere to turtle skin or shells. Turtles surfacing within or near an oil spill may inhale petroleum vapors. While vapor inhalation changes the behavior and pathology of marine mammals as evidenced by an increase in time spent submerged, such behavior is not evident with turtles (Milton et al., 2003). In experiments, sea turtles showed no overall avoidance behavior, though some were clearly disturbed by the fumes. Sea turtles have shown an apneic response when confronted with disagreeable odors and, thus, may be able to minimize their exposure to inhaled petroleum vapors.

Ingested oil, particularly the lighter fractions, can be toxic to sea turtles. The oil may remain within the gastrointestinal tract and may be absorbed into the bloodstream and thus irritate and/or destroy epithelial cells in the stomach and intestine. Certain constituents of oil, such as aromatic hydrocarbons and PAH's, include some well-known carcinogens. These substances, however, do not show significant biomagnification in food chains and are readily metabolized by many organisms. Hatchling and juvenile turtles feed opportunistically at or near the surface in oceanic waters, and are especially sensitive to spilled oil and oil residues such as floating tar (Lutz and Lutcavage, 1987). Tar found in the mouths of turtles may have been selectively eaten or ingested accidentally while feeding on organisms or vegetation bound by tar (Geraci and St. Aubin, 1987). Certain species of sea turtles may be at greater potential risk from spilled oil, based on their relative exposures. These include loggerheads or Kemp's ridleys that may inhabit or frequent areas such as bays and estuaries. Spilled oil may also affect the life stages of sea turtles that show some dependence on selected localized habitats for feeding, shelter, or reproduction, such as post-hatchlings in offshore debris lines (convergence zones) (Milton et al., 2003).

Small spills in shallow water could originate from tankers approaching Chesapeake Bay. As most sea turtles in the Atlantic are distributed within waters of the continental shelf, it is probable that some individuals would come into contact with spilled oil from these sources. A spill could also contact a nesting beach if the spill were to occur during nesting season. The loggerhead would be the only turtle adversely impacted by oil washing ashore on its nesting beaches.

Deepwater oil spills would include small platform spills and one large tanker spill. Most adult turtles are distributed along the continental shelf; however, leatherbacks and some loggerheads occur within deepwater areas over the continental slope. In addition, juvenile turtles are regularly found within convergence zones in deepwater areas. Although the relative numbers of turtles within the deepwater Atlantic are relatively small when compared to the continental shelf, it is possible that individuals may come into contact with these sources of spilled oil. It is possible that some individuals may not recover from such exposure. Oil spills, particularly a large one, would likely have more significant adverse impacts than effects from other exploration, development, and production activities; however, only a small probability exists that the viability of loggerhead, leatherback, green, and possibly Kemp's ridley populations as a whole would be threatened.

Oil-spill response activities that may affect sea turtles involve the application of dispersant chemicals to spilled surface oil. These dispersant chemicals contain constituents that are considered to be low in toxicity when compared to the toxic constituents of spilled oil (MMS, 1989d). There are, however, little available data regarding the effects of oil dispersants or coagulants on sea turtles. Oil-spill response equipment and support vessels are also other sources of underwater noise, and may increase the risk of collisions between these vessels and sea turtles. In addition, beach cleanup and remediation activities may affect sea turtle nests. However, the use of these chemicals and activities is expected to be localized and infrequent. Shoreline cleanup operations may involve crews working with sorbents, hand tools, and heavy equipment. The most likely impacts are temporary behavioral disruption and avoidance.

Conclusion

It is not expected that exploration, development, and production activities would measurably affect the populations of marine turtles in the Mid-Atlantic Planning Area. The generally inshore distribution of these animals, as well as their seasonal geographical distribution on the Atlantic OCS, substantially reduces the potential for impacts stemming from routine oil and gas activities offshore. Other than collisions with vessels and accidental oil spills, potential impacts are expected to be sublethal. Impacts from routine activities and small accidental events are not expected to measurably affect the distribution, behavior, or population size of marine turtles on the Atlantic OCS. An oil spill of 1,500 bbl in size would result in more measurable impacts and possibly affect sea turtle populations in the area.

g. Coastal Habitats

Exploration

Activities associated with exploration include drilling 10-15 exploration and delineation wells, 1-5 service vessel trips and 5-10 helicopter trips per week to the drilling rigs, and discharges of drilling muds (7,860 bbl/well) and cuttings (2,680 bbl/well). Infrastructure and facilities associated with exploration include one or more drilling rigs operating in the lease area and a support base for service vessels at the Hampton Roads area in Norfolk, Virginia (Table IV-3). Vessels and helicopters servicing the offshore drilling rigs would operate out of the same area. No oil spills are likely to occur during exploration. The only exploration activity that could impact coastal habitats stems from supply vessel traffic to and from drilling rigs.

Service vessel traffic to exploration wells could contribute to the erosion of barrier beaches and shorelines. Increases in wave activity from vessel traffic could contribute to the removal of sediments along barrier beaches that currently experience beach losses. Greater erosion effects might result from the use of larger vessels required for deepwater and ultra-deepwater exploration and development. Wave activity could be minimized by maintaining reduced vessel speeds in the vicinity of barrier islands. However, with the low number of vessel trips expected per week, and since all vessel traffic is assumed to use established port facilities, impacts are expected to be nonmeasurable.

Submerged aquatic vegetation and seagrass beds may be damaged by vessel traffic outside established traffic routes, which could result in long-term scars on these vegetation communities. However, if vessels stay on established routes, other than localized impacts to small areas, the condition of submerged aquatic vegetation and seagrass communities is not expected to be measurably adversely affected.

Conclusion

No impacts on coastal habitats from vessel traffic or oil spills are expected to occur during exploration.

Development and Production

Activities associated with development and production include all the parameters described above for exploration plus drilling 8-12 development and production wells, placement of one platform off the Virginia coast, 1-5 service vessel trips and 5-10 helicopter trips per week to the production platform, discharges of drilling muds (5,800 bbl/well) and cuttings (1,630 bbl/well), construction of a pipeline (25-75 miles long) from the platform to a gas facility onshore, transport of natural gas to shore via a pipeline, transport of liquid hydrocarbons to shore via tankers, and processing of gas at an onshore facility (Table IV-3). Several small oil spills (5-10 spills of less than 50 bbl; 1-2 spills of 50-999 bbl) could occur, and it is assumed that one large oil spill (1,500 bbl) would occur during transportation of oil by tanker to a marine terminal (Table IV-4).

Infrastructure and facilities associated with development and production include those described for exploration plus a single platform in the lease area, a single pipeline with landfall in the Virginia Beach area, a support base for service vessels in the Hampton Roads area in Norfolk, and a processing facility and pipe coating yard onshore. Vessels and helicopters servicing the offshore drilling rigs would operate out of the same area. All onshore facilities would be located at existing industrial sites. Since the level of activity expected for the Atlantic could be handled by existing port facilities, no new port construction or dredging of waterways is assumed.

(1) Coastal Barrier Beaches and Dunes

The potential effects on coastal beaches and dunes from development and production would be associated with the impacts from ground-disturbing activities during pipeline construction and impacts associated with spills of oil and other petroleum hydrocarbons such as fuel oil or diesel fuel, and subsequent cleanup efforts.

Construction of a pipeline in the coastal area of Virginia can affect the shoreline in the vicinity of the pipeline landfall. The pipeline would come ashore in an area where the beach is part of the mainland. Barrier beaches would be avoided when the pipeline landfall is being located. Trenching and excavation activities during pipeline installation would disturb sand beaches, dunes, or other coastal habitats. In addition to the direct habitat losses that would result from excavation, erosion of sand beaches and dunes could be induced adjacent to the pipeline. Stabilization of dune margins could be difficult, and establishment of vegetation cover might be slow, possibly resulting in prolonged losses of dune habitat near the pipeline route. Barring any other stresses, the area would revegetate in 2-3 years, returning to preconstruction conditions.

It is assumed that up to 12 small oil spills (1 to 999 bbl) would occur with uniform frequency over the life of the proposed action (Table IV-4). Platform spills are assumed to occur in the area proposed for consideration for lease. Tanker spills are assumed to occur along the tanker route. Although a large spill is not likely, for purposes of analysis it is assumed that one large spill (1,500 bbl) from a tanker would occur. While small spills are more numerous, they are also more easily contained and cleaned up, and usually have less damage potential than large spills. Accidents that could impact barrier beaches and dunes could also arise from spills of diesel fuel from supply vessels and would most likely occur only in the immediate vicinity of the areas used as support bases.

The potential effects on coastal barrier beaches and dunes from small spills would primarily be associated with impacts from oil and other petroleum hydrocarbons, such as fuel oil or diesel fuel, and subsequent cleanup efforts. Impacts on beach environments from small spills are expected to affect areas in the vicinity of the support base only. It is unlikely that a spill in deepwater areas would contact barrier beaches, because of the length of time it would take the spill to reach shore and the natural degradation and dispersion/dilution that would occur in addition to expected containment actions. Contamination of beaches would more likely result from spills near shore or in the vicinity of the support base, including spills from vessel accidents. Beaches could be impacted by oil spills, and direct mortality of biota could result. Although beach and foredune areas are often sparsely vegetated, impacts to vegetation might occur if oil was carried to higher elevations by storm waves and tides.

The most likely hydrocarbon to contact shorelines in small spills is diesel fuel. Effects of diesel fuel on sandy beaches are relatively short-lived in that diesel fuel evaporates readily and would leave behind no residue (such as tar balls). The majority of a diesel fuel spill would most likely evaporate within 1 day, even with no cleanup efforts attempted (NRC, 2003a). If any of the sandy beaches are contacted by spilled diesel fuel, the fuel is expected to be incorporated into the sandy sediments. This would increase the amount of time necessary for these hydrocarbons to evaporate completely. However, diesel fuel does not have the heavier hydrocarbon components necessary to form tar balls and would not leave behind long-term pollution. The effects of most small oil spills are expected to last for only a few days to possibly months if vegetation were contacted. Therefore, if a small spill would occur in or near a barrier island or mainland beach, its effects would be expected to be minimal.

If an oil spill of 1,500 bbl were to occur, beaches near the spill area, or further away, could be contacted by the oil. Spilled oil might be located only on beach surfaces, or it could penetrate into subsurface layers. Permeable substrates, generally associated with larger sand grain sizes, and holes created by infauna could increase oil penetration, especially that of light oils and petroleum products. Although any residual oil that might remain following cleanup could be largely removed in highly exposed locations through wave action, oil could remain in the shallow subsurface for extended periods of time. In some locations, oil might become buried by new sand deposition. Natural degradation and persistence of oil on beaches are influenced by the type of oil spilled, amount present, sand grain size, degree of penetration into the subsurface, exposure to the weathering action of waves, and sand movement onto and off the shore. Spilled oil might be entirely absent from affected beaches within a year or less, or it might persist for many years with continued effects to infauna (Hayes et al., 1992). On sheltered beaches, heavy oiling left for long periods could form an asphalt pavement relatively resistant to weathering (Hayes et al., 1992).

Left untreated, wave action would slowly clean the oil from a beach and return it to prespill conditions within approximately 2-3 years (NRC, 2003a). If cleanup activities are conducted to remove oiled sand from the shoreline, the longshore sand budget can be temporarily disrupted. This can cause erosion problems downcurrent from the area in which cleanup activities are conducted. This problem would exist until sand supply is stabilized. Spill cleanup operations might adversely impact barrier beaches and dunes if the removal of contaminated substrates affected beach stability and resulted in accelerated shoreline erosion. However, sand removal is generally minimized in areas of sand deficit. Foot traffic during cleanup might mix surface oil into the subsurface where it might persist for a longer time.

(2) Wetlands and Estuaries

The potential effects on wetlands and estuaries from development and production would be associated with the direct impacts from ground disturbing activities during pipeline construction; indirect impacts from decreased water quality, air quality, and altered hydrology; and impacts associated with spills of oil and other petroleum hydrocarbons, such as fuel oil or diesel fuel, and subsequent cleanup efforts.

Although wetlands may be avoided during site selection, it is possible that construction of a pipeline would affect estuarine and wetland areas (Fig. III-48). Most of the effects from a pipeline are expected to occur during construction. Various construction methods are used in estuarine and wetland areas. Two frequently used installation methods are the flotation canal method and the push ditch method (Wicker et al., 1989). Pipeline construction with a flotation canal involves digging a 12- to 15-m (40- to 50-foot) wide by 2-m (6-foot) deep canal through which a pipe lay barge is floated, and a 1- to 2-m (4- to 6-foot) ditch in the middle of the canal in which the pipe is laid. Preferred in most cases, both environmentally and economically, the push ditch method involves the digging of a 2.5-m (8-foot) deep by 1- to 2-m (4- to 6-foot) wide ditch. This method only disturbs about 10 percent of the amount of area disturbed when the floatation canal method is used. Consequently, both direct and indirect impacts are substantially lower when the push ditch method is used. After the pipe is laid, the pipe ditch and flotation canal are typically backfilled and allowed to naturally revegetate. This recovery can be expedited by manually replanting, if deemed appropriate and/or beneficial.

Both direct and indirect impacts are greatest during the ditch digging and ditch backfilling operations (Baumann and Turner, 1990). The direct effects from laying a pipeline include the destruction of any plant life or sessile organisms in the path of the ditch dredging operation and their burial by disturbed sediments. Indirect impacts extend several hundred meters to either side of the pipeline path, altering the water quality by affecting the water temperature, turbidity, pH, and concentrations of nutrients, DO, CO_2, and H_2S, and by releasing pollutants such as pesticides and toxic metals from sediments. These changes in water quality cause decreased photosynthesis, mortality of benthic flora and fauna from siltation, algal blooms with related anoxic conditions, and avoidance of the area by other organisms until conditions restabilize. Improper disposal of dredged spoil or poorly backfilled ditches can modify the water-flow regimes draining upland areas, contribute to loss of wetlands, and change salinities in the estuaries. If water-flow regimes are altered, areas distant from the pipeline route could be affected with long-lasting results.

While complete recovery of the area disturbed during pipeline construction can take several years, the direct impacts affect only a limited area and are temporary. Gulf of Mexico wetlands typically revegetate in 2 years (Wicker et al., 1989). Proper construction and restoration methods will allow the area to return to preconstruction conditions and are not expected to result in modification of water flow, loss of wetlands, or altered salinities. Often the choice of where to place the pipeline has less to do with the amount of total environmental impact than the construction and restoration methods used. Rerouting can sometimes be used to avoid areas that are especially vulnerable to impacts. Additionally, controlling the timing of construction activities, rapid restoration of the disturbed area, maximal use of previously disturbed areas and existing rights-of-way, and use of silt curtains can also mitigate impacts from pipeline construction.

Impacts to wetlands near constructed facilities might also result from factors such as reduced air quality. Exhaust emissions from equipment and atmospheric releases from processing facilities could have local adverse effects on vegetation. Disposal of wastes from processing could also introduce contaminants into wetlands. Contaminants from land storage or disposal sites might migrate into soils and groundwater or could be present in stormwater runoff that could flow into wetlands. Contaminants might also be released to surface water in service vessel discharges, and they might affect wetlands. Impacts to wetlands could be minimized by implementing practices to minimize air and water quality impacts. Construction in wetlands is managed and regulated by the appropriate State agencies and the COE. This document assumes that standard mitigation measures will be applied to any construction project associated with the proposed program.

It is assumed that up to 12 small oil spills (1 to 999 bbl) would occur with uniform frequency over the life of the proposed action (Table IV-4). Platform spills are assumed to occur in the area proposed for consideration for lease. Tanker spills are assumed to occur along the tanker route. Although a large spill is not likely, for purposes of analysis, it is assumed that one large spill (1,500 bbl) from a tanker would occur. While small spills are more numerous, they are also more easily contained and cleaned up, and usually have less damage potential than large spills. However, even small spills can cause long-term adverse impacts if they occur in sensitive areas where containment and cleanup are difficult. Accidents that could impact estuaries and wetlands could also arise from spills of diesel fuel from supply vessels and would most likely occur only in the immediate vicinity of the areas used as support bases.

While it is assumed that one or more small spills would occur, many of the small spills would be from production activities at rig or platform locations. Oil or other spilled materials might be transported to coastal wetlands by currents or tides. It is unlikely, however, that a spill in deepwater areas would contact coastal marshes because of the length of time it would take the spill to reach a marsh and the natural degradation that would occur in addition to expected containment actions. Contamination of wetlands would more likely result from spills in shallow water near shore or inshore in the vicinity of the support base, including those involving vessel traffic routes near coastal marsh areas. These spills would most likely be of diesel fuel and would evaporate and/or be cleaned up with the sorbent material required to be present at fueling docks. The refueling areas are required to maintain oil cleanup and containment equipment that could easily handle small spills (33 CFR 153 and 154). Therefore, if a small spill would occur in or near an estuarine or wetland environment, its effects would be expected to be minimal.

A spill of 1,500 bbl could cause much greater damage and could require years for complete recovery to prespill conditions. If a spill that occurred at the mouth of the Chesapeake Bay were to enter the bay, it could encounter many wetlands and tributaries. The exact amount of damage and time needed for recovery are difficult to predict since these factors are dependent on not only the amount of oil spilled but also the time of year, type of beach contacted, chemistry of the spilled oil, amount of weathering, as well as cleanup techniques and recovery efforts. Freshly spilled oil contains more toxic components than older, weathered oil. The components of freshly spilled oil are also more soluble in water and more likely to contact mid-water flora and fauna. However, the concentration of the dissolved hydrocarbons is typically low in both untreated and dispersed slicks, and it is unlikely to cause a measurable effect on any organisms in the water column (McAuliffe, 1987).

Impacts to coastal marsh vegetation could range from a short-term reduction in photosynthesis to extensive mortality and subsequent loss of marsh habitat as a result of substrate erosion and conversion to open water (Hoff, 1995; Proffitt, 1998). Vegetation that dies back could recover if roots and rhizomes remain viable, even following the death of all existing leaves. Long-term impacts could include reduced stem density, biomass, and growth (Proffitt, 1998). Annuals such as *Salicornia* spp. and shallow rooted plants tend to have higher mortality from single oilings than plants with underground storage organs. Other effects of spills could include a change in plant community composition or the displacement of sensitive species by more tolerant species. In locations where soil microbial communities are impacted, effects might be long-term, and wetland recovery might be slowed. The degree of impacts to wetlands from spills are related to the oil type and degree of weathering, amount of oil, duration of exposure, season, plant species, percent of plant surface oiled, substrate type, and oil penetration (Hayes et al., 1992; Proffitt, 1998). Higher mortality and poorer recovery of vegetation generally result from spills of lighter petroleum products (such as diesel fuel), heavy deposits of oil, spills during the active growing period of a plant species, contact with sensitive plant species, completely oiled plants, and deep penetration of oil and accumulation in substrates. Because aquatic vegetation plays such a vital role in maintaining the stability of estuarine and wetland ecosystems, a permanent loss of vegetation can result in significant modification to these systems (Proffitt, 1998).

Long-term effects on the estuarine and wetland fauna would depend on environment factors such as water flow patterns and depth, loss of vegetative cover, and changes in the dominant species of plants, all of which are tied to the effects of the spill on the estuarine and wetland flora. If the plants survive, the animals will recover more quickly and completely than if there is widespread plant loss or changes in dominant plant species. Marsh and seagrasses serve to stabilize the sediments, trap nutrients, and provide shelter and food for many of the faunal species. Incorporation of oil into wetland sediments could retard degradation of the oil and could cause contamination to remain for many years. Estuaries act as nutrient and pollution traps, thus preventing spilled oil from being flushed from the system. This could increase the amount of exposure of many estuarine plants and animals to spilled oil.

Seagrasses near where oil contacted the shore could be affected by the oil, but no long-term damage would be expected to occur except possibly to intertidal vegetation. Recovery of some invertebrate populations could take up to 3 years, depending on the degree of oiling and the amount of oil retained in the sediment (Teal and Howarth, 1984). Impacts to marsh grasses would be of limited extent because of the extensive protection of lower bay marshes by the beaches. Any impacts to marsh grasses would be limited to the vicinity of the tributaries that feed into the lower bay. Recovery of these areas would be expected to occur in 1 to 3 years, depending on the amount of oil reaching the marsh.

Spilled oil remaining after cleanup degrades naturally by weathering processes and biodegradation caused by microbial communities in the soil. Full recovery of coastal wetlands might occur in less than 1 year or might require more than 5 years, depending on site and spill characteristics (Hoff, 1995). Oil could remain in some coastal substrates for decades, even if it was cleaned from the surface. Heavy deposits of oil in sheltered areas or in the supratidal zone could form asphalt pavements resistant to degradation (Hoff, 1995).

Spill cleanup actions might damage coastal wetlands through trampling of vegetation, incorporation of oil deeper into substrates, increased erosion, and inadvertent removal of plants or sediments, all of which could have long-term effects (Hoff, 1995; Proffitt, 1998). These actions could result in plant mortality and delay or prevent recovery. In locations where spill cleanup would include the excavation and removal of contaminated soils and biota, increased erosion and lowered substrate elevation could result in marsh loss by conversion to open water, unless new sediments were applied. Effective low-impact cleanup actions could include bioremediation, low-pressure flushing, or use of chemical cleaners (Mendelssohn and Lin, 2003; Hoff, 1995; Proffitt, 1998).

Conclusion

Development and production activities could have impacts on coastal barrier beaches and dunes primarily as a result of pipeline construction and vessel traffic. Impacts on wetlands could result from construction activities and indirect impacts as a result of poorer water and air quality and altered hydrology. The magnitude of these impacts would depend on the location of new construction, the level of shipping activity in a specific area, and existing environmental conditions. Potential impacts from spills could have direct impacts on wetlands and beach habitats. Impacts to wetlands from small spills are expected to be limited to temporary shifts in flora and fauna ratios in the vicinity of support bases. These will most likely be imperceptible in an area with existing daily ship traffic, such as Virginia Beach. No measurable impact to shorelines is expected from small spills. The magnitude of impacts from a large spill would depend on a variety of factors, including the location and size of the spill, weather conditions, remediation efforts, beach conditions (e.g., grain size), existing environmental conditions (such as plant species or substrate type), and natural localized erosion and deposition patterns. Cleanup operations themselves might also impact wetlands, estuaries, beaches and dunes. Adverse impacts on coastal habitats from a large spill can range from insignificant to high degrees of damage, including extensive mortality and loss of habitat.

h. Seafloor Habitats

Most of the continental shelf seafloor in the potential sale area is composed of sand bottoms over clay sediments (NRDC, 2006; Steimle and Zetlin, 2000; MMS, 1999; Wigley and Theroux, 1981). There are small areas of sand-shell and sand-gravel along the coast south of the Chesapeake Bay mouth, and a larger area of sand-shell adjacent and slightly south of the Virginia Eastern Shore peninsula at the Bay mouth (Steimle and Zetlin, 2000). At the shelf break, there are additional small areas of sand-shell, while on the continental slope, the substrate tends to be finer grained silt and clay.

Impacts to seafloor habitats from the exploration for hydrocarbons and their development and production are similar, largely varying in intensity and in potentially wider geographic distribution because of the larger scope of the later stages. Some of these impacts could be mildly beneficial, such as the provision of additional hard bottoms or reef structures from the mooring of exploration, development, and production facilities and infrastructure on the seafloor. However, most impacts to seafloor habitats would be mildly to substantially adverse. Such adverse impacts would include direct and indirect impacts to seafloor habitats from: (1) the bottom disturbance associated with placement of exploration, development, and production structures on the seafloor (including the possibility of using explosives for the removal of retired underwater structures); (2) the discharge and transport of drilling muds used in the exploration, development, and production drilling processes; (3) the construction of development and production infrastructure, such as pipelines employed to bring gas onshore for processing and distribution; (4) oil spillage as a result of routine operations or accidents associated with oil transport to shore by tanker or barge; and (5) noise from all undersea activities, but especially any explosive materials utilized.

Impacts to seafloor habitat (largely benthic) organisms from bottom disturbance include physical destruction of organisms and habitat, and burial. Impacts from the discharge and transport of drilling muds used in the exploration, development, and production drilling processes include burial and ingestion of heavy metals, both of which are heavily dependent on local conditions such as depth, current pattern, wave regime, and substrate type. As would be expected, effects are most pronounced and definitely measurable in the vicinity of well sites (MMS, 1982).

Impacts to seafloor habitat organisms from the construction of development and production stage infrastructure, such as pipelines, employed to bring gas onshore for processing and distribution include the same aforementioned beneficial impacts from the provision of hard bottom habitat and the adverse impacts from bottom disturbance and discharge of drilling muds. However, these impacts have the potential to be more extensive as a result of their greater area of application, typically occurring from the site of the development and production activities across the continental shelf to a landfall support facility.

Impacts to seafloor habitat organisms from oil spillage as a result of routine operations or accidents associated with its transport to shore by tanker or barge include direct mortality to organisms, chronic effects of sub-lethal dosages, and bioaccumulation up benthic and aquatic food chains. The intensity of these impacts would depend largely on the amount of oil that sinks (typically 0.1-5%) and the distribution by currents and winds (Gordon, et al., 1976, Hoffman and Quinn, 1978). In addition, finer grained sediments, such as silts and clays hold oil longer than coarser-grained sands (Boesch et al., 1977). Mass mortality is more common in nearshore spills (North, 1965, J.E. Smith, 1968, Mulligan et al., 1974, Hampson and Sanders, 1969, Blumer et al., 1970). Sublethal cellular and physiological interference can disrupt normal feeding and reproductive patterns (S.F. Moore et al., 1973). Habitat recovery can be slow, requiring more than 10 years in fine grain substrates such as clay and mud (MMS, 1982).

Noise impacts from all activities should be inconsequential, unless explosives were to be used to remove retired underwater structures. The use of explosives would result in locally very substantial underwater noise and shock wave damage to seafloor habitats.

Such impacts would be greatest in the areas of increased ecological sensitivity nearshore, on the continental shelf, and on the continental slope. The major areas of increased ecological sensitivity that have been identified in the Mid-Atlantic OCS region are: nearshore bottoms, hard bottoms (also called "reef structures" and "obstructions"), and submarine canyons (NRDC, 2006, Hecker et al., 1980).

Outside such areas of increased ecological sensitivity, impacts from these activities on the continental shelf would be minimal because of the relative paucity of organisms on and in the relatively barren sand and gravel bottoms that predominate there. Thus, adverse impacts would have the greatest potential to occur in areas of increased ecological sensitivity during the development and production stages.

Impacts in areas of silt and clay bottoms, which are more common on the continental slope, would have the potential to be somewhat greater because of the greater density of benthic organisms there but would still be relatively modest. Impacts to submarine canyons, hard bottoms (reef structures and obstructions), and nearshore seafloor habitats could be substantial because of the greater biological diversity of organisms in these areas and their characterization as ecologically sensitive habitats (Hecker et al., 1980, Steimle and Zetlin, 2000, Zeman, 2005, NRDC, 2006). Lease stipulations designed to protect biological resources and to minimize the adverse impacts of hydrocarbon transportation would be employed to mitigate these adverse impacts to the maximum extent possible.

The potential for impacts to the environment from routine operations and accidents during each of the stages of the OCS leasing processes is discussed below.

Exploration

Under the hypothetical scenario used for this analysis, during the exploration stage 10-15 exploratory wells would be drilled from one or more rigs in the lease area (Table IV-3). At this early stage in the sale planning process we assume that these wells could be located anywhere in that area. This exploratory drilling would be supported by 1-5 vessel trips and 5-10 helicopter trips per week. During the exploration/ delineation process it is estimated that 7,860 bbl/well of drilling muds would be used and 2,680 bbl/well of drill cuttings would result from the drilling. Impacts to seafloor habitats likely to occur during the exploration stage would include the direct impacts from drilling and the discharge of drilling muds, cuttings, and produced water discussed above. The major accident scenario that could occur during the exploration stage would be a blowout from an exploratory well. The impacts from these limited operations would be inconsequential on all but the areas of increased ecological sensitivity, such as nearshore areas, hard bottoms (including reef structures and artificial obstructions), and submarine canyons, where they could be locally severe but would not adversely affect a substantial area.

Conclusion

During the exploration stage, there would probably be some unavoidable, localized, benthic population reductions due to changes in sediment characteristics from the discharge of drilling muds, cuttings, and water, and from the ingestion of oil and other materials in sediment by benthic organisms. However, it is unlikely that any demersal fish populations would be adversely affected by this low level of activity. The effects on benthic organisms would be most pronounced in areas of high biological productivity and increased ecological sensitivity, such as hard areas (including reef structures and artificial obstructions) and the heads of submarine canyons. Impacts from blowouts, bottom disturbances, and discharges will be mitigated by lease stipulations and regulations to minimize impacts and protect benthic resources.

Development and Production

The development scenario for the proposed action projects 1 production platform and 8-12 development and production wells. Each wells would use an estimated 5,800 bbl of drilling muds, produce an estimated 1,630 bbl of drill cuttings, and result in 450 bbl of produced water being discharged into the surrounding waters. Support of these facilities would involve 1-5 vessel trips and 5-10 helicopter trips per week. An estimated 0.25-0.50 tcf of natural gas would be transported to the Hampton Roads area for processing and distribution by approximately 25-75 miles of pipeline. The 0.05-0.08 Bbbl of oil projected to be produced would not be sufficient to support a pipeline and would, therefore, be brought ashore to an existing refinery in the greater Hampton Roads area by tanker or barge.

Two to five ha (5-12.5 acres) of bottom area would be disturbed by placement of the platform, and 50-125 ha (123-309 acres) by the placement of the pipeline. One large (1,500 bbl) oil spill, 1-2 medium (50-999 bbl) oil spills, and 5-10 small (< 50 bbl) oil spills would be projected during the expected 40-year life of the field (Table IV-4). The platform, pipeline, and oil-spill impacts could occur anywhere in the potential lease area generally in a line from the production platform to the landfall area in Hampton Roads.

Impacts to seafloor habitats likely to occur during the exploration, development, and production stages would include the impacts discussed under the exploration stage above, plus the impacts from the construction of development and production structures and infrastructure that would be used to bring any commercially viable hydrocarbon resources discovered ashore for processing and distribution. Because of the more substantial level of activity involved in this stage, the potential for adverse impacts would be greater but still modest as a result of the relatively low level of activity.

The major accident scenarios that could occur during the development and production stages would be the 13 oil spills projected. Impacts from spreading oil would vary depending on the depth of the water in which the spill occurred and the wind and current conditions at the time of the spill. Spills could have substantial adverse impacts if they occurred in areas of increased ecological sensitivity, such as nearshore areas, hard-bottom areas (including reef structures and artificial obstructions), and submarine canyons. In these areas, spill effects could be locally severe but would not cover a substantial area due to the limited intensity of hydrocarbon development and production and the long period of time (estimated at 40 years) during which the spills would be likely to occur.

Conclusion

During the development and production stages, there would probably continue to be some unavoidable localized, benthic population reductions due to changes in sediment characteristics from the discharge of drilling muds and cuttings and from the ingestion of spilled oil in sediment by benthic organisms. These effects would be most pronounced in areas of high biological productivity and increased ecological sensitivity, such as nearshore areas, hard bottoms (including reef structures and artificial obstructions), and the heads of submarine canyons. However, the lease stipulations employed in this stage, the large area over which the activities would occur, and the extensive timeframe during which activities would likely occur should result in small, if any, adverse impacts to the environment.

i. Areas of Special Concern

Several federally protected areas of special concern lie within or directly surround the area of the proposed action and, thus, may be impacted by oil and gas activity. For the purposes of this analysis, impacts vary depending on whether events occur in marine or coastal environments.

There are fewer marine than coastal protected areas. Monitor National Marine Sanctuary, located 16 miles southeast of Cape Hatteras in North Carolina, and similar nautical archaeological sites protect shipwrecks and other distinctive features, attract fish, and serve as recreational destinations with historical value. Shelf canyons such as Washington and Norfolk Canyons, within the outer edges of the proposed lease area, are inhabited by unique mixes of species and their nurseries. They are fished for highly valuable tuna, swordfish, and marlin. Relatively little study has been completed in the Washington Canyon, but it is believed to be similar, and ecologically related, to the nearby Norfolk Canyon, which was nominated as a marine sanctuary in 1975 but never designated because of lack of funding.

More popular areas of special concern along the coast include national wildlife refuges (NWR's), national parks and seashores, and national estuaries and estuarine reserves (Fig. III-49). Of particular relevance are the areas along the Eastern Shore of Virginia and the Chesapeake Bay. The southern half of Assateague Island, a barrier island that stretches from Maryland to Virginia, encompasses a large portion of Chincoteague NWR and is part of Assateague National Seashore. It is an important breeding area for a number of beach nesting waterbirds, including the threatened piping plover (*Charadrius melodus*). The barrier islands south of Assateague Island (i.e., Wallops Island, Assawoman Island, Metompkin Island, and Cedar Island) represent an important stopover site and wintering area for shorebirds and waterfowl, and recently have provided nesting habitat for two loggerhead sea turtles. The entire Eastern Shore of Virginia's seaside lagoon system and barrier island chain serve as globally important migration corridors and stopover sites for thousands of shorebirds annually, and are protected under the NWR program.

The largest and most biologically diverse estuary in North America, the Chesapeake Bay, is the only estuary with status as both a National Estuary and a National Estuarine Research Reserve. The Bay hosts young crabs and other species at critical stages of their life cycle, and is a major migration path for anadromous fish species. The Chesapeake Bay is protected as a public water supply and for the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife. Recreation, both in and out of the water, is widely encouraged.

Although commercial activity and associated impacts are prohibited within the boundaries of all protected areas under the authority of one or multiple agencies, accidental impacts due to oil and gas activity in the proposed lease area may be delayed or mitigated through the development and implementation of contingency plans where resources of concern are carefully identified prior to exposure. Lease stipulations provide a formal mechanism for identifying important or unique biological populations or habitats which may require additional protections because of their sensitivity or vulnerability. If special biological resources are identified, the lessee may be required to modify operations to ensure that significant biological populations or habitats deserving protection are not adversely affected.

Exploration

Activities associated with exploration that may impact areas of special concern in the marine environment include the drilling of 10-15 exploratory wells, 1-5 service vessel trips and 5-10 helicopter trips per week to the drilling rigs (Table IV-3), the establishment of a support base for vessels in the Hampton Roads area, the use of an existing airfield for helicopter support, and discharges of drilling muds (7,800 bbl/well) and cuttings (2,680 bbl/well). No large oil spills from exploration activities are assumed in the scenario, and small spills are unlikely.

Noise from seismic surveys and the drilling of 10-15 exploratory wells, and the physical disturbance to seafloor environments and associated species, may adversely affect nearby protected areas. Air emissions during such operations would not directly and noticeably impact marine life. Chronic and catastrophic discharges of oil into the marine environment are possible, although unlikely during exploration. Since it is difficult to contain oil spills in the open ocean, as discussed in previous sections, marine flora and fauna may be highly vulnerable to even small amounts of oil.

Under the proposed scenario, only small oil spills are anticipated at the drilling location during exploration. Table IV-4 lists the total number of spills assumed for all phases of operations during the 40 years of activity from the proposed lease sale. Accidental spills are more likely during development and production. Oil pollution that originates outside of areas of special concern may reach within the boundaries or buffers of protection, but impacts would likely be minimized by dispersion and dilution. The risk of surface oil affecting sensitive seafloor communities is nominal.

Exploration activities that may impact areas of special concern in the coastal environment include service vessel and helicopter trips to the drilling rigs and small spills. Service vessel trips to the drilling rigs from the Hampton Roads area could interfere with the migration or breeding patterns of anadromous and other fish species that depend on the mouth of the Chesapeake Bay. Wakes from vessels may damage sensitive submerged aquatic vegetation, oyster beds, and other natural features that occur in shallow-water environments, thus clearing the way for nonnative invasive vegetation such as *Phragmites australis* and purple loosestrife to proliferate and compromise the functioning of the ecosystem. Helicopters may startle sensitive birds during nesting and cause them to flee the region, or accidentally collide with important bird species during migration. However, helicopters are subject to flight restrictions to protect sensitive natural areas, and the level of vessel and helicopter traffic supporting exploration activities is projected to be low. Furthermore, since the Chesapeake Bay is already a major thruway to Hampton Roads, the second largest hub for cargo on the east coast, impacts on the Bay and other areas of special concern due to vessel and helicopter travel are expected to be negligible.

It is unlikely that impacts due to discharges of drilling muds and cuttings, construction of a support base for vessels, and use of an existing airfield for helicopter support will affect areas of special concern in the Mid-Atlantic Planning Area. The USEPA, through the NPDES permit process, regulates discharges of both water-based and synthetic drilling muds and cuttings, which are generally of low toxicity, do not drift far from the well of origin, and are rapidly diluted in a high-energy environment such as the open ocean. Construction of a support base and use of an existing airfield would occur in the Hampton Roads area, which is already heavily used for industrial and commercial purposes.

Conclusion

Exploratory oil and gas activity would be prohibited in designated areas of special concern throughout the proposed lease area. Activities outside these areas may cause impacts within their boundaries that could compromise the integrity of protected marine and coastal environments, thus threatening visitation and use, awareness, and support for current and future protections. The low level of exploratory activity projected and the use of mitigation measures, including lease stipulations, will minimize the risk to these areas. No measurable impacts to these features are expected as a result of exploratory activities.

Development and Production

Activities associated with development and production that may impact areas of special concern in the marine environment include drilling of 8-12 development and production wells, construction and placement of 1 platform from which all wells would be drilled, 1-5 service vessel trips and 5-10 helicopter trips per week to the production platform, use of a support base and an existing airfield for service vessels, discharges of drilling muds (5,800 bbl/well) and cuttings (1,630 bbl/well), construction and placement of a pipeline (25-75 miles long) from the platform to a gas facility onshore, transportation of natural gas via the pipeline, construction and use of a gas processing facility and pipe coating yard onshore, transportation of oil by tanker to a port in the Hampton Roads area, and construction and use of an oil terminal (Table IV-3). One 1,500-bbl spill and several small spills (1-2 spills of 50-999 bbl, and 5-10 spills less than 50 bbl) are assumed in the scenario (Table IV-4). Development and production are expected to occur for 40 years.

One platform, from which all wells would be drilled, would be placed in the proposed lease area. Although MMS regulations (30 CFR 250) prohibit operators from disposing of waste overboard from rigs and platforms, accidentally discarded solid debris, such as plastic and other non-biodegradable drilling and construction materials, may drift into protected marine areas. Since only one platform is proposed, minimal amounts of debris are expected.

The extent of impacts of one large oil spill in the marine environment would depend on a variety of factors such as the physical and chemical nature of the product released, the size and location of the spill, weather conditions, time of year, and the type of cleanup mechanisms adopted. There is a greater likelihood during a large spill than during a small spill for spreading, dissolution and dispersion, and sedimentation of oil particles to the ocean floor over time.

Overall ecological health of some localized areas could be compromised if oil particles come in contact with sensitive habitats and species. For instance, the viability of fish eggs and larvae populations in the Norfolk Canyon could decrease and ultimately impact fishing yields in the area. Although highly unlikely because of the location of oil drilling activities, artifacts in Monitor National Marine Sanctuary could be covered with oil residues and, thus, result in reduced visitation to the site, which is already limited to the diving community. If the integrity of resources under protection is compromised, awareness and support for them may follow.

Development and production activities that may impact areas of special concern in the coastal environment include activities discussed in the exploration section plus the construction and placement of 25-75 miles of pipeline from the platform to a gas facility onshore, transportation of oil by tanker to a port in the Hampton Roads area, and a large oil spill.

Construction and placement of a pipeline from the platform to a gas facility in the Virginia Beach area would require some excavation and vegetation removal within a portion of the 200-foot right-of-way at the landfall site. Horizontal directional drilling will likely be the construction method because it reduces impacts to beach and marsh areas. Dredging along the ocean floor would not be necessary. Pipeline placement and dumping of excess materials is prohibited in areas of special concern such as

Back Bay NWR, south of Virginia Beach. Precautions would be taken to ensure that protected areas are not disturbed.

The transportation of oil by tanker could result in oil spills near the coast. Prevailing ocean currents within 20 miles seaward of the Eastern Shore of Virginia appear to have the potential to direct any spilled material to the mouth of the Chesapeake Bay. The Chesapeake Bay has experienced numerous large spills during the past several decades. There are over 3,600 different species of animals and plants in the Bay that may be affected by one or more routes of exposure to oil, including ingestion, inhalation, dermal contact, bioconcentration through the food chain, smothering, poisoning, and death. The health of the Bay is already less than optimal as a result of spills and other sources of pollution. In 1999 and 2000, the health of the Bay rated 28 on a scale of zero to 100 (Chesapeake Bay Foundation, 2000). Impacts of a large spill may hinder extensive restoration efforts and divert limited resources away from the important protection schedules at other areas of special concern.

Small spills may occur at the surface in shallow waters from the coast to the port. Impacts would vary depending on the location and size of the spill, the type of petroleum spilled, weather conditions, time of year, and a variety of other factors. For instance, remnants of oil may collect in sand and harm shorebirds, or persist in tidal wetlands for years. However, areas of special concern would likely continue their status despite such disturbances. While resources may temporarily be diverted away from other protected areas to support cleanup activities, benefits associated with various cleanup mechanisms would likely outweigh environmental costs associated with their use.

A large oil spill at sea would likely go through a minimum amount of weathering before reaching sensitive nearshore and intertidal areas. The weathering process would allow the more toxic fractions of the petroleum to evaporate and would permit some natural dispersion to occur. Spill response crews would have more time to reach the spill site and deploy cleanup equipment. Physical removal of oil from a marsh, such as the Chesapeake Bay, is extremely difficult and would be addressed by multiple parties, although strategies to address occurrences that may affect other areas of special concern such as Assateague National Seashore would be planned as well.

It is not anticipated that use of a support base, transportation of natural gas via the pipeline, construction and use of a gas processing facility and pipe coating yard on shore, and construction and use of an oil terminal would impact areas of special concern.

Conclusion

It is unlikely that oil and gas development and production activities will significantly impact areas of special concern within the proposed lease area, although large spills have the potential to threaten protection efforts. Mitigation efforts and thorough contingency planning by multiple parties will minimize the risk to these areas.

j. Population, Employment and Regional Income

In 1990, the 16 jurisdictions of Hampton Roads had a combined population of 1,454,185 persons. By 2000, the U.S. Census indicated that the regional population had grown to 1,574,801 for an increase of 120,616 over the decade. Between the first quarter of 2002 and the first quarter of 2003, the region created 11,162 net new civilian jobs, resulting in a 1.5 percent annual increase. (Hampton Roads Planning District Commission, 2003)

The Hampton Roads region's economic base is largely port-related, including shipbuilding, ship repair, naval installations, cargo transfer and storage, and manufacturing related to the processing of imports and exports. Since 1989, Hampton Roads has been the mid-Atlantic leader in U.S. waterborne foreign commerce and is ranked second nationally behind the port of South Louisiana based on export tonnage. Coal loading facilities in the port of Hampton Roads are able to load in excess of 65 million tons annually, giving the port the largest and most efficient and modern coal loading facilities in the world. The Norfolk Naval Shipyard is a major contributor to the economy of Hampton Roads. The work force of the shipyard includes 70-percent highly skilled, 20-percent moderately skilled, and 10-percent unskilled workers (Fonseca, 1990).

The tourism industry is a significant contributor to the regional economy in the Norfolk area. In Hampton Roads, for example, direct travel employment totaled 42,048 workers, generating $682 million in payroll in 2001. In addition, tourism is a substantial source of tax revenue for area jurisdictions. In 2001, local travel taxes totaled $85.3 million in Hampton Roads. (Hampton Roads Planning District Commission, 2003).

The military also plays a vital role in the Hampton Roads economy. Hampton Roads has one of the largest concentrations of military personnel in the world, with military employment comprising more than 11.5 percent of the total employment in the region. The region had 112,440 military personnel in 2001. As a result of the large military presence in the region, Virginia's Hampton Roads has a skilled pool of potential workers that few other metropolitan areas have to offer. Each year over 15,000 trained and disciplined personnel exit the military. Many of these persons elect to stay in the area and look for employment in the private sector. In addition, there are approximately 40,000 military spouses available for employment. (Hampton Roads Planning District Commission, 2003).

In addition to contributing to the well being of Hampton Roads residents, agriculture plays a role in the region's economic health. Farmland adds to the aesthetic appeal of the region by maintaining wide-open green spaces in areas of encroaching residential and commercial development. Overall, the agricultural industry provides not only the obvious benefits traditionally associated with farming but aesthetic and environmental benefits as well.

Exploration

During the exploration phase of an oil and gas drilling operation, there would be a need for some on-shore support from the Norfolk-Hampton Roads area. Potential jobs would be created from a need for workers for 2-3 supply boats and a crew boat, and sufficient helicopter crew to support 5-10 trips per week (Table IV-3). Workers with expertise to work on supply boats and crew boats should be readily available in an area where shipping is an important industry. With the strong military presence in Hampton Roads, helicopter pilots should also be available. If there is a discovery of hydrocarbons, some local people would probably also be employed on supply boats and pipeline crews, although technical expertise for specialized tasks would probably come from outside the region.

Secondary onshore support would be needed to provide food service and other services such as housing and transportation. However, the exploratory activities generally would last no longer than 45-120 days, so the need would be short lived, and there would be no overall impact on the economy.

Conclusion

During the exploration phase, there would probably be some small increase in local revenue, although given the size of the Hampton Roads economy, it will have limited impact. Some local labor will be needed to support supply boats and helicopters, but at a level so small there will be little impact on overall employment and unemployment. Equipment to support the exploration phase, with the possible exception of crew boats and helicopters, will most likely be brought in from outside the local area.

Development and Production

If exploratory operations result in the discovery of commercial quantities of hydrocarbons, the development and production phases will require additional workers. Development drilling requires a work force of 125-250 people at any given time. However, since there is no resident expertise in oil and gas drilling in the Norfolk area, most of these workers will come from other parts of the country. Offshore pipeline construction requires an average of 40 employees, and onshore construction requires another 60-70 workers. While many of these workers will come from other areas, there would probably be some need for local workers, particularly in supply and onshore construction activities.

If exploratory operations are successful, there will be a need to construct an onshore service base, gas processing facility, and pipe coating yard in Norfolk. While some of this construction will require outside expertise, there will be a need for local construction workers to support the effort.

A need for secondary onshore employment will also be created to provide supplies, housing, transportation, and other services. Once the project goes into the development and production phases, there will be a demand for some onshore housing. Once again, given the size of the Hampton Roads economic area, these needs should be readily absorbed into the existing real estate market. Since the military makes up such a large part of its population, the area's real estate market is accustomed to adjusting to a high turnover of residential units. The current military turnover rate is approximately 15,000 per year. The small number of new residents that result from OCS activities should be easily accommodated in the region as a whole.

In many other areas where oil and gas activities take place, employment opportunities provided by the industry are essential to the ongoing survival of many communities. This is not the case in Hampton Roads, where oil and gas activities—at least at the proposed level—should have little impact on the overall economy of the region.

Although a large spill is not likely, for purposes of analysis we assume a 1,500-bbl spill would occur from a tanker (Table IV-4). Depending on the location, a large spill could have a significant impact on the local economy. Damage to tourist sites, beaches, wildlife sanctuaries, hotels and resorts along the coast, as well as damage to harbors where cruise ships are berthed, could seriously affect the tourist industry and recreational and commercial fishing. However, even in the case of tanker spills, such as the Exxon Valdez, which are much larger than those reasonably foreseeable from OCS activities, serious effects to toursim and recreational and commercial fishing have been relatively short-lived; usually less than a year. Some impact might be felt in the real estate market if coastal residential and vacation home areas are impacted.

There are a number of Naval commands in the Hampton Roads area, including the Naval Station Norfolk; Norfolk Naval Shipyard, Portsmouth; Fleet Combat Training Center Atlantic, Dam Neck; Naval Amphibious Base, Little Creek; Naval Weapons Station, Yorktown; and Naval Air Station, Norfolk; Naval Air Station, Oceana. Located at these installations are hundreds of commands, large and small, afloat and onshore. Without specifying the activities that take place within these commands, it is probably safe to say that they are also potentially vulnerable to an oil spill of the projected magnitude.

Cleanup activities associated with a large spill would generate some local employment, although oil companies would hire companies specializing in clean-up, and local help would only provide minimal support to a professional crew coming into the area from elsewhere.

Conclusion

The necessary expertise in development and production of oil and gas does not exist in Hampton Roads, and workers with these skills will have to be imported from other areas where offshore drilling is already being done. However, there is a large labor pool in the Hampton Roads area, including workers skilled in construction and maritime trades. These workers could provide support services in the drilling and pipe-laying phases, as well as in the construction of needed onshore facilities such as the service base, gas processing facility, and pipe coating yard.

Any increase in population as a result of development and production is not expected to have a significant impact on the housing market or on the economy. Purchases of food, transportation and other miscellaneous supplies are likely to not have an impact on the Hampton Roads economy as a whole.

Depending on the location, a large spill could affect the recreation, tourism, commercial fishing, and cruise ship economies, and possibly negatively affect the real estate market, resulting in temporary losses of jobs and income.

k. Sociocultural Systems and Environmental Justice

Executive Order 12898 on environmental justice for minority and low-income populations was issued in 1994. It specifies that "… each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations" (59 FR 7629).

Hampton Roads is a sprawling, polycentric urban area of approximately 1.4 million people, sometimes referred to as the "Los Angeles of Virginia." Roughly one-third of Hampton Roads' residents are black. The median income of black households in Hampton Roads in 2000 was $30,500, 3.7 percent higher than that of the average black household in the Nation. However, black household incomes in the region were only 62.8 percent of white household incomes. Nearly 21 percent of black citizens in Hampton Roads live in poverty, even though the overall regional poverty rate is about 10 percent. Proportionally, about four times as many blacks as whites live below the poverty line in Hampton Roads. (Old Dominion University, 2003)

At the same time, however, blacks in Hampton Roads have a long history of owning their own businesses. Hampton Roads is one of the leading metropolitan areas in the Nation in the proportion of businesses owned by blacks. The increase in income and quality of life for many blacks in Hampton Roads is attributed to the presence of the military whose payroll provides solid incomes for increasing numbers of African-Americans. (ibid.)

The separation between blacks and whites in terms of income in Hampton Roads does not translate to residential living patterns. Studies by a number of groups reveal the region's neighborhoods to be the most integrated in the Nation. Relatively more blacks and whites live next to each other on the same residential block in Hampton Roads than almost anywhere else in the Nation.

The proportion of blacks in Hampton Roads who owned their own home in 2000 was 45.6 percent, compared to 71.5 percent for whites. The median value of black homes was $85,200 in 2000, 71.3 percent of the value of white homes. This is significantly higher than the national average of 65.6 percent. Blacks within the region are unique in that 35.4 percent of those who own their homes have no home mortgage. This is almost 60 percent greater than that of the region's white homeowners and is one of the highest rates of any racial group in the country. A combination of relatively low home prices and military housing allowances may be responsible for this. Fewer blacks than whites own their own homes, but blacks appear to place a high priority on not having any mortgage debt. (ibid.)

Analyses of block-level census data show that Hampton Roads integrated faster than most of the country, but the cities with the most blacks, Portsmouth and Norfolk, are integrating less rapidly in the neighborhoods and subdivisions than the new sections of Virginia Beach and Chesapeake. Demographers use a score called the delta value to measure the degree to which black and white families live on the same block, in a range of 0 (most segregated) to 100 (totally integrated). Hampton Roads' score in 1990 was 44, while Virginia Beach had a score of 57. Other 1990 scores were 35 for Norfolk, 22 for Portsmouth, and 30 for Chesapeake. All of these scores had increased substantially since similar analyses were conducted in 1980. (Quinn and Pasawarat, 2003)

According to the latest census data, Virginia as a whole has become more racially diverse over the last decade. White non-Hispanics account for 70 percent of Virginia's residents compared to 69 percent nationally. Conversely, the African-American population of Virginia represents 20 percent of the population compared to 13 percent nationally. Locally, white non-Hispanics comprise 62 percent of the South Hampton Roads population, and African-Americans account for 30 percent of the population. In addition, about 3.5 percent of the population is Asian, a group that grew by 25 percent over the last 10 years. The Norfolk area, in particular, has one of the Nation's largest Filipino communities. (Puentes, 2003)

The Hispanic population of Hampton Roads has grown threefold over the past 14 years to 71,000, with roughly 29 percent living in Virginia Beach. A breakdown shows that the vast majority of Hispanics in Hampton Roads, most of whom are younger than 40, are from Mexico, followed by Puerto Rico, Central America, and the Caribbean. Nationally, Hispanics constitute 14 percent of the Nation's total population, making them the largest ethnic minority in the country. (Newswanger, 2005)

The Asian community is one of the fastest-growing in Hampton Roads and probably the most diverse. The community totals about 44,000—just 3 percent of the total population—but it is splintered among many nationalities that have almost nothing in common. Each has its own language, religion, national history and customs. In Hampton Roads, Asians are clustered in the Kempsville area of Virginia Beach, near Stumpy Lake. About one-quarter of all Asians live there. (Davis, 2001)

Ten years ago, most Asians in Hampton Roads were Filipinos. Today, Filipinos are still the majority (54 percent), but other Asian nationalities are growing faster. Koreans remain the second-largest Asian group in Hampton Roads, with 4,000 residents. The Asian Indian community has almost doubled during the decade, from 1,700 to 3,200. The Chinese and Vietnamese communities each have about 3,000 people and both are growing faster than the general population. New census figures show that Thais are among the smaller Asian communities in Hampton Roads, but are growing fast. (Davis, 2001) Table IV-24 shows the racial composition of Hampton Roads in 2005.

Hampton Roads is considered a place of great natural beauty, with a high standard of living. Community cultural life includes concerts, performing arts, and museums. Beach lovers have hundreds of miles of sand to explore. Virginia Beach, for example, is a year-round resort with a noncommercial boardwalk. Nature lovers are drawn to areas like the Chincoteague Wildlife Refuge, one of the most visited refuges in the United States, which includes more than 14,000 acres of beach, dunes, marsh, and maritime forest on the Atlantic Flyway. Needless to say, Hampton Roads' location provides many opportunities for water-based activities, whether it's fishing on the James River or sailing on the Chesapeake Bay.

Exploration

During the exploration phase of the operation, there would be a need for some onshore support from the Norfolk-Hampton Roads area, such as workers for 2-3 supply boats and 1 crew boat, and sufficient helicopter crew to support 5-10 trips per week (Table IV-3). Workers with expertise to work on supply boats and crew boats should be readily available in an area where shipping is an important industry. The strong military presence virtually assures the availability of helicopter pilots. Secondary onshore support would be needed to provide food service and other services, such as housing and transportation, during the brief exploratory period.

In regard to equal opportunity, it can be expected that the few jobs that would be open to local workers during exploration would be available to all qualified workers. Virginia is a Right-To-Work State. Virginia's Right-To-Work law prohibits a closed shop where employers must hire only members of the contracting union. The level of population diversity in the Hampton Roads area indicates that opportunities for work would not be constrained by race or ethnic background.

Conclusion

The activities that would occur during exploration would be concentrated in industrial-port areas and would be limited in size and duration. They would be unlikely to have noticeable sociocultural effects. During the exploratory phase of the operation, there would be a limited need for local workers—particularly those with maritime and construction skills—as well as some support businesses such as food service and temporary housing. Availability of workers from the current population in Hampton Roads is assured because of the large, skilled, labor pool that exists in the region, and it is expected that the few jobs available for local workers would be available to all eligible applicants, regardless of race or ethnic origin.

Development and Production

In the event that hydrocarbons are discovered, additional facilities will have to be constructed somewhere in the Hampton Roads area. This will include the service base, gas processing facility, and pipe yard. It has already been determined that this construction will be located in an area that is currently being utilized as an industrial site. A location will have to be found for the new pipeline landfall as well, either in the same location or a location in another industrial area.

Determining a location for such facilities, even in industrial areas, invariably raises the concerns of local citizens. Other studies of citizen response to oil and gas development and construction have determined that the biggest concern in all of the communities was environmental degradation linked to industry activities. Areas heavily invested in tourism were especially worried about oil spills, beach tar, and trash, while other areas were most concerned with the air and water pollution produced by refining and petrochemical complexes. There was the additional concern that drilling and exploration activities would also inevitably compromise the purity of wetlands and coastal waters.

Research has identified five classes of activity that pose hazards to a nearby community: transportation corridors, oil and natural gas pipelines, petroleum bulk storage facilities, shipyards, and a natural gas processing plant (Hemmerling and Colten, 2004). Vulnerability zones range from one-half mile for transportation corridors, crude oil pipelines, petroleum bulk storage facilities, and shipyards to one mile for the natural gas processing plant and natural gas pipelines. These distances represent the distance emergency response workers would need to evacuate in case of a fire involving the specific substances at each site.

Based on past experience, some groups may accuse the industry and local governments of actively discriminating against poor and minority residents living in refinery neighborhoods. Analyses of oil and gas activities in other areas reveal that minority population is a more important factor than income in determining the degree of environmental inequality. We have already seen that Hampton Roads has a higher than average degree of racial integration in housing. However, we also have seen that pockets of segregated housing still exist. It is very possible that this racial segregation already exists in neighborhoods close to industrial areas, since many of the industries are well-established.

At the time of development and production, additional workers will have to be hired for construction and operation activities, and workers skilled in oil and gas operations will be brought in from other areas. At that point, there will be a demand for onshore housing, as well as other community services, such as education and health care if workers move their families with them.

The development and production stage of the operation will involve not only the logistics of identifying a site and starting the construction, but also the probability that the residents of Hampton Roads—particularly those that have an interest in tourism, the environment, and shoreline activities—will actively oppose the project. Efforts will be made to provide assurances that measures will be taken to safeguard shoreline resources from contamination and that public information is complete and readily available.

Social scientists have found that the power structure of various communities needs to be understood because it determines which groups benefit from industry presence and which are marginalized, a key issue in social impact assessment. Community stakeholders vary across communities and could include political groups, property owners, and business owners. Identifying the political voice of a community is important to understanding the nature of the relationship between the community and the offshore industry.

Although a large oil spill is not likely, for the purposes of analysis, we assume a 1,500-bbl tanker spill (Table IV-4). Cleanup activities associated with a large spill would be handled primarily by the oil and gas company. A large spill in this area would probably not have a disparate impact on minorities or low-income families. In fact, the greatest impact, in terms of race and social class, would probably be felt by upper income owners of beachfront property, owners of shoreline hotels and resorts, and cruise lines that bring tourists in and out of the docks at Hampton Roads. So many activities important to Hampton Roads are associated with the shore, such as sunbathing, fishing, bird-watching, boating, and hiking, that a large spill could have very dramatic effects on the area's economy and quality of life.

An influx of workers for the development and production phase of the operation will most likely have little impact on the Hampton Roads area. Depending on location, there may be a few communities or neighborhoods that will feel the effect of the change in population because of an increased demand for health care, for example, or for school services. These demands are highly localized, however, and would not be felt in the Hampton Roads area as a whole. Since thousands of military families are constantly coming and going in Hampton Roads, realtors, schools, churches, and other organizations are well accustomed to a changing population.

Conclusion

A wider range of activities would occur during development than during exploration. While most would occur in industrial-port areas and have limited sociocultural effects, some, such as pipeline landfalls, might occur outside of these areas. Because of the level of population diversity in the Hampton Roads area, opportunities for work would not be constrained by race or ethnic background. Because the Hampton Roads area is ethnically and racially integrated, the limited sociocultural effects of new OCS-related activity and infrastructure would probably not have a disparate impact on minorities or low-income families. Likewise, if a large oil spill occurred in the area, it probably would not have a disparate impact on minorities or low-income families. The proposal may have a low level of socioeconomic impacts on the Hampton Roads area; however, there would not be disproportionately high and adverse human health or environmental impacts on minority or low-income populations. Thus, the activities likely under the proposal do not raise strong Environmental Justice concerns.

l. Archaeological Resources

Archaeological resources in the Mid-Atlantic Planning Area that may be impacted by the proposed action include historic shipwrecks and inundated prehistoric sites offshore, and historic and prehistoric sites onshore. Historic shipwrecks will tend to concentrate in the area between the shoreline and about the 20-m isobath. Inundated prehistoric sites dating from 12,000 B.P. will most likely exist shoreward of the 26-m isobath. There may be even earlier preserved prehistoric sites on the continental shelf out as far as the 130-m isobath. Although the existence of these earlier sites is not as certain as those dating 12,000 B.P. and later, such earlier sites would be extremely important archaeologically.

Onshore historic properties include sites, structures, and objects such as historic buildings, forts, lighthouses, homesteads, cemeteries, and battlefields. Onshore prehistoric archaeological resources include sites, structures, and objects such as shell middens, earth middens, campsites, kill sites, tool manufacturing areas. Currently unidentified onshore archaeological sites would have to be assessed after discovery to determine the uniqueness or significance of the information that they contain. Sites already listed in the National Register of Historic Places and those considered eligible for the Register have already been evaluated as having the potential for making a unique or significant contribution to science.

Exploration, Development, and Production

Routine exploration, development, and production activities associated with the proposal that are likely to affect archaeological resources include drilling wells, platform installation, pipeline installation and anchoring, as well as onshore facility and pipeline construction projects. While the source of potential impact will vary with the specific location and nature of the routine operation, the goal of archaeological resource management remains the protection and/or retrieval of unique information contained in intact archaeological deposits.

Direct physical contact between a routine activity and a shipwreck site could destroy fragile ship remains, such as the hull and wooden or ceramic artifacts, and could disturb the site context. The result would be the loss of archaeological data on ship construction, cargo, and the social organization of the vessel's crew, as well as the concomitant loss of information on maritime culture for the time period from which the ship dates. Ferromagnetic debris associated with proposal-related activities could mask magnetic signatures of significant historic archaeological resources, making them more difficult to detect with magnetometers. Interaction between a routine activity and a prehistoric archaeological site could destroy artifacts or site features and could disturb the stratigraphic context of the site. The result would be the loss of archaeological data on prehistoric human migrations, settlement patterns, and subsistence strategies, some of which may be available only from sites on the OCS.

Regulations at 30 CFR 250.194 allow the MMS Regional Director to require that an archaeological report based on geophysical data be prepared, if there are indications that a significant archaeological resource may exist within a lease area.

For historic resources, this decision is based on whether a lease block falls within an area assessed as having a high potential for shipwreck occurrence, such as the entrances to historic ports and harbors, or whether an historic shipwreck with a known location is reported to exist within or adjacent to a lease area. For prehistoric resources, all leases shoreward of the 26-m isobath would be required to have an archaeological survey and report prior to initiating exploration and development activities. For those leases between the 26- and 130-m isobaths, the data collected for shallow geohazards surveys would be evaluated to determine whether well-preserved geomorphic features exist, which would indicate areas having potential for early (i.e., pre-12,000 B.P.) prehistoric site deposits.

If the survey data indicate that an archaeological resource may exist within the lease area, the lessee must either plan proposed lease activities to avoid the area of the possible resource or conduct further investigations to determine if an archaeological resource actually exists at the location. If the further investigations determine that an archaeological resource is present at the location of proposed activity and cannot be avoided, the MMS procedures require consultation with the State Historic Preservation Office to develop mitigating measures prior to any exploration or development.

Under the proposed action, it is assumed that one natural gas pipeline would be constructed which would come ashore in the Norfolk area. New onshore facilities, including a service base, a processing facility and pipe-coating yard would be constructed at an existing industrial site in the Norfolk area. Federal, State, and local laws and ordinances, including the National Historic Preservation Act and the Archaeological Resources Protection Act, protect known sites and also as-yet-unidentified archaeological resources onshore. Existing regulations require archaeological surveys to be conducted prior to permitting any activity that might disturb a significant archaeological site. Therefore, most archaeological resources will be located, evaluated, and mitigated prior to any onshore construction activities. New data related to the human history and prehistory of the mid-Atlantic coastal region likely will be produced from compliance-related archaeological projects associated with the proposal.

It is assumed for this analysis that the level of protection provided by existing laws and regulations is in place. However, a routine activity could contact a shipwreck if the MMS failed to require a survey because of incomplete knowledge of the location of all historic shipwrecks. Such an event could result in the disturbance or destruction of unique or significant historic archaeological information. It is less likely that an inundated prehistoric site would be contacted by a routine activity because archaeological surveys are required on all leases that have any potential for prehistoric site occurrence.

An accidental oil spill resulting from the proposed action could impact shipwrecks in shallow coastal waters, and coastal historic and prehistoric archeological sites. Archaeological resource protection during an oil spill requires specific knowledge of the resource's location, condition, nature, and extent prior to impact; however, the mid-Atlantic coastline has not been systematically surveyed for archaeological sites. Existing information indicates that, in coastal areas of the mid-Atlantic region, prehistoric sites occur frequently along the barrier islands and mainland coast and the margins of bays and estuaries. Thus, any spill that contacted the land would involve a potential impact to a prehistoric site.

Should an oil spill contact a coastal historic site, such as a fort or a lighthouse, the major impact would be visual due to oil contamination of the site and its environment. This impact would most likely be temporary, lasting up to several weeks depending on the time required for cleanup. Gross crude oil contamination of shorelines is a potential direct impact that may affect archaeological-site recognition. Heavy oiling conditions (Whitney, 1994) could conceal intertidal sites that may not be recognized until they are inadvertently damaged during cleanup. Crude oil may also contaminate organic material used in ^{14}C dating, and, although there are methods for cleaning contaminated ^{14}C samples, greater expense is incurred (Dekin et al., 1993). An Alaskan study examining the effects of the 1989 *Exxon Valdez* oil spill on archaeological deposits revealed that oil in the intertidal zone had not penetrated the subsoil, apparently due to hydrostatic pressure (Dekin et al., 1993); however, due to the different environments, these results should not be translated into the coastal environment of the Mid-Atlantic Planning Area without further study.

The major source of potential impact from oil spills is the harm that could result from unmonitored shoreline cleanup activities. Unmonitored booming, cleanup activities involving vehicle and foot traffic, mechanized cleanup involving heavy equipment, and high-pressure washing on or near archaeological sites pose risks to the resource. Unauthorized collecting of artifacts by cleanup crew members is also a concern, albeit one that can be mitigated with effective training and supervision. As Bittner (1996) described in her summary of the *Exxon Valdez* oil spill: "Damage assessment revealed no contamination of the sites by oil, but considerable damage resulted from vandalism associated with cleanup activities, and lesser amounts were caused by the cleanup process itself."

The National Response Team's Programmatic Agreement on Protection of Historic Properties During Emergency Response Under the National Oil and Hazardous Substances Pollution Contingency Plan clarifies interagency and regulatory aspects of archaeological site protection during oil-spill response. This 1997 agreement outlines the Federal On-Scene Coordinator's responsibility for ensuring that historic properties are appropriately considered in planning and during emergency response.

Conclusion

Assuming compliance with existing Federal, State, and local archaeological regulations and policies, most impacts to archaeological resources resulting from routine activities under the proposed action will be avoided. Based on the proposed scenario, some impact could occur to coastal historic and prehistoric archaeological resources from an accidental oil spill. Although it is not possible to predict the precise numbers or types of sites that would be affected, contact with archaeological sites would probably be unavoidable, and the resulting loss of information would be irretrievable. The magnitude of the impact would depend on the significance and uniqueness of the information lost. However, based on experience gained from the *Exxon Valdez* oil spill, no to limited impacts are expected from direct contact with oil, but some impacts can be expected during cleanup operations.

m. Land Use and Existing Infrastructure

Exploration

During the exploration phase of the proposed project, most of the activity will take place offshore, but a support base will be built onshore to provide supplies and equipment to the offshore facilities. Statistics on employment and industrial development in Hampton Roads indicate that there will be a ready availability of construction workers with the appropriate skills. Norfolk, Newport News, and Portsmouth already have extensive industrial areas adjacent to waterfront facilities where a support base with both boat and helicopter access could be constructed. Industrial and maritime development is strongly supported by local government planning agencies as part of their overall comprehensive plan for development, and more sites are being developed. Given the transportation network in Hampton Roads, the support base can be resupplied by boat, truck, or train.

In addition to a support base, facilities for supply and crew boats and helicopters will be needed. It is assumed that there will be 1-5 vessel trips per week, and 5-10 helicopter trips per week (Table IV-3). Supply boats require an all-weather harbor, wharf space, and a nearby repair and maintenance facility. All of these are available within the existing maritime infrastructure of Hampton Roads. It is assumed that a helicopter would make use of an available airport—several of which can be found nearby.

Conclusion

The existing industrial/maritime infrastructure in the Hampton Roads area can fulfill the requirements of a support base, as well as boat and helicopter traffic. Given the current level of activity in Hampton Roads, there will be minimum impact on the workforce or land use as a result of exploration activity. There are several options for transporting necessary supplies to the support base.

Development and Production

In the development and production phase, there will be a need for a permanent support base, a processing facility, and a pipe coating yard. In addition, a location must be found for a pipeline landfall.

Although construction of a permanent support base, processing facility, and pipe coating yard will require additional land, it appears that sufficient land would be available. According to local planning data, more land is currently being developed. Promotional material from the Norfolk Chamber of Commerce advertises the availability of industrial sites.

Siting of the pipeline landfall must conform to local, State, and Federal regulations. The Federal Energy Regulatory Commission regulates the transportation of all natural gas produced on the OCS. Even though the central harbor areas of Hampton Roads are highly industrialized, they are surrounded by miles of coast that are protected by numerous environmental laws and regulations. The Chesapeake Bay Commission, for example, has an extensive environmental program to protect the water quality of Chesapeake Bay. Virginia's Coastal Zone Management Program has numerous initiatives to protect water quality, habitat, estuaries, and beaches. The Virginia Seaside Heritage Program is addressing management of the aquatic resources of the barrier islands, bays, and salt marshes along the shore.

Although a large spill is not likely, for the purposes of analysis, we assume that a 1,500-bbl spill will occur from a tanker transporting OCS oil from the platform offshore to a Hampton Roads terminal (Table IV-4). A large spill that reaches some of the pristine beaches and estuaries around Hampton

Roads could be extremely serious. Due to its position in the middle of the east coast, Virginia's coastline is critical to hundreds of species of migratory birds. Cape Charles, for example, is one of the most important areas for migratory bird staging in Northern America. Specific impacts on the natural environment are being addressed in other sections of this analysis.

While much of the coastal land around Hampton Roads is protected and kept in its natural state, there are coastal areas that have been developed with summer residences, hotels, and resorts. A large spill, depending on its location, could have significant economic, environmental, and aesthetic impacts on these areas.

Conclusion

Given the current level of activity in Hampton Roads, there will be minimum impact on land use or infrastructure as a result of exploration, development, and production activity.

n. Tourism and Recreation

The coastal zone along the Mid-Atlantic Planning Area offers a range of recreation and tourism opportunities, as discussed in Section III.C.17. Offshore oil and gas activity may impact the quality of visitor experiences (visual, audible) or visitor participation in recreational activities (i.e., access to fishing and swimming areas). Unless they result in negative branding of the region, impacts are expected to be minor or temporary except in rare cases.

The landmass immediately adjacent to the potential lease area that would be most directly affected by oil and gas activity includes the Virginia Beach area and Virginia's Eastern Shore. Popular activities that have growth potential include water recreation, fishing, and wildlife watching (including but not limited to bird watching, whale watching, and dolphin watching). The 3-mile-long oceanfront boardwalk in Virginia Beach is the eighth most popular boardwalk in the nation (Virginia Department of Environmental Quality, 2001). The extent of impacts would depend on the proximity of oil and gas activities to recreational use areas. In general, public controversy, such as a large oil spill reported in the mainstream or national media, could have a negative impact upon the tourism industry's ability to brand Virginia as a pristine destination for public recreation (House Joint Resolution 625, 2006). In the absence of a major environmental accident, negative press surrounding offshore oil and gas drilling is expected to have only a temporary adverse impact on tourism.

Exploration

Activities associated with exploration that may impact tourism and recreation include the drilling of 10-15 exploratory wells, and 1-5 service vessel trips, and 5-10 helicopter trips per week to the drilling rigs (Table IV-3). Under the proposed action scenario, no large oil spills are assumed during exploration, and small spills are unlikely (Table IV-4).

The location of drilling rigs and the drilling of exploratory wells in the westernmost portion of the lease area may visually impact visitors. Under optimum atmospheric conditions, the viewshed off Virginia's shores is approximately 11 miles. There would be no visual impact to tourists on land if drilling activities occur beyond the viewshed. If drilling operations occur within Federal waters less than 11 miles from shore, it is likely that the rigs would be visible on clear days. The impact of the visibility of drilling operations on tourism and recreation is uncertain. While some visitors may be turned away by industrial views, the sight may intrigue others.

One to five (1-5) service vessel trips and 5-10 helicopter trips per week to the drilling rigs may result in visual and audible impacts if travel paths are in close proximity to recreational destinations. Insofar as military, commercial, and recreational water and air vessels currently traverse the region with no reported negative impact upon the region's ability to attract tourists, no detrimental impact from oil and gas industry vessels in anticipated (House Joint Resolution 625, 2006).

Several small oil spills could occur at the drilling rigs or from service vessels. A small spill that occurs near a recreational destination, such as First Landing State Park, may cause one or more beach or destination closings. The smell of oil may persist in the air, and the taste of oil may linger in shellfish harvested from the affected area, such as mussels or oysters from the Chesapeake Bay. Based on similar occurrences in the Gulf of Mexico, impacts would likely be temporary. Visitors may simply divert their attention to alternate activities in the area.

It is not expected that construction of a support base for vessels in the Hampton Roads area, use of an existing airfield for helicopter support, and discharges of drilling muds and cuttings would impact tourism and recreation.

Conclusion

Oil and gas activities during exploration may have visual and audible impacts on coastal visitors, particularly if a drilling rig and production platform are within 11 miles of the shoreline. Impacts from routine activities are expected to have no noticeable effects on recreation and tourism activity.

Development and Production

Activities associated with development and production that may impact tourism and recreation include those discussed in the previous section plus placement of 1 platform, drilling of 8-12 development and production wells, 1-5 service vessel trips and 5-10 helicopter trips per week to the production platform, construction of a pipeline (25-75 miles long) from the platform to a gas facility on shore, and transportation of oil by tanker to a port in the Hampton Roads area (Table IV-3). One large spill and several small spills are assumed in the scenario and could adversely affect tourism and recreation (Table IV-4).

Placement of a platform may create visual impacts that last as long as 40 years, depending on the distance of the platform from shore, as discussed above for exploration. Regardless of platform location, there is a potential visual impact for tourists arriving and departing on cruise ships out of Norfolk; however, there appears to be no detrimental visual impact on the cruise industry in other destinations, such as the Gulf of Mexico (House Joint Resolution 625, 2006). There is potential visual impact to recreational boaters who may not want any structures offshore. However, the production platform may actually serve as a visual point of navigation, communication, and search-and-rescue infrastructure, contributing to the overall safety of recreational and commercial boat traffic.

There are also potential positive impacts as offshore structures can create artificial reefs over time and become attractive to recreational anglers and scuba diving enthusiasts. A study on the economic impact to recreational fishing and diving associated with offshore oil and gas structures in the Gulf of Mexico found that the presence of such structures contributed substantially to the fishing and diving industries in the region. Since only one platform is projected in the mid-Atlantic lease area, the extent of positive impacts is questionable.

Construction of a pipeline with landfall in Virginia Beach may impact visitor use and experience in the area immediately surrounding the 200-foot right-of-way, particularly if the pipeline enters shore at a popular recreational destination spot. Impacts would vary depending on the location of landfall, the duration and season of construction, and the construction method. For instance, if public access to a popular public beach is restricted for an entire summer season, the tourism industry may experience an economic burden from oil and gas activity despite the availability of alternatives to that destination. Off-season construction would result in fewer disturbances.

Transportation of oil by a tanker to a port in the Hampton Roads area may result in visual impacts such as those previously discussed resulting from vessel traffic. Tourism and recreation would be more significantly impacted by a large oil spill from a tanker or the drilling platform. The net loss of participation in coastal activities due to a large oil spill would depend on the size of the affected area, the timing of the spill, and other factors. A large spill response would likely involve access restrictions to particular areas while cleanup is conducted. Reactions to a large oil spill could be offset, to some extent, by informing the public promptly if the visual and natural impacts are negligible. However, negative media coverage may deter visitors and offset economic expenditures from tourism in the region.

In the case of an extreme event, the loss of all or most of a season's tourism income may undermine the viability of seasonal enterprises in future seasons as visitors form new preference patterns, although it is difficult to predict how many tourists would stay home or vacation elsewhere. Finally, a large spill may impact dredging of sand for public beaches that protects them from wave damage and flooding during storms and chronic shoreline erosion. If a recreational beach noticeably decreases in size, the return ratio of tourists can decrease with it.

It is not anticipated that use of a support base, transportation of natural gas via the pipeline, construction and use of a gas processing facility and pipe coating yard on shore, and construction and use of an oil terminal would impact tourism and recreation.

Conclusion

Routine activities associated with oil and gas exploration, development, and production may result in visual, natural, and branding impacts on tourism and recreation. Except in extreme circumstances, impacts are expected to be minor or temporary. An oil spill could result in temporary beach closures.

o. Fisheries

Commercial and recreational fishing are important estuarine and marine activities all along the U.S. eastern seaboard. Fish and fishermen can be found from the inshore waters of the bays and sounds to the deep offshore waters of the Gulf Stream off the mid-Atlantic. The mid-Atlantic area is one of transition and seasonal migration for a number of species. Because of the complexity of the mid-Atlantic ecosystem, fish species distribution, abundance, and community composition vary greatly during the year. Commercial fishing in the mid-Atlantic takes place year-round, and the diversity of fish species and habitats produces numerous fishing techniques for harvesting the fish resources. In recognition of this diversity, the Chesapeake Bay fisheries (landings for Maryland and Virginia) are treated statistically by the National Marine Fisheries Service as a distinct region.

(1) Commercial Fisheries

The Atlantic menhaden (*Brevoortia tyrannus*), a commercial species, has the highest landings, by weight, of all the species in the Mid-Atlantic Bight. Typically, these fish are harvested by purse seiners in the shallower near-coastal waters. Modern vessels use spotter planes to locate dense schools of this migratory species. Pound nets are used in the rivers and estuaries of the mid-Atlantic to harvest those species that migrate along the shore, including spot (*Leiostomus xanthurus*), spotted sea trout (*Cynoscion nebulosus*), and croaker (*Micropogonias undulatus*). Trawls are used year-round in the mid-Atlantic, although annual changes in water temperature on the shelf result in varying seasonal abundance of some species. In the spring and summer, trawl fisheries harvest squid (*Loligo pealeii* and *Illex illecebrosus*), butterfish (*Peprilus triacanthus*), and mackerel (*Scomber scombrus*). Trawl fisheries in the late fall and winter harvest flounder (*Pseudopleuronectes americanus*) and fluke (*Paralichthys dentatus*). Along the outer shelf edge and shelf break, swordfish (*Xiphias gladius*) are harvested using surface longlines, and tilefish (*Lopholatilus chamaeleonticeps*) are harvested from submarine canyons and along the slope break by bottom longlines.

Several commercially valuable species of shellfish are harvested in the mid-Atlantic region. Oysters (*Crassostrea virginica*), hard clams (*Mercenaria mercenaria*), and soft clams (*Mya arenaria*) are harvested in the bays and sounds by dredges and tongs. Ocean quahogs (*Arctica islandica*), scallops (*Placopecten magellanicus*), and surf clams (*Spisula solidissima*) are harvested offshore by power and mechanical dredges. Potting for lobsters occurs in the nearshore and offshore areas in the northern portion of the Mid-Atlantic Bight and offshore in the southern portion. Potting for blue crabs (*Callinectes sapidus*) is common in the bays and sounds in the southern portion of the mid-Atlantic.

Exploration

During exploration activities, damage to fishing gear potentially could result from geophysical survey vessels encountering fixed gear (e.g., pots, pound nets, and anchored gill nets) on the fishing grounds; however, the Fishermen's Contingency Fund, established under the OCS Land Act Amendment (43 U.S.C. 1841-1846), can provide compensation for damaged or lost gear. The Fund can reimburse up to 100 percent of the costs of repair or replacement of damaged gear and up to 50 percent for loss of income. Additionally, compensation could be arranged with the operator without going to the fund if loss or damage occurred.

Today, most seismic surveys use low-frequency acoustic pulses from an air gun towed behind the survey vessel. There have been no documented cases of fish mortality from these seismic sounds under field operating conditions (Department of Fisheries and Oceans, 2004). The effects of seismic surveys on fish resources are discussed in Section IV.B.4.e.

Conclusion

Because of the minimal level of exploration activity projected for the proposed action, no discernible impacts are expected for commercial fisheries from oil and gas exploration.

Development and Production

The impacts on commercial and recreational fishing would result primarily from spatial exclusion (due to the placement of rigs, platforms and pipelines) and oil spills.

The placement of rigs, platforms, and a pipeline as a consequence of the proposed action will restrict some portion of the area now being commercially fished. Conflicts arise when fishing activity is preempted by petroleum-related structures (e.g., drillships, anchors, platforms, and pipelines). The size of the area that will effectively preclude fishermen will depend on many factors including the type of oil and gas equipment, fishing vessel maneuverability, gear used, weather and sea conditions, legal and safety requirements, bottom topography, and a fisherman's experience and willingness to work near OCS structures.

Mobile gear (e.g., longlines, trawls, and dredges) is more susceptible to damage from collisions or entanglement than fixed gear (e.g., pots, pound nets, and anchored gill nets). Therefore, fishermen employing mobile gear could be impacted more than those employing fixed gear. Because the level of oil and gas activity is projected to be small in the mid-Atlantic, few spatial conflicts on the fishing grounds are anticipated. Some competitive exclusion could occur in fisheries targeting epipelagic species, such as tuna and swordfish, along the shelf edge. Deepwater trawl fisheries, which operate out to the shelf edge, also could be impacted.

Subsea production systems preclude space only for bottom fishing and not for mid-water trawls or long lining. If fishermen know the location of these structures, they could avoid them unless there is a good reason to fish nearby. Most subsea completion components are coupled with surface facilities for either processing, storage, or transport functions. The actual position of subsea wellheads around a common gathering manifold would depend primarily on the areal extent of the reservoir. If a subsea completion is used for the one production facility projected in the Mid Atlantic, it would likely be on the continental slope and not in areas of greatest fishing activity. There could be some spatial exclusion of the lobster and red crab fisheries.

In the Mid-Atlantic Bight, there appears to be an inshore and offshore lobster population. Both populations exhibit lateral movement, and the offshore population migrates inshore and offshore seasonally. The inshore fishery is almost entirely a trap fishery, while both traps and otter trawls are used offshore. Lobster are selective of substrate, preferring shelter in the form of rocks, rubble, or areas where the substrate is cohesive enough to permit burrowing. These conditions limit lobster within the proposed sale area primarily to the canyon areas. There could be some impact to the lobster fishery in the shallower canyon areas, but the impact to the total fishery in the Mid-Atlantic should be small and localized.

In the Mid-Atlantic Bight, red crab are found in 100- to 1,460-m water depths, with greater concentrations in the 320- to 550-m depth range. The major effort for the red crab is directed along the shelf break and on the upper continental slope. Excluding a possible buffer zone around platforms, the only limiting factor to the red crab trap fishery is how close to vessel activity and fixed surface structures traps can safely be set. Considering the depths at which red crabs are found, their mobility, and the small spatial exclusion factor, possible impacts on the commercial fishery should be insignificant.

The Fishermen's Contingency Fund permits commercial fishing vessels to be reimbursed for lost or damaged equipment as a result of OCS development. The fund may also pay for economic loss associated with gear damage.

Many fish and shellfish are harvested commercially in the area along the assumed gas pipeline corridor and are principally caught by bottom trawling and dredging. Unburied pipelines with smooth surface designs and some type of protection over irregular surfaces are most compatible with fishing gear. Because pipelines will be buried near shore, conflicts with commercial fishing activities in coastal waters are not expected.

The major impacts to fisheries from pipelaying activities include the direct burial of benthic organisms, secondary effects associated with increased turbidity levels during pipelaying operations, and modification of the historic benthic and demersal communities in the vicinity of the pipelines.

Typically, fishermen would avoid areas of oil contamination. However, should fishing gear contact spilled oil, it would coat the wings and cod end of the net and be transferred to part of the harvest, even if the fish were not in the vicinity of the spill. If these fish were included with the rest of the fish in the hold, the entire catch could be imperiled at the market. More likely, the fishing vessel could be coated by the oil.

Long-term field studies generally have shown that oil pollution can have serious local and temporary consequences on fisheries, but these occurrences are no greater, and generally less, than natural fluctuations (Bender et al., 1980; Blackman and Law, 1980). For example, changes in landings of commercial species in Texas following the Ixtoc I blowout (which deposited between 3,000 and 4,000 tonnes (t) of oil onshore in Texas in 1979) could not be distinguished from normal variations in annual landings in the previous 8 years (Restrepo et al., 1982). The study by Restrepo et al. (1982) concluded that "no biological basis exists for projecting a direct, economically significant impact on commercially important species." No evidence of large-scale losses of juvenile or adult fish was observed in the 12 months following the spill of 26,000 t of No. 6 fuel from the *Argo Merchant* on Nantucket Shoals south of Cape Cod, Massachusetts (Sherman and Busch, 1978). One year after the *Amoco Cadiz* spill of 223,000 t off Brittany, France, many of the heavily impacted finfish and edible crab species had returned to normal population levels, although young soles were still absent (Gundlach et al., 1983). It should be understood, however, that although oil-spill effects may not have been detected on entire fish populations, it does not mean that some did not occur. Most long-term studies of oil spills are quite selective and limited in scope (Teal and Howarth, 1984; Vandermeulen, 1982). Moreover, finfish and shellfish from specific localities can be tainted and unmarketable for long periods (McIntyre, 1982).

A spill of 1,500 bbl could affect commercial fisheries in several ways. Damage to fishing gear could result in loss of fishing time and/or contamination of the catch. A more serious consequence of a large oil spill is the potential for oil to cause a decline in fishery resources. Nearshore fisheries are particularly vulnerable to an oil spill because of the potential for oil to be concentrated and become entrained in the sediments. Oil reaching these areas could result in large losses, with recovery taking several years. Whether or not this mortality has substantive longer-term effects on a fishery depends upon, among other things, the reproductive biology and population dynamics of the species. Large losses of adult and/or larval stages of inshore fishery species that are fully or over-exploited could affect present and future catches.

Almost the entire soft clam catch in the Mid-Atlantic occurs made in the Chesapeake Bay. This population is not considered susceptible to an oil spill originating from a platform associated with the proposed action due to its location up-bay and to the net down-bay movement of the Chesapeake Bay water. A single spill should not seriously affect the soft clam industry in the mid-Atlantic. Commercial populations of oysters are found in the Chesapeake Bay with a secondary population near the Delmarva Peninsula. Because of net tidal movement, the bay would probably be protected from most oil spills in the open ocean, but the oyster population along the ocean side of the Delmarva Peninsula could be exposed and, therefore, more susceptible.

Significant quantities of blue crabs occur along the coast of the Delmarva Peninsula and within and at the mouth of the Chesapeake Bay. An oil spill at the mouth of the Chesapeake Bay could kill overwintering females, or, during the summer, larvae would be affected adversely. Either possibility would probably result in a year-class failure, which could affect the commercial fishery, but the probability of a spill occurring and affecting all blue crab grounds is very slight.

Conclusion

Development and production impacts from the proposed action in the Mid-Atlantic Planning Area on commercial fisheries are not expected to produce losses in fish and shellfish stocks that are measurable against natural variation. Economic losses are expected to be limited to a few fishermen and to last less than 1 year.

(2) Recreational Fisheries

Surf fishing from the beach is a major recreational activity all along the mid-Atlantic coast, but especially along the northern beaches of the Outer Banks of North Carolina. Sought-after species include bluefish, red drum, black drum (*Pogonias cromis*), and sea trout. Fishing in sounds and bays from piers and small boats is an important late spring, summer, and early fall activity. The typical catch is comprised of bluefish, fluke, winter flounder, weakfish (*Cynoscion regalis*), and Atlantic mackerel in the northern part of the mid-Atlantic and bluefish, fluke, spot, croaker, sea trout, and black sea bass (*Centropristis striata*) in the southern part. Charter boat fishing also is a valuable enterprise in the Mid-Atlantic Bight. Offshore boats may fish for yellowfin tuna (*Thunnus albacares*), marlin (*Istiophoridae*), dolphin (*Coryphaena hippurus*), or swordfish. Nearshore headboats typically target bluefish, winter flounder, fluke, sharks (*Carcharinus* sp.), and spotted sea trout. Many of the offshore recreational fishing areas are centered around old shipwrecks, submarine canyon heads, or high-productivity areas of recurring upwelling events.

Impacts to recreational fisheries from routine activities could include spatial conflicts on the fishing grounds and effects from drilling discharges, emplacement of a pipeline, and noise.

Spatial conflicts on the fishing grounds could arise, particularly in areas where trolling is common. On the outer shelf and upper slope, the most likely impacts would occur in those sport fisheries targeting epipelagic bluewater species, such as tuna and billfish, along the shelf edge. Conflicts also could arise around OCS structures located on the continental shelf. Conversely, in a number of regions with important sport fisheries, submerged structures provide substrate for the attachment of fouling biota that attract both fish and fishermen (Gallaway and Lewbel, 1982).

Although most sport fisheries occur within waters less than 16 km (10 miles) from shore, there are specialized offshore game fish fisheries that operate at extended distances from the coast, within or near the Gulf Stream. In waters occupied by oil and gas activities, operators in the offshore recreational fisheries could experience a highly localized loss of habitat access due to exclusion based on safety considerations. Because only one platform is projected for the Mid-Atlantic Planning Area, the anticipated level of impact to recreational fisheries from routine OCS gas and oil activities, including habitat exclusion, is expected to be minimal.

The presence of an offshore platform may have a positive effect on availability of recreational fishing opportunities. In the Gulf of Mexico, for example, approximately 20 percent of private boat fishing trips, 32 percent of charter boat fishing trips, and 51 percent of party boat fishing trips offshore Alabama, Mississippi, Louisiana, and Texas anchored within 300 feet of an oil or gas structure because the presence of structures aggregate pelagic and reef-associated fish species that are targeted by many recreational fishers (Hiett and Milon, 2002). A similar phenomenon could occur offshore Virginia.

The impact of an oil spill on recreational fishing should be temporary. Loss of fishing would result from the presence of an oil slick and dispersion of the fish population. The Chesapeake Bay is one area of high recreational fishing activity in the mid-Atlantic, but the likelihood of an impact to recreational fishing in the Chesapeake Bay from an oil spill occurring from the proposed action is quite small.

The magnitude of the impact on the recreational fishery would depend upon the time of year a spill occurred, the location, and the areal extent of the spill. For example, as bluefish are sought from early summer through fall and striped bass from spring through early winter, a spill in early spring would have little impact on either fishery. With the exception of canyon head areas, the most important grounds fished by saltwater anglers are located nearshore, west of the proposed lease sale area. Offshore, the most heavily fished area is Baltimore Canyon for pelagic game fish such as tuna, marlin, and swordfish. This is primarily a seasonal fishery from late June to early September.

The most serious consequences would result from a large spill in nearshore waters where most recreational fishing takes place. Nearshore habitats also are particularly vulnerable because oil reaching these areas tends to be concentrated by wind and waves, resulting in massive deaths of eggs, larvae, and adult recreational species. High-energy environments, such as headlands, would be cleansed relatively quickly, and recovery should occur within a few years. The longest-term effects are expected to occur in soft-bottom communities in protected waters where oil could become entrained in the sediments. Recovery of these habitats could take several years or more.

Conclusion

No losses distinguishable from natural variation in recreational fish and shellfish stocks in the mid-Atlantic are expected. An oil spill in nearshore waters could reduce or prohibit recreational fishing in the affected area for months or longer.

The Department of the Interior Mission

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

The Minerals Management Service Mission

As a bureau of the Department of the Interior, the Minerals Management Service's (MMS) primary responsibilities are to manage the mineral resources located on the Nation's Outer Continental Shelf (OCS), collect revenue from the Federal OCS and onshore Federal and Indian lands, and distribute those revenues.

Moreover, in working to meet its responsibilities, the **Offshore Minerals Management Program** administers the OCS competitive leasing program and oversees the safe and environmentally sound exploration and production of our Nation's offshore natural gas, oil and other mineral resources. The MMS **Minerals Revenue Management** meets its responsibilities by ensuring the efficient, timely and accurate collection and disbursement of revenue from mineral leasing and production due to Indian tribes and allottees, States and the U.S. Treasury.

The MMS strives to fulfill its responsibilities through the general guiding principles of: (1) being responsive to the public's concerns and interests by maintaining a dialogue with all potentially affected parties and (2) carrying out its programs with an emphasis on working to enhance the quality of life for all Americans by lending MMS assistance and expertise to economic development and environmental protection.