began when Asian buyers courted Santa Barbara fishermen in 1978, asking about the availability of this pickle-shaped echinoderm, found in waters about 30 fathoms deep. The sea cucumber fishery steadily grew until yearly landings in Santa Barbara began averaging more than 100,000 pounds, with trawlers earning $50 per pound (draggers harvest a giant red sea cucumber, while divers harvest the somewhat more lucrative warty sea cucumber). Trawl prices can vary, however, based on whether cucumbers are dry or full of water—a function of handling or even time of year.

Hook and Line. As with other gear types, the design of hook-and-line equipment has evolved only modestly from prehistoric times, although technological advances have caused dramatic changes in the manner in which lines are constructed, deployed, and hauled. Still, the modern age remains dominated by a few basic styles of hook-and-line fishing.

Vertical longline. Also called "buoy lines" or "Portuguese lines," this gear is deployed vertically (figure 4.12-8). It typically consists of a gangion to which hooks are attached at various locations, either directly or on short leaders, or "tippets". A weight is secured to the bottom of the gangion, often with a lighter piece of material, called a breakaway, so if the gear becomes snagged, the weight will detach before the entire gangion breaks. A buoy tied at the top of the line keeps it vertical in the water column. The number of hooks deployed on vertical longline gear is usually limited by water depth and how high a certain species or school of fish will "climb". Rarely are more than 200 hooks deployed on a vertical longline. Most often, hook and line fishermen use their fathometers to seek out relatively deep water rocky outcrops having "stacks" of fish showing over them. The buoyed vertical longline is baited and placed in the water upcurrent of the stack

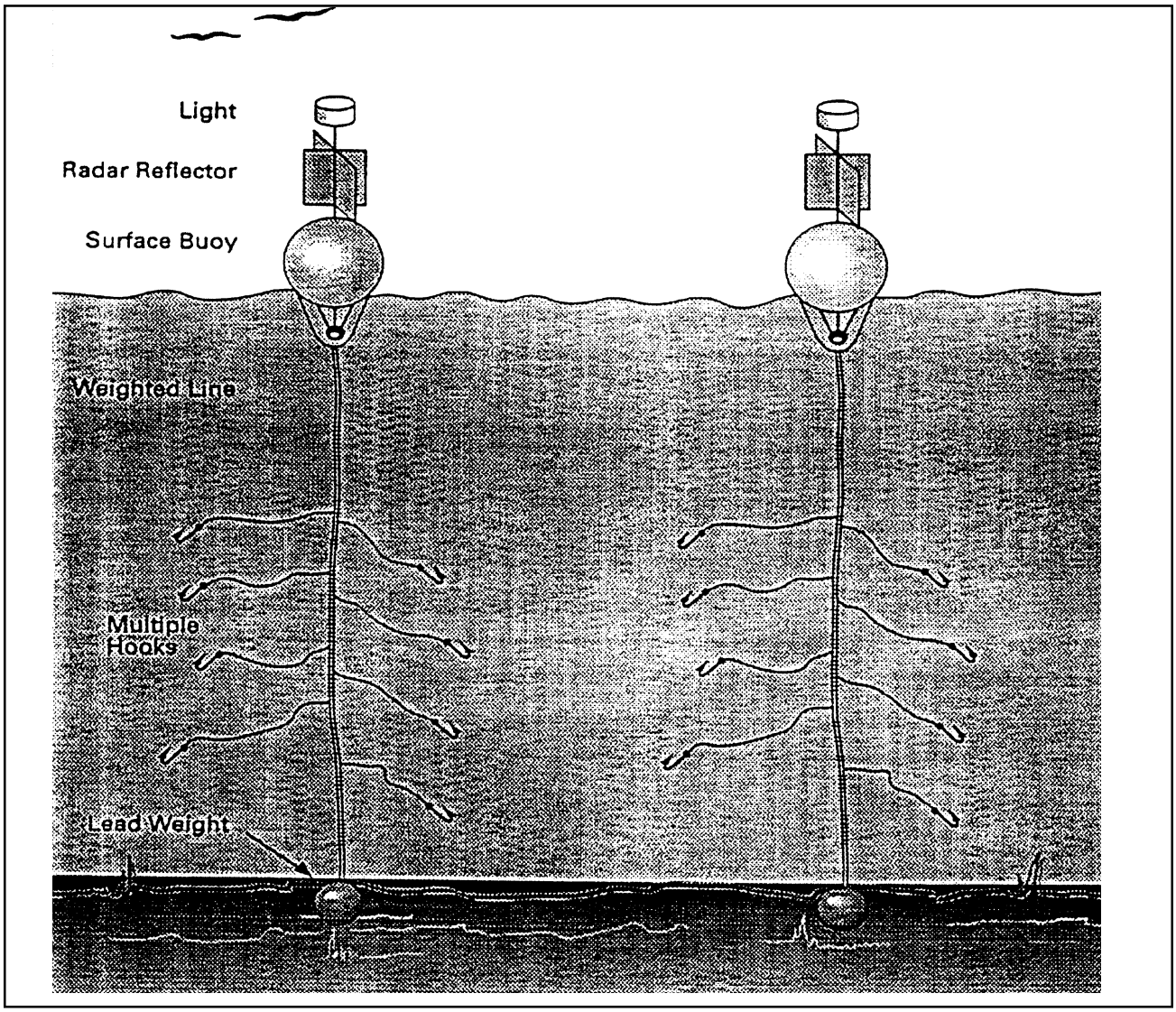

Figure 4.12-8. Hook and Line Gear Deployed

of fish and drifts through the fish. The lines are then retrieved, any fish hooked are removed, the hooks rebaited, and the process is repeated. Vertical longlines are typically used to take rockfish, and are set on pinnacles, reefs, rocks, rubble, hard bottom, canyon edges or seamounts where they congregate.

Traditional longline. Unlike vertical longlines, traditional longlines are deployed horizontally, usually near the seafloor. Longlines are designed to cover much more territory than vertical lines, and may contain hundreds or even thousands of hooks. Rockfish are also taken on traditional longlines, especially in areas characterized less by distinct reefs than by broad stretches of suitable, hard-bottom habitat.

Traditional longlines typically feature a mainline ("groundline", in the case of bottom gear), to which hooks are attached at various intervals. Sometimes the groundline is set just above the seafloor and has small floats attached to keep it from snagging. These floats may be alternated with small lead weights to keep the gear close to the bottom without snagging. Longlines set from tubs are called tub gear. Longlines can also be set from mechanical reels or spools, depending on the size and nature of the operation. Anchors are set at either end of bottom longlines to keep the gear from moving or tangling. The term "set line" is often applied to shorter longlines that contain fewer hooks, usually about 50 hooks. Several set lines might be deployed in a given area and moved around during the day. Like traditional longlines, these lines are often laid close to the ocean floor.

The vertical and traditional longline fisheries of the SBC and SMB primarily targets several species of rockfish, such as the red (vermilion), bocaccio, chili, and several others; incidental catch includes rocky reef associated fish such as lingcod and cabezon. The fishery, up until recently, has had no seasonal restrictions, but is most active during the fall and winter months. In 2001, the rockfish fishery was closed to recreational and commercial harvest during January and February in southern and central California. This fishery as it exists in the SMB and SBC is a "fallback" fishery for some of the fishermen who enter it, since many of these fishermen also fish in other fisheries during other times of the year. As such, a variety of vessel types and sizes are involved in the fishery, ranging in size from weekend skiffs with rod and reel to larger commercial vessels from other fleet types, using buoyed, vertical longline techniques.

Rockfish have been commercially fished since the mid-1800's, and for over a century regional fishermen working from boats ranging in size from 26 to 60 feet have targeted rockfish with hook and line, often earning higher prices for their catch than those offered for trawl-caught species because they are handled individually, not taken in large numbers in a towed net. Most of the fish have been taken from depths of 50 to 100 fathoms.

Before the 1960's, rockfish prices averaged 3 to 4 cents per pound, depending on market conditions and the species being sold. Brokered through or processed at plants ranging from Larco Fish Company to Castagnola Seafoods, Eureka Fisheries and Seafood Specialities, prices rose, hitting 25 cents per pound for reds and 17 cents per pound for fillet fish in the 1960's, and 35 cents per pound for reds by the 1970's. Twenty years later, reds earned $1.50 per pound, as fishermen sought to make the most of limited availability and increasingly low quotas.

By the early 1970's, the number of hook-and-line rockfish fishermen working local waters was increasing. A core fleet of 25 boats was fishing at the Channel Islands and along the coast, doubling in winter when fishermen sought "fill in" fisheries between salmon, seabass, swordfish, or lobster seasons. This pattern changed little since the fishery's early days, even though the rock cod fleet was growing. Since 1938, nearly half the year's total rockfish landings for the Santa Barbara area have been taken between December and February.

In the early and mid-1980's, offshore oil development dealt the fleet a serious blow. Rockfish fishermen were affected by seismic surveys (which scatter rockfish) and siting or construction of drill rigs and platforms, barges, and pipelines. Conflicts were aggravated by the fact that rockfish congregate over rocks or hard bottom in the same depths and locales that harbor oil reserves. As a result, fishermen were often precluded from working. Unlike trawlers, crabbers, or gill netters, however, the hook-and-line fishermen had few other places to go, since hard-bottom rockfish spots are small and often separated by many miles (Kronman, 1995).

By 1987, the number of hook-and-line rockfish fishermen was shrinking because of the perceived long-term effects of seismic blasting, reduced fish availability due to overfishing and poor regional recruitment, and market competition from trawl-caught rockfish from California to Canada. Trawler catches were reaching regional markets only a day or two after harvest, or being sent to the market as frozen fillets when opportunity for profit peaked.

Despite substantial blackgill landings, which in Channel Islands Harbor alone rose from 10,000 pounds in 1991 to 95,000 pounds in 1994 and a port-record 115,000 pounds in 1996 (reflecting the region-wide trend), breaking into a market that had dealt primarily with other rockfish species for decades was difficult. Prices lingered at 40 to 60 cents per pound until fishermen advertised in Asian newspapers and began selling blackgill rockfish at Los Angeles-area outlets. This effort increased the price to 75 cents per pound, which then made it profitable to fish for blackgills instead of competing for dwindling supplies of vermilion rockfish.

Quotas shrank in the late 1990's to levels that rendered both longlining and vertical lines temporarily obsolete for catching rockfish, although longlines continued to be used for deepwater species such as sablefish, which are not members of the rockfish family. Also known as black cod, sablefish limits remained at levels reasonable enough (1,050 pounds per week) to warrant some effort. Rockfish quotas, however, fell to 500 pounds per month in 1999 and are expected to drop further in the future, as federal fisheries managers endeavor to rebuild depleted groundfish stocks, especially bocaccio, lingcod, cow cod, canary rockfish, and Pacific Ocean perch. The rockfish fishery was closed for the first time from January to February 2001.

In the mid-1980's, demand among Asian consumers for live finfish stimulated growth of nearshore fisheries for cabezon, sheephead, grass rockfish, sculpin, gopher rockfish and other species found at depths of 5 to 60 feet. As the fishery grew, landings escalated from 52,000 pounds in 1989 to 988,000 pounds in 1995, with the number of live-fish fishermen statewide rising from 70 to nearly 700 during the same period.

The gear soon gained the attention of state regulators, who expressed concern for the health of nearshore fish stocks. Ultimately, legislation was passed that targeted coastal fisheries, limiting each line to a maximum of 15 hooks, with no more than 150 hooks permitted on a single boat.

An opportunity for shallow-water longlining at the islands emerged following implementation of Proposition 132 in 1994. By eliminating gill nets within 1 mile of any island, the initiative created a "harvest vacuum" for other commercial gear types. Seizing the opportunity, a few fishermen began longlining near the islands for white seabass, and also were catching sheephead, halibut, rockfish, and other shallow-water species (including those destined for the "live" market).

Trolling. In trolling, lines are pulled through the water from the stern of a boat that is underway. This method is primarily employed to catch salmon, although it is also used to catch species like albacore, California halibut, and occasionally bonito. Salmon-trolling gear consists of up to six stainless steel (wire) mainlines unwound from electrically powered, hydraulically powered, or hand-cranked gurdies (spools). The wires are suspended from outrigger poles on either side of a boat (occasionally including two sets of poles, one amidships and one on the bow), which help spread out the gear. Monofilament leaders with attached hooks (either lures or baited hooks) are clipped to the mainline, often at three-fathom intervals, although the placement of hooks can vary depending on geographic location, water temperature, water color, or depth. For example, in shallow water where fish are concentrated in a cold thermocline on the bottom, only three hooks or "spreads" might be employed. In deeper water, where fish are dispersed throughout the water column, 7 to 10 spreads might be used.

Each wire line, with its series of leaders, is held in place by a large, round weight called a cannonball. Ranging from 10 to 60 pounds, the cannonballs help keep the gear somewhat vertical as the boat trolls the leaders through the water, dragging bait such as herring, anchovies, or sardines, or lures such as hootchies, plugs or spoons, behind it. Trollers sometimes also clip a float onto the line at the surface ("float bag"), to help regulate the gear's depth and spacing relative to the other lines. As the troll lines are hauled, a leader with a fish on it is unclipped from the mainline as it nears the surface. The fish is then pulled carefully to the boat, where it is netted or gaffed aboard. Trolling for albacore employs a similar design, although the lines are fished solely on the surface.

Trolling is done primarily in the SMB, and to a lesser extent in the SBC, depending on where the fish are from year to year. A troller is most often a relatively small vessel (from 20 to 40 feet long). Trolling gear can trail the vessel by 100 to 300 feet. Trollers work in highly variable areas, since this fleet targets highly migratory and widely ranging fish. As in the hook and line fishery, trollers are often in another fishery, and enter the troll fishery in the off-season of their principal fishery.

Peaks in salmon fishing have occurred in Santa Barbara (one in the mid-1980's, one in the mid-1990's) that were notable enough to lure fishermen from Crescent City, swelling the local fleet for a period of days or even weeks. In 1995, the year a Saturday fishermen's market opened at Santa Barbara Harbor, local trollers delivered 138,000 pounds of chinook worth $251,000, most of it in a period of just two months. On Saturday mornings throughout May and early June, boats and customers crowded the City Pier, with salmon selling for $3.30 per pound. The Saturday market was not only good for fishermen due to the high direct-sale price paid for salmon, it gave them an alternative to traditional markets, where prices had fallen from $2.50 to $3.00 per pound in the 1970's to $1.25 per pound in the 1990's because of competition from farm-raised fish, primarily from Chile and British Columbia.

Salmon fishermen are careful where they troll. Otherwise, they risk losing expensive, 50-pound leads, leaders, lures and even an outrigger pole if they snag-up badly. If a troller sees an obstruction looming on his fathometer, such as a rock or a sunken boat or oilfield debris, he might slow down to try and ease over it, or speed up to raise the gear above it.

Using modified salmon-trolling gear, often without outrigger poles and often with rods and reels instead of gurdies, a few Santa Barbara fishermen fish for halibut with hooks when the fish are plentiful,

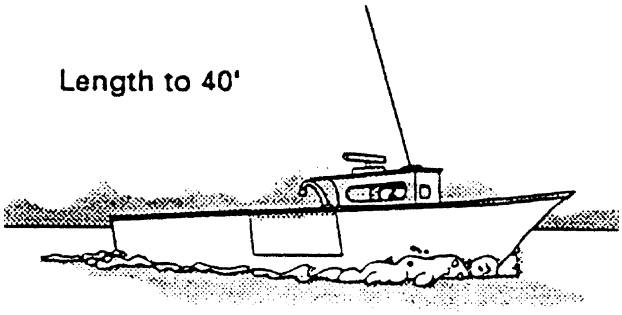

Figure 4.12-9a. Crab Vessel, Bow Cabin.

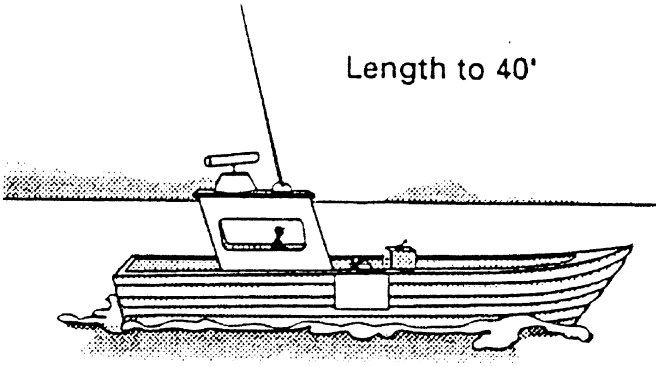

Figure 4.12-9b. Crab Vessel, Stern Cabin.

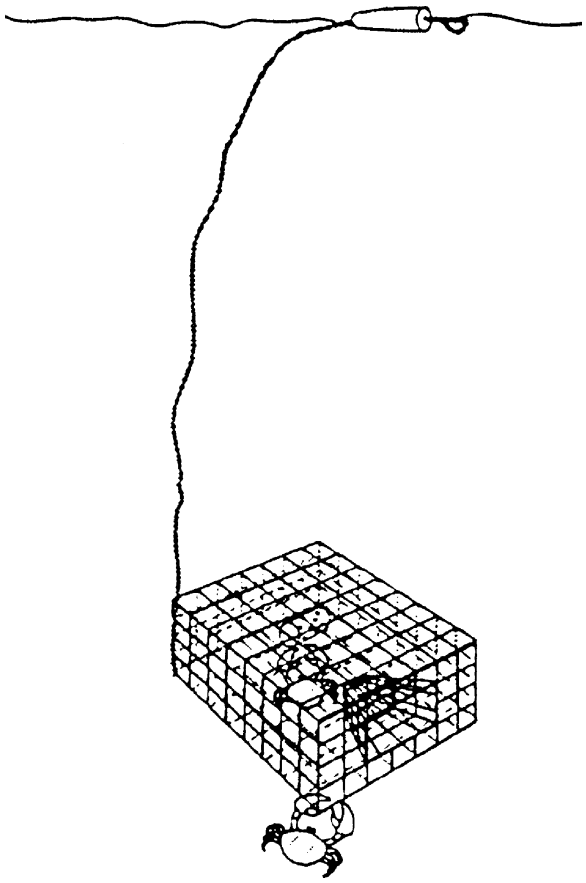

Figure 4.12-9b. Crab/Lobster Pot.

especially during spring. Although they enjoy periodic success, only the best, most knowledgeable, and most persistent fishermen appear able to profit from hook-and-lining halibut, a species that has traditionally been taken in cotton or nylon trammel nets or monofilament gill nets.

Trap fisheries.

Crab Fishery. Two different groups of crabs are trapped in the south/central California region. The largest crab fishery is for what is commonly called "rock crab". Three types of rock crab are found along the Santa Barbara coast and at the Channel Islands: red rock crab *(Cancer productus*), brown rock crab *(Cancer antennarius*), and yellow rock crab *(Cancer anthonyi*). The red rock crab is caught primarily around or on submerged rocky outcrop areas. The other types are caught in areas of low relief sand or sandy mud bottom. The fishery is active all year, and many of the fishermen who fish crab gear also fish lobster gear in lobster season (October to March).

Traps are basically wire, plastic coated wire, or plastic mesh boxes 2–4 feet square, which are weighted to stay in place on the seafloor (figure 4.12-9). Braided polypropylene rope (usu. 3/8 inch diameter) is used to deploy and retrieve traps, which are set in nearshore waters from shore to 40 or 50 fathoms deep. Crab traps are baited and deployed in fishing grounds and commonly left to soak 3 days. The crab fishing vessel (figure 4.12-9) pulls alongside the trap buoy, and grapples the buoy on deck, feeds the line through a pinch puller winch, and raises the trap from the seafloor. The crabs are taken from the pot, it is rebaited, and redeployed.

It is difficult to predict the location of any particular sting of gear at a given time. Most full-time crab fishermen have at least 50-70 traps, and many have upwards of several hundred traps arranged in "strings" of from 5-25 individual traps set along depth contours. If traps are fishing well, they left where they are. However, if they are not producing, they will be moved to try a new location. This occurs on an unpredictable time schedule dictated by crab population movements. Also, crab vessels are small, ranging from 20 to 40 feet. Therefore, traps are deployed over several trips, since only 10 to 30 traps can be carried safely on one trip. Relocating gear is also done in increments.

Beginning in the 1980's, regulators required a 3 ¼-inch-diameter escape ring to avoid undersized crabs, although some fishermen voluntarily used a larger ring, to protect stocks and weed out small crabs not

popular in the market. The legal minimum size was set, and remains at, 4.25 inches carapace width. Typically, crabbers set their gear deeper than lobster traps, and usually over sand bottom. The Santa Barbara fishery began at the shallower depths, then worked deeper with time. In addition, with the appearance of shellfish-eating sea otters in the late 1990's, Santa Barbara trappers moved their gear to depths of 200 feet to avoid them.

The second crab fishery is a southern extension of a larger, northern California to Alaska fishery for Dungeness crab. Both the trap and buoy systems are somewhat different for this fishery, and is highly variable in the area depending on signs of stock early in the season. The fishery extends from northern California south through the SMB to Point Arguello in some years. Dungeness crab vessels tend to be larger (25-75 feet) than those fishing rock crab south of Point Conception.

Most of the crab, rock or Dungeness, are marketed locally to fresh fish wholesalers, markets, or restaurants. Since the early 1980's, markets have not only strengthened, but tanking systems at oceanfront eateries have improved, allowing more crabs to be kept alive longer in larger systems and reducing "dead loss" to 1 percent. Also, self-contained tank systems that do not depend on circulating seawater make the crabs more accessible to inland restaurateurs, especially in the ethnic communities of Los Angeles, where the product is most popular.

The fishery is considered easy to master. However, as pressure on the resource has grown (annual Santa Barbara landings in the 1990's averaged 500,000 pounds, split among 15 or so trappers), fishermen have begun fishing the outer islands of Santa Rosa and San Miguel. The market is also highly competitive. If a particular crab fisherman cannot assure his market of a steady supply, he is not likely to continue to be able to sell to that market, since the market can seek product from other more steady producers of crab. Therefore, minimizing interactions with crab fishermen and their gear minimizes the potential for altering an individual's position in this highly competitive market.

Spiny lobster. The California spiny lobster *(Panulirus interruptus*), a mainstay of the trapping industry, is found from the intertidal zone to depths of 240 feet from Monterey to Mexico. California spiny lobsters live amid rocky coastal habitats throughout the SCB, including the Channel Islands. They spend daylight hours in holes, crevices and under ledges, then crawl out at night to scavenge or hunt food, or to migrate, moving progressively from shallow water to deeper water from fall to winter and their yearly breeding cycle begins.

The lobster fishery is similar to the crab fishery. The traps are of similar size, the marking buoys are similar, and they are set for similar sized vessels. In fact, most crab fishermen also fish lobster, changing over some of their crab gear for lobster gear, or adding strings of lobster gear to their deployed crab gear in nearshore waters.

One of the main differences between crab and lobster fishing is that lobster fishing is confined to a specific season: fall through winter. Opening day of lobster season is the first Wednesday in October, and the season closes on the first Wednesday after the 15th of March. Another difference is lobster gear is deployed not only in strings along depth contours, but also grouped in clusters, which fringe rocky outcrops on the seafloor. Lobster gear is fished in exactly the same manner as crab gear.

At the beginning of the season, most traps are set in shallow water, hugging the shoreline. As the season progresses, the gear is likely to be found further and further from shore, as fishermen follow the movements of the lobster population offshore into deeper water throughout the season. Toward the end of the season (March), it would not be unusual to find most of the gear in the 20 to 40 fathoms range.

To contend with an expanding fishery that by the mid-1970's included over 200 trappers deploying over 20,000 pots in southern California, regulators, beginning in 1976, required that traps include an escape port through which small, sublegal lobsters (less than 3.25 inches carapace length) could freely exit the gear. Measuring 2.375 by 11.5 inches, the escape panel ensured longevity for a fishery whose target catch had dropped in average size to about 1.25 to 1.5 pounds per lobster. However, this is exactly the size preferred by markets, since its tail is plate size. The escape ports appear to have stabilized the fishery, landings from which had slipped to less than 100,000 pounds per year beginning in 1968, then rebounded to more than 100,000 pounds in the 1978-1979 season - a level below which they have not dropped since. In the 1997-1998 season, in fact, area landings of 210,000 pounds were the highest since 1954-1955.

Along with the escape ports, state regulators also began requiring the use of "destruct clips" in the 1970's. These clips, made of weaker metal than the trap wire, are attached to the trap in strategic spots and corrode rapidly if a trap is lost or left unattended. Ultimately, the entire lid of the pot falls off, freeing any trapped lobsters and preventing the cage from trapping any more.

Beginning in the early 1980's, a dramatic change in markets had an equally dramatic effect on the fishery. Overseas buyers, particularly in Asia, began purchasing live lobsters at prices never before seen by local trappers. When the price exceeded $5 per pound, local restaurants, unable to compete, stopped buying.

Asian economies were booming, with an ascending interest in California lobsters. Boats and gear were changing, too, to meet the demands of shipping live lobsters overseas by air. Some fishermen bought east coast lobster boats that were fast, roomy, and required no waiting time to build. Others customized their boats to include self-bailing live wells, which replaced hose-fed rubber barrels to keep lobsters healthy.

With increasing demand came a rapid rise in participation. The number of permits issued by the California Department of Fish and Game climbed from 213 in 1980 to 440 in 1984. And while some trappers fished more and more pots, others believed reducing their string was more cost-efficient. They could make more money with fewer traps, they reasoned, by saving fuel and not risking gear loss in ocean storms or swells.

By the early 1990's, lobster prices hit an astounding $7 per pound, and competition increased from countries such as Mexico, Australia, and Costa Rica. Meanwhile, landings in the Santa Barbara area stayed at a steady 150,000 pounds per year.

Finally, however, at the urging of the California Lobster and Trap Fishermen's Association, the California Department of Fish and Game put a moratorium on new entrants into the fishery in 1995, then closed it to new entrants the following year. Fishermen said they were concerned not only about overcapitalization of the lobster fishery, but entry into the fishery from fishermen closed out of other fisheries that implemented similar limited entry schemes.

Ultimately, prices flattened too, as Asian economies (and their taste for expensive lobsters) weakened. In fact, Santa Barbara-area fishermen who were able to set top prices for their 210,000-pound catch during the 1997-1998 season saw prices and landings in 1998-99 drop to levels of half what they were the previous year.

Diving. Commercial divers in the Santa Barbara Channel primarily seek sea urchins, although a small dive fishery has recently developed for sea cucumbers. Divers usually work rocky reef areas in water no deeper than 20 fathoms, since the two primary species sought are distributed in that depth-range. Historically, the coast was dived extensively for abalone and urchins, but the primary dive grounds for urchins are now the Channel Islands.

Commercial dive boats are usually small, fast vessels from 22 to 32 feet in length. Normal operations can be either anchored or "live-boat". One to several divers may be in the water. A "tender" or deck hand operates the vessel and diver air compressor, and tends the divers air hose and game bags. Typically, the diver will work a "bed" of urchins until his bottom time is exhausted or the bed is fished of all legal size urchins.

Five of the eight species of abalone found in California have been harvested commercially by diving along the Santa Barbara Coast and the Channel Islands. The Santa Barbara-based California Abalone Association (CAA) was formed in 1972 to represent the state's abalone divers. CAA offered them a vehicle for providing input into the management of those abalone stocks, which are also consumed by sea otters.

CAA also formed at a unique, if not coincidental time, the same year as passage of the federal MMPA. Among other things, the MMPA transferred sea otter management from the state to the USFWS. CAA has also negotiated several regulations, including a limited-entry permit system for abalone (1977), and development of an assessment tax for enhancement projects (1991). A Director's Abalone Advisory Committee (DAAC), including divers, biologists, and Sea Grant representatives, oversaw the $12.5-per- pound assessment tax fund and recommended enhancement projects to CDFG. Limited entry was widely credited with helping stabilize southern California's red abalone fishery. With design help from industry, the program allowed for the transfer of permits, thus maintaining their value as a business investment. To enter the fishery, however, a newcomer had to buy two diver's permits. This was considered a good means of reducing the overall number of abalone divers, which declined to 100 before the fishery was terminated in 1997.

By 1974, Santa Barbara was the capitol of the state's abalone fleet, generating two-thirds of its annual harvest and generating $791,000 for the local fleet, making it the single most valuable species at that port. By the late-1970's, as many as 70 divers worked out of Santa Barbara, although by then some were also diving for sea urchins.

While annual Santa Barbara-area landings of red and black abalone were both at 400,000 to 500,000 pounds apiece during the late 1970's, more black abalone were landed in 1980. More black than red abalone was landed for the next 5 years, until disease began to affect populations of the shallow-water black abalone. While some fishermen continued collecting the higher-priced red abalone, others preferred the more easily captured black abalone.

Around 1986, the black abalone population began dying in great numbers from a natural but disturbing mortality that became known as "withering foot syndrome". Mysteriously, the animals would shrink in their shells, grow weak, and even fall off the rocks. They died by the tens of thousands. Caused by a bacterial pathogen whose exact source has never been identified, withering foot syndrome wiped out most of the black abalone population at the Channel Islands, with only isolated populations surviving there and on the coast. Santa Barbara landings of black abalone decreased rapidly, from 227,000 pounds in 1987 to 22,000 pounds in 1991 and just 1,600 pounds in 1993.

Meanwhile, Santa Barbara landings of red aba-

lone remained strong at more than 300,000 pounds per year. However, with virgin stocks thinned and the abalone harder to find, a good day was five dozen abalone per diver, not 30 dozen. However, they were worth $170 per dozen in 1989 and $420 per dozen by 1994, as the market shifted from pounded steaks to live abalone shipped to Asia.

About 30 abalone divers fished out of Santa Barbara during the early 1990's. Despite bag limits, size limits, area closures and seasons, the combination of disease, pollution, politics, sea otters, and sport and commercial pressure led first to the banning of black abalone harvests in July 1993, then to the banning of commercial takes of pink, green, and white abalone in March 1996.

In 1997 the California Fish and Game Commission placed a moratorium on the commercial take of red abalone, a move extended by legislation for a five-year period, until a management plan for rebuilding abalone stocks can be completed. If no plan is forwarded by the California Department of Fish and Game, the ban could be extended another 5 years. The law also created a $12 abalone stamp that sport divers must purchase before taking abalone from the northern California coast, where recreational harvests (by "breath-hold diving" also known as "free-diving") remain legal. Revenue from the stamps is projected to generate up to $1.2 million for an Abalone Preservation and Restoration Fund.

Sea urchins are also harvested commercially by divers. While continued harvests, plus regulated size limits and seasons, steadily decreased statewide urchin landings from the 1988 record to 32 million pounds in 1992 and just 18 million pounds in 1997, rising prices compensated for reduction. In the early 1990's sea urchins were $1 per pound, with increases around winter holidays, when Japanese demand increases. At times, Santa Barbara divers earned over $2 per pound for their catch; this price dropped when Asian economies suffered a downturn in the mid-1990's. Ironically, high prices also reflected the quality of roe, which, to a degree, got better as urchin beds thinned and competition for food among remaining animals declined.

Meanwhile, harvesting big loads was getting more difficult, despite the fact that only 300-plus divers held permits as of 1998. Divers were working deeper and many employed electric, underwater scooters to survey areas before anchoring the boat and committing to a given spot.

In the mid- and late 1990's, two events occurred that drove prices down to 1980 levels: the Asian economic crisis and two El Niño events that affected the quality of roe. In 1999, however, a cold-water La Niña event began benefiting urchin stocks by stimulating kelp growth, thus increasing the amount and quality of roe. The change helped move prices back close to $1 per pound.

Harpooning. Swordfish and shark are taken by harpoon. By the early 1970's, Santa Barbara harpooners were taking 15 to 30 percent of the coastal catch. Just as the swordfish fishery reached its peak, with 150 harpooners from Santa Barbara to San Diego averaging 400,000 pounds per year (with single boats landing up to 200 fish per season), concerns were raised over mercury contamination.

In 1971, no swordfish with mercury levels above 0.5 parts per million were allowed on the market. Samples from all landed fish had to be tested at special laboratories (at $10 per test), and fishermen went to great lengths to avoid the process or have their fish test "clean". Concerns over mercury faded over 2 years, but a political controversy began when some fishermen, often more affluent ones, began using airplanes to spot swordfish. By 1974, some 20 spotter planes were hunting swordfish, raising catch rates and concern in the fishery.

In 1974 the California Fish and Game Commission outlawed the planes, but in 1976, when the measure was to take effect, it passed a regulation limiting their use to scouting only, requiring that they not work within 5 miles of a harpoon boat. In 1984, the commission again allowed planes to locate individual fish, after the harpoon fishery faded in light of a burgeoning gillnet fishery for swordfish. As the fishery's efficiency increased, so did participation and landings; the latter hit a record high of 7,000 fish in 1978. Top boats had over 300 fish for the season.

Following the 1978 record high, the number of swordfish harpoon permits issued by the California Department of Fish and Game soared to a record 1,200, up from just 397 permits in 1974. Unfortunately, the fish were less plentiful for several years following 1978, and landings dropped commensurately. As overall swordfish production rose (hitting a record 5.1 million pounds in 1985), prices fell, making harpooning less profitable for those who had not converted. Fish that in 1978 fetched $3.50 per pound earned $2.50 per pound a decade later. Ultimately, Santa Barbara's harpoon fleet began shrinking. By the early 1990's, only a few boats remained in this fishery, and usually only when a lot of "finners" appear to be available at Santa Cruz Island.

Impacts of Past and Present OCS Activities. OCS oil and gas activities began off southern California in the late 1960's (Galloway, 1997). Section 4.0 provides information on current offshore infrastructure and levels and types of activities. Several reviews have been made of the possible cumulative impacts of these activities on commercial fishing in the region (Van Horn et al., 1988; Bornholdt and Lear, 1995, 1997;

MMS, 1996). Furthermore, several studies have examined the effects of OCS activities on commercial fishing of the study area (Richards, 1991; Fusaro, 1991; Centaur, 1985).

Although the MMS requires OCS operators to conduct activities without interfering with fishing activities, fishermen have experienced adverse impacts due to past and present OCS activities in the Pacific Region. This includes space use conflicts, OCS-associated seafloor debris, and reduced catch due to seismic surveys. The oil industry has achieved peaceful co-existence with the fishing industry during the past 15 years by funding mitigation programs, providing fishing gear, paying fishermen to avoid operations, and avoiding major spills as oil production increased from 80,000 barrels/day to 220,000 barrels/day between 1985 and 1995 (Kronman, 1995). The programs, however, have failed to prevent loss of access to fishing grounds. It will be decades before the current facilities on the Pacific OCS are removed and fishermen can access these areas again. Pipelines, in all likelyhood, will be abandoned in place and will continue to pose an obstruction to trawl fishermen after all platforms offshore California have been decommissioned.

Although relations between oil companies and commercial fishermen have improved, part of this trend can be attributed to a lack of new development on the Pacific OCS since the mid-1980's. The lack of development stems from the fact that no offshore leases have been offered for sale in the SBC or SMB. Thus, there has only been one high energy seismic survey (Exxon, 1995), no exploratory drilling from mobile rigs, and no new platforms on the Pacific OCS for the past 10 years. Any future development on Federal leases could test the effectiveness of mitigation and communication programs such as the Joint Committee and Liaison Office, Santa Barbara County's Fisheries Enhancement Fund and Local Fishermen's Contingency Fund, and the Local Marine Fisheries Impact Program. In conclusion, fishermen have experienced moderate impacts from past and present oil and gas activities on the Pacific OCS. However, the mitigation programs have effectively minimized these impacts to low, or insignificant, for the commercial fishing industry as a whole.

MARICULTURE AND KELP HARVESTING

Mariculture is the practice of culturing, growing, and harvesting marine species in a controlled setting. California has approximately 400 registered aquaculturists who raise products within intensive systems (enclosed, or on land) (Resources Agency of California 1997). Currently, Ecomar is using several the OCS oil and gas structures in the Study Area to raise mussels and other invertebrates. The bulk of the statewide mussel production (85percent) comes from offshore oil production platforms, while 91 percent of abalone production, valued at close to $2 million (in 1992), takes place in the Study Area and Morro Bay (Resources Agency of California 1997).

There are at least nine different mariculture leases scattered within state waters along the coast of the SBC. These commercial operations grow kelp, mussels, oysters, abalone, and/or a number of other species. These leases are easily identified by a fixed marker buoy, or several fixed, permanent buoys or rafts which locate the lease for the operator and permitting authority. Likewise, there are fixed buoys in place for various research institutions throughout the west coast, gathering information on the oceanography or ecology of the SBC. Kelp harvesting occurs in the Study Area near Point Conception, San Miguel Island, Santa Rosa Island, and near Point Mugu (Resources Agency of California 1997).

Impacts of Past and Present OCS Activities. The OCS leases and oil and gas platforms lie beyond the three mile state boundary. It is unlikely that effluents from OCS platforms have affected mariculture or kelp beds of the project area which generally lie within state waters. One mariculture venture is actually harvesting mussels from offshore platforms.

4.13 MARINE RECREATIONAL FISHING

Regional Setting: Recreational fishing involves hook-and-line fishing from piers and docks, jetties and breakwaters, beaches and banks, private or rental boats, and commercial passenger fishing vessels. Recreational fishing also includes activities such as dive, spear and net fishing. Recreational fisheries in southern California access both nearshore and offshore areas, targeting both bottom fish and mid-water fish species. Boats can either drift with the currents, anchor, or live-boat to remain on the specific spot. The majority of recreational fishing is done by "jigging" baited hooks or lures. Several hooks or lures often occur on a single weighted line. For pelagic species such as salmon, trolling methods are also used. The top five recreational landings in California between 1993 and 1998 are Pacific mackerel, kelp bass, barred sand bass, white croaker, and Pacific bonito.

A commercial passenger fishing vessel (CPFV) is a boat which is operated by a hired skipper, and on which anglers pay a fee to board and fish. The term CPFV encompasses the terms charter boat (which usually refers to a boat carrying a prearranged, or closed, group of anglers) and party boat (which usually refers to a boat carrying a non-prearranged group). CPFV's in the Santa Barbara Channel and central California typically have capacities of six to 50 anglers. Fishing trips normally are for one-half day or a full

Table 4.13-1. Number of Marine Recreational Fishing Trips in Southern California: 1993 - 1998

Year	Total	Private/Rental Boat	Charter/Party Boat	Shore
1993	4,037,548	1,625,306	1,174,125	1,238,118
1994	4,748,031	1,931,685	1,200,634	1,615,712
1995	4,300,264	1,700,620	1,128,652	1,470,991
1996	3,768,537	1,478,258	889,256	1,401,024
1997	3,232,417	1,274,901	788,071	1,169,445
1998	2,972,828	1,325,482	673,813	973,533
Percent Change 1993-1998	-26.4	-18.4	-42.6	-21.4

Source: National Marine Fisheries Service, Marine Recreational Fisheries Statistics Survey (MRFSS) http://www.st.nmfs.gov/st1

day; overnight trips are unusual.

Private boat fishing encompasses all hook and line sport fishing activity from boats other than CPFV's. These vessels are typically 5-8m long, privately-owned, trailered, and launched from ramps for single-day trips.

Southern California is a leading recreational fishing area along the west coast. Weather and sea conditions allow for year-round fishing. Private boat fishing, the most popular fishing method, occurs heavily around the Channel Islands and along the coastline off Point Sal on the central coast. Charter and party boat fishing, the most productive method, is heaviest at the Channel Islands and along the Santa Barbara Channel coastline. The most popular fishing grounds are along the kelp beds within 1 nm of shore, although some fishing areas extend as far as 5 nm from shore and include lingcod and rockfish grounds over hardbottom areas. Trolling for pelagic species such as salmon, tunas, and billfish species can occur throughout the project area depending on the year and ocean conditions.

Between 1993 and 1998, marine recreational fishing trips declined by 26.4% according to MRFSS. Private/Rental boat trips declined 18.4%, Charter/Party boat trips declined 42.6%, and shore fishing trips declined 21.4% (table 4.13-1). Leeworthy and Wiley (1999) estimated that in 1997, marine recreational fishermen in the SBC and SMB spent between $61 and 75 million dollars. This had an income impact of between $50 and 57 million dollars, and an employment impact of between 1,404 and 2,288 full and part-time employees. These impacts are less than one-half of one percent of the income and employment in the Santa Barbara and Ventura county economies.

4.14 MILITARY OPERATIONS

DESCRIPTION OF MILITARY OPERATIONS

The surface and subsurface waters and surrounding airspace above the coastal waters of southern and central California are used intensively for military-related operations. The U.S. Navy and U.S. Air Force conduct military operations throughout the Point Mugu Sea Range. The Naval Air Warfare Center Weapons Division (NAWCWDPNS) at Point Mugu conducts extensive operations in the Sea Range, as does the Vandenberg Air Force Base. The majority of NAWCWDPNS operations are conducted in the portion of the Sea Range that lies west and south of the Channel Islands and San Nicolas Island. The Sea Range, particularly Military Warning Area W-532, is also used intensively by Vandenberg Air Force Base for military operations. Most of the Santa Barbara Channel lies outside the Sea Range. Consequently, the number and scope of military operations conducted in the Channel are very limited relative to other portions of the Sea Range.

Other military uses of the coastal waters in the vicinity of the offshore project include a military dumping site, and a submarine transit lane. OCS Lease-P 0315, which is located in the Point Arguello Unit about 16 km (10 mi) west of Point Conception, is about 64 km (40 nm) east of military dumping area "Charlie". Charlie was established in 1959 to handle explosives, toxic chemicals, munitions, and radioactive wastes. Dumping activities at this site were discontinued in 1971. Submarine Transit Lane Sierra Venus is located 42 km (26 nm) to the west of the OCS Lease-P 0315.

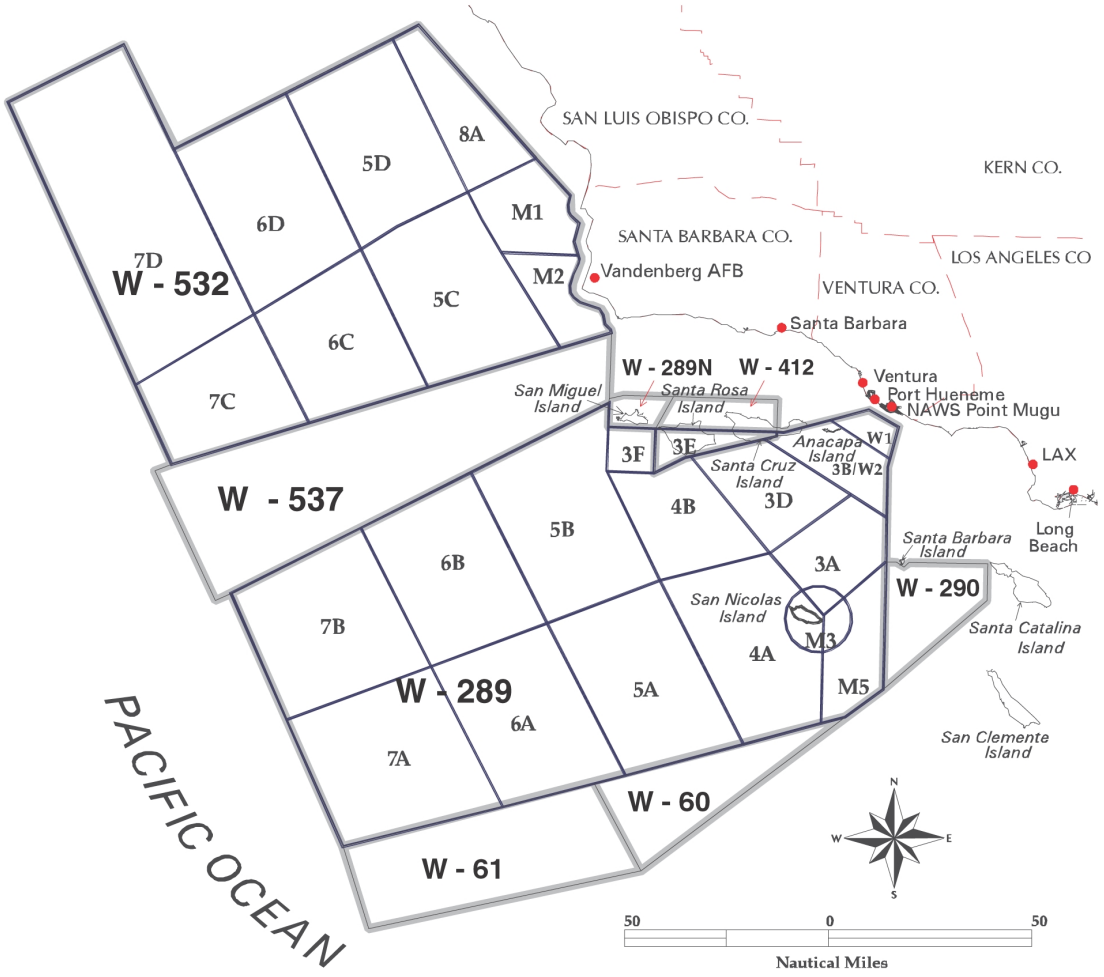

Figure 4.14-1. Point Mugu Sea Range

DEPARTMENT OF THE NAVY

Point Mugu Sea Range: The NAWCWDPNS Point Mugu Sea Range is a 93,240 sq. km (36,000 sq. mi.) area of ocean and controlled airspace, roughly 322 km (200 nm) long (north to south) and extending west into the Pacific Ocean from its nearest point at the mainland coast (5 km [3 nm] at Ventura County) out to approximately 290 km (180 nm) offshore (see figure 4.14-1). The Sea Range includes San Nicolas Island and portions of the northern Channel Islands. The Sea Range is used primarily by the Navy to test guided missiles and other weapons systems, as well as ships and aircraft that serve as platforms to launch them. The Navy has been conducting activities on the Sea Range for over 50 years.

The Point Mugu Sea Range currently supports five general categories of tests to evaluate sea, land, and air weapons systems: (1) air-to-air tests, (2) air-to-surface tests, (3) surface-to-air tests, (4) surface-to-surface tests, and (5) subsurface-to-surface tests. The Sea Range also supports three general categories of training including: (1) fleet training exercises (FLEETEXs), (2) small-scale amphibious warfare training, and (3) special warfare training. In addition to the current test and training operations conducted on the Sea Range, NAWCWPNS Point Mugu proposes to accommodate Theater Missile Defense (TMD) test and training activities and an increase in the current level of both FLEETEXs and special war-

Table 4.14-1. Baseline military plus proposed Sea Range activites (annual)

Category	Aircraft sorties	Ships and boats	Missiles fired and ordinance deployed	Targets launched
Operations baseline	3,934	799	351	300
Proposed new activity				
- Theater Missile Defense	89		20	17
- Additional FLEETEX	57	18	34	33
- Additional Special Warfare	4	32	0	0
Total new activity	150	161	54	50
Total	4,084	960	405	350

fare training. The Navy is planning to modernize facilities at Point Mugu and San Nicolas Island to increase the Sea Range's capability to support existing and future operations.

The Navy prepared a Draft Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS) for the Point Mugu Sea Range that compared baseline military activities with the proposal to expand military operations in July 2000 (U.S. Navy, 2000). Table 4.14-1 shows the current level of military activity and the increased levels that would result from the proposed military action. The draft EIS/OEIS determined there would be no significant environmental impacts associated with the proposed military activities and that no significant cumulative impacts would occur from military operations and other non-military activities, including offshore oil and gas operations. On February 14, 2001, the California Coastal Commission (CCC) concurred with the Navy's consistency determination that the proposed activities were fully consistent, to the maximum extent practicable, with the enforceable policies of the California Coastal Management Program (CCC, 2001).

Naval Facilities Engineering Service Center: The Naval Engineering Service Center (NFESC) is located at Port Hueneme, California. The NFESA conducts various military activities in the project area. The activities are described in a Programmatic NEPA document prepared by NFESC in 1994 (U.S. Navy, 1994). The activities include: (1) mechanical load testing of cranes, A-frames and other equipment onboard vessels and piers, (2) deployment and testing of fiber optic cables, (3) oceanographic surveys, (4) geotechnical surveys to determine sediment and geologic conditions, (5) testing of ship and equipment moorings, (6) Remotely Operated Vehicle (ROV) surveys, (7) sinking and re-floating of equipment, and (8) diving operations to test tools and equipment. The activities are conducted in the Santa Barbara Channel and the Point Mugu Sea Range. The programmatic document concluded the activities had no significant impact on the navigable waters of the United States, the coastal zone, any endangered or threatened species or their critical habitat, and would not interfere with the regulations set-forth by other local, State, or Federal agencies.

Naval Surface Warfare Engineering Facility: The Surface Warfare Engineering Facility (SWEF) is located at the Naval Construction Battalion Center in Port Hueneme, California. The SWEF is a component of the Port Hueneme Division Naval Surface Warfare Center. During testing, the SWEF functions like a "ship on land." It is used for testing shipboard systems to accomplish the following objectives: investigate engineering solutions for existing systems, provide training for military and civilian personnel, and evaluate self-defense systems without requiring installation aboard ships or equipping a laboratory at sea. Aircraft used by SWEF to test radar detection and tracking capabilities fly from, to and/or through the Sea Range and use its range operations and air controllers to assist in detecting aircraft. All aircraft operations are scheduled and controlled by NAWCWPNS Point Mugu.

The Navy published an Environmental Assessment (EA), and issued a Finding of No Significant Impact (FONSI) on June 22, 2000 addressing current operations and proposed implementation of the Virtual Test Capability at SWEF (U.S. Navy, 2000).

Naval Construction Battalion Center: The Naval Construction Battalion Center (CBC) is located at Port Hueneme, California. The CBC is tasked with the construction, maintenance, repair, and inspection of ocean facilities including waterfront structures,

submarine cables, pipelines, and tracking ranges. The CBC operations are conducted in the Pacific and Indian Oceans, and the Arctic and Antarctic. The CBC, which was officially established in 1942, has been conducting operations for nearly 60 years.

DEPARTMENT OF THE AIR FORCE

Vandenberg Air Force Base: The Vandenberg Air Force Base (VAFB) occupies approximately 39,822 ha (98,400 acres) on the south-central coast of California, about 80 km (50 mi) northwest of Santa Barbara (see figure 4.14-1). As headquarters for the 30th Space Wing, the Air Force's primary missions at VAFB are to launch and track satellites in space and test and evaluate strategic intercontinental ballistic missile (ICBM) systems. There are also several tenant users of the base, the primary being the National Aeronautic and Space Administration (NASA) Space Shuttle Program. Commercial space launches are also conducted on the base.

The VAFB's military history dates back to 1941, when it served as an Army training facility. With the advent of the missile age in the 1950's, a large portion of the base was transferred to the Air Force as a missile launch and training base. The first missile was launched from VAFB in 1958. Through February of 2000, 1,790 orbital and ballistic missiles had been launched from the base.

The following description of operations at VAFB was excerpted from the Draft EIS/OEIS for the Point Mugu Sea Range, and other NEPA documents prepared for selected military activities.

30th Space Wing Operations: The 30th Space Wing conducts west-coast space and missile launch operations using a variety of launch vehicles, including the Minuteman III, Peacekeeper, Titan II, and Titan IV. To achieve a polar launch (i.e. which would place the launch vehicle into a polar orbit), a southerly launch trajectory is required. To achieve an equatorial launch, a western launch is required. Since these missiles affect the scheduling of other operations on the Sea Range, NAWCWPNS Point Mugu provides tracking support, back-up command destruct capabilities, and scheduling support for all west-bound launches.

Airspace overlying the Sea Range includes both Warning Areas and Restricted Areas. There are eight Warning Areas that comprise the majority of airspace over the Sea Range: W-289, W-289N, W-290, W-412, W-532, W-537, W-60, and W-61 (see figure 4.14-1). Warning Areas are designated airspace for military activities that are in international airspace but are open to all aircraft. The Warning Areas are active on an intermittent basis and activated by NAWCWPNS Point Mugu in coordination with the Federal Aviation Administration (FAA). Restricted Areas are airspace over U.S. land and Territorial Waters that are used by the military to exclude non-authorized aircraft and to contain hazardous military activities. The Restricted Areas on the Sea Range are over San Nicolas Island, over the Point Mugu airfield, and over nearshore waters adjacent to the airfield.

The NAWCWPNS Point Mugu and VAFB have developed a comprehensive safety program to ensure that aircraft and vessels are kept clear of safety hazard zones and potential impact areas. The program includes detailed agency coordination and public notification procedures that include Notices to Airmen (NOTAM's) and Notices to Mariners (NOTMAR's).

The safety program has contributed to a very impressive safety record for military operations in the Point Mugu Sea Range. During the 50-year operational history of the Navy in the Sea Range, there have been no accidents involving non-participants (U.S. Navy, 2000).

Proposed Evolved Expendable Launch Vehicle Program: Currently, VAFB launches a variety of launch vehicles from a number of launch sites. The U.S. Air Force (USAF) is considering participation in the continued development and deployment of Evolved Expendable Launch Vehicle (EELV) systems to replace current Atlas IIA, Delta II, Titan II, and Titan IVB launch systems. An EIS has been prepared to address this proposal (USAF, 1998). The EIS concluded that the proposed action would not represent a noticeable change from current and past VAFB activities. The proposed EELV launches would be conducted at the same azimuth altitudes as are typical of VAFB operations.

Commercial Space Launch Program: In addition to military and other government launches, there have been approximately 10 launches of commercial space vehicles from VAFB since 1995. A total of two to three commercial launches are anticipated during 2001-2002 (Caresio, G., personal communication). The number of commercial launches is less definitive for the 2003-2005 timeframe but based on current projections is expected to range from a low of 4 to as many as 10 on an annual basis.

F-22 Low-Level Supersonic Testing Over-Water Testing: The USAF is also planning to test the F-22's ability to perform low-level flight maneuvers at supersonic speeds and to determine what, if any, maintenance concerns result from testing in an ocean environment. The proposed action is to conduct up to an average of 24 low-level supersonic sorties per year over open ocean areas within the Point Mugu Sea Range and in adjacent airspace off the coast of California. Flight tests would involve use of one F-22 aircraft, an F-15 or F-16 as a chase aircraft, and tanker aircraft for aerial refueling. The USAF prepared an EA to address potential impacts of the proposed action (USAF, 2000). The USAF issued a FONSI on Feb-

ruary 2, 2000 stating that noise from these activities would not have significant impacts to marine mammals or other animals because noise levels would be within the range of those produced by existing aircraft using the Point Mugu Sea Range. The FONSI also stated that cumulative impacts of this action on the Sea Range would not be significant because the F-22 over-flights would not result in a perceptible increase in noise levels on the range.

IMPACTS OF PAST AND PRESENT OCS ACTIVITIES

Military operations have been conducted in the Point Mugu Sea Range for more than 50 years. During the 50-year operational history of the military in the Sea Range, there have been no accidents involving oil and gas related operations or other parties (U.S. Navy, 2000).

Oil and gas exploration and development activities on the Pacific OCS began in the late 1960's (Galloway, 1997). Section 4.0 provides information on the offshore oil and gas infrastructure and the levels and types of activities. Currently, 23 oil and gas platforms are located on the Pacific OCS. The platforms were constructed between 1967 and 1989. Four of the platforms (Harvest, Hermosa, Hidalgo, and Irene) are located in the Santa Maria Basin and within Military Warning Area W-532. The four Santa Maria Basin platforms were installed in 1985 and 1986. During the 15-year operational history of the facilities, no military operations have been delayed, disrupted, or cancelled due to offshore oil and gas activity. In addition, there have no accidents (vessel/aircraft collisions, deaths, or serious injuries) involving oil and gas activities and military operations on the Sea Range since the initiation of exploration and development activities in the Santa Maria Basin more than 30 years ago.

In summary, the military and the oil and gas industry have sharing use of the Sea Range for more than 30 years. Military and oil and gas operations have been able to successfully coexist due in large part to the effective policies and procedures that have been developed to minimize the potential for space use conflicts. Section 5.2.24 describes the interaction of military and oil and gas activities and the measures that have been taken to eliminate, reduce, and minimize space-use conflicts resulting from these activities.