NOAA Deep-Sea Coral and Sponge Research and Management Strategic Plan

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Introduction

The National Oceanic and Atmospheric Administration (NOAA) is the lead Federal agency mandated to protect and preserve the Nation's marine resources, including deep-sea coral and sponge ecosystems. As our understanding of these resources has grown, so too has the need to target research and management actions. The *NOAA Deep-Sea Coral and Sponge Research and Management Strategic Plan* represents a concerted effort to identify exploration, research, management, and international activities that provide the necessary information to implement appropriate management measures to protect and conserve deep-sea coral and sponge ecosystems.

Overview of Deep-Sea Coral and Sponge Ecosystems

Complex benthic (bottom) habitats that are created by larger sessile organisms are known to play an important role in marine ecosystems. In deeper or colder oceanic waters, complex habitats are most often formed by species of corals or sponges that are adapted to these unique environmental conditions. Deep-sea corals and sponges form remarkably complex and fragile ecosystems throughout the world's oceans, both within and beyond areas of national jurisdiction. In U.S. waters, deep-sea coral communities are found in the Atlantic Ocean, the Gulf of Mexico, and the Pacific Ocean and occur primarily on hard substrate on continental shelves and slopes, in offshore canyons and on oceanic island slopes and seamounts. Deep-sea sponge communities have not been well mapped, but are often found on similar substrates and may be collocated with deep-sea corals. Beyond U.S. waters, deep-sea coral and sponge ecosystems have gained interest as vulnerable marine ecosystems and have been the focus of international efforts to address the impacts of fishing on them, especially in areas beyond national jurisdiction.

Deep-Sea Corals

Deep-sea corals, also referred to as cold-water corals, are a taxonomically and morphologically diverse collection of organisms distinguished by their occurrence in deeper or colder oceanic waters. The calcified skeletons of certain branching stony coral species form large reef-like structures in deep water. Gorgonians, gold corals, and black corals often have branching tree-like forms and either occur singly or form thickets of many colonies. The three-dimensional features formed by many deep-sea corals provide habitat for numerous fish and invertebrate species and, like shallow-water tropical corals, appear to enhance the biological diversity of many deepwater ecosystems. A number of deep-sea corals are also of commercial importance; in particular, black, pink, and red corals are the basis for a large jewelry industry.

Deep-sea corals lack symbiotic algae (zooxanthellae). Unlike their shallow water relatives, which rely heavily on photosynthesis by their symbionts to produce food, deep-sea corals assimilate plankton and organic matter for much of their energy needs. They generally grow much more slowly than their shallow water counterparts.

Deep-Sea Sponges

Deep-sea sponges also provide important three-dimensional structure to benthic habitats, and are thought to play similar ecological roles to deep-sea corals. Sponge-dominated habitats in deeper waters may be more widespread than are coral-dominated habitats. In the northeast Pacific, glass sponges (Class: Hexactinellida) form unique sponge reefs up to 19 m high and many kilometers long (Krautter et al. 2001). Although much less is known about deep-sea sponges, they have been identified as habitat for managed fish stocks in certain regions and face many of the same threats as deep-sea corals. A large variety of chemical compounds, many with significant biological activity, have been isolated from sponges, and a number are currently in used in pharmaceuticals or undergoing clinical trials.

Threats to Deep-Sea Coral and Sponge Communities

Deep-sea corals are generally slow-growing and fragile, making them and their associated communities vulnerable to human-induced impacts, particularly physical disturbance. With the exception of a few areas (e.g., the *Oculina* Banks), the full extent of habitat degradation resulting from these threats is largely unknown. Less is known about the long-term impacts of human activities on deep-sea sponges or their ability to recover.

Disturbances to deep-sea coral communities from bottom-tending fishing gear, especially bottom trawl gear, are the best documented and pose the most widespread threat (Rogers 1999; Koslow et al. 2000; Hall-Spencer et al. 2001; Fosså et al. 2002; Roberts 2002; Grehan et al. 2005; Wheeler et al. 2005; Waller et al. 2007). Disturbances from bottom trawls and dredges have also been documented in U.S. waters (e.g., Krieger 2001; Koenig et al. 2005; Stone 2006) and are considered the major threat to deep-sea corals in most U.S. regions where such fishing is allowed (Hourigan et al. 2007). Studies of sponges indicate that they are also damaged to a large extent when hit by bottom-trawl gear (Sainsbury et al. 1997, Freese et al. 1999, Freese 2003, Løkkeborg 2005). The National Research Council (2002) concluded that bottom trawling and dredging reduce habitat complexity by removing or damaging the physical structure of the seafloor and by causing changes in species composition.

Other activities that can directly impact deep-sea coral communities include other bottom-set fishing gears (e.g., gillnets and longlines); coral harvesting; oil, gas, and mineral exploration and extraction; and submarine cable/pipeline deployment (Freiwald et al. 2004; Hourigan et al. 2007). Deep-sea sponge communities are likely to be vulnerable to many of these impacts. Invasive species, climate change, and ocean acidification represent additional potential threats that have not been adequately explored. The extent of impact from these activities and the type of stressors that cause the most degradation vary among regions.

Deep-Sea Coral and Sponge Definitions:

Structure-forming deep-sea corals: Any colonial, azooxanthellate corals providing vertical structure above the seafloor that can be utilized by other species. It includes both deep reef-building stony corals (e.g., *Lophelia pertusa*) as well as individual branching colonies of corals (e.g., gorgonians, black corals). These are often referred to as habitat-forming deep-sea, deep-water, or cold-water corals.

Structure-forming deep-sea sponges: Any sponges generally occurring at depths below 50 m that provide vertical structure above the sea floor and can occur at a density such that they promote the development of associated communities.

Deep-sea coral communities: Habitats formed by azooxanthellate corals that occur deeper than 50 m and other species of organisms associated with these deep-sea coral habitats.

Deep-sea sponge communities: Assemblages of structure-forming deep-sea sponges and other associated species below 50 m.

Purpose

The *NOAA Deep-Sea Coral and Sponge Research and Management Strategic Plan* is a 5-year strategic plan that identifies goals, objectives, and approaches to guide NOAA's deep-sea coral and sponge research, management, and international activities for Fiscal Years 2009 through 2013. It is intended to integrate research and conservation needs and to be a flexible, evolving document that allows NOAA and its partners to address our growing understanding of new management challenges and allow new issues and priorities to be addressed as appropriate. The primary goal of the Plan is to improve research, conservation, and management of deep-sea coral and sponge ecosystems.

Over the next five years, NOAA will develop implementation plans that will identify specific activities and allow for the refinement of the objectives and approaches identified in the *NOAA Deep-Sea Coral and Sponge Research and Management Strategic Plan.* This will require NOAA to further focus limited funds, respond to emerging issues and changing priorities, and take advantage of technologies developed to better understand and manage deep-sea coral and sponge ecosystems.

Scope

The *NOAA Deep-Sea Coral and Sponge Research and Management Strategic Plan* is designed to guide NOAA activities for deep-sea coral and sponge ecosystems by establishing a framework and strategies in three sections: (I) Exploration and Research;

(II) Conservation and Management; and (III) International Cooperation. The Plan covers deep-sea coral and sponge ecosystems under the jurisdiction of the United States; and is written for a broad audience including, resource managers, scientists, policy decision-makers, and the public.

Section I, identifies the role of research in management, including NOAA's priorities and objectives for research and exploration of deep-sea coral and sponge ecosystems and anticipated deliverables for each objective. The goal of NOAA's exploration and research on deep-sea coral and sponge ecosystems is to provide sound science to enable effective ecosystem-based management. Section II, lays out objectives and approaches that NOAA will undertake to enhance protection of deep-sea coral and sponge ecosystems working with the Fishery Management Councils (FMC), other Federal agencies and interested partners. NOAA's strategy for managing deep-sea coral and sponge ecosystems is centered on the authority provided to NOAA through the Magnuson-Stevens Fisheries Conservation and Management Act (MSA) and National Marine Sanctuary Act (NMSA). Section III, describes NOAA's participation in international activities to protect and/or conserve deep-sea corals and sponges ecosystems. These three goals and associated objectives are summarized in Table 1.

Table 1. NOAA's goals and objectives for enhanced exploration and research, conservation and management, and international cooperation to protect deep-sea coral and sponge communities.

Exploration and Research	1. Locate and characterize deep-sea coral and sponge habitats. 2. Understand the biology and ecology of deep-sea corals and sponges. 3. Understand the biodiversity and ecological function of deep-sea coral and sponge ecosystems. 4. Understand the extent and degree of impact caused by fishing and other human activities. 5. Understand the impacts of climate change and past oceanic conditions.
Conservation and Management	1. Protect areas containing major known deep-sea coral or sponge communities from impacts of bottom-tending fishing gear. 2. Protect areas that may support such communities where mobile bottom-tending fishing gear has not been used recently as a precautionary measure. 3. Develop regional approaches to further reduce interactions between fishing gear and deep-sea corals and sponges. 4. Enhance conservation of deep-sea coral and sponge communities in national marine sanctuaries. 5. Assess and encourage avoidance or mitigation of adverse impacts of non-fishing activities on deep-sea coral and sponge communities. 6. Provide outreach to enhance public understanding of these resources.
International Cooperation	1. Promote international partnerships to conserve deep-sea coral and sponge ecosystems through the sustainable management of activities impacting those resources 2. Ensure that international trade of deep-sea coral and sponge species, and their parts and products, is sustainable 3. Increase international collaborative research and exploration of deep-sea coral and sponge ecosystems.

Requirements and Drivers

NOAA has the statutory authority and scientific expertise to take a lead role in conducting research and management of deep-sea coral and sponge ecosystems. The primary and secondary requirement drivers for the *NOAA Deep-Sea Coral and Sponge Research and Management Strategic Plan* are listed below (see Appendix A and B for additional information).

Primary Requirements:

- ◊ Magnuson-Stevens Fisheries Conservation and Management Act (16 U.S.C. 1801 et seq.) as reauthorized in 2006 (Public Law 109-479). NOAA manages fisheries in federal waters through Fishery Management Plans (FMPs) developed in conjunction with the Regional Fishery Management Councils (the Councils).
  - Deep-Sea Coral Research and Technology Program (Sec. 408)
  - Deep-sea coral discretionary provisions [Sec. 303(b)(2)(b)]
  - Minimize bycatch [Sec. 301(a)(9)]
  - Identification and conservation or enhancement of essential fish habitat for managed species [Sec. 305(b)]
- ◊ National Marine Sanctuary Act (16 U.S.C. 1431 et seq.). Authorizes NOAA to identify and protect nationally significant habitats and resources throughout U.S. waters. Deep-sea corals are known to exist within the boundaries of seven National Marine Sanctuaries: Florida Keys, Flower Garden Banks, Channel Islands, Monterey Bay, Gulf of the Farallones, Cordell Bank, and Olympic Coast.
- ◊ Presidential Proclamation: Establishment of the Northwestern Hawaiian Islands Marine National Monument (2006)
- ◊ Presidential Memorandum on Promoting Sustainable Fishing and Ending Destructive Fishing Practices

Secondary Requirements:

- ◊ American Fisheries Act (PL 105-277)
- ◊ Convention on International Trade in Endangered Species of Wild Fauna and Flora
- ◊ Endangered Species Act (16 U.S.C. 460 et seq.)
- ◊ Executive Order 13158: Marine Protected Areas (2000)
- ◊ Deep Seabed Hard Mineral Resources Act (30 U.S.C. 1404 et seq.)
- ◊ Fish and Wildlife Coordination Act (16 U.S.C. 1531 et seq.)
- ◊ Government Result and Performances Act (31 U.S.C. 1115 et seq.)
- ◊ High Seas Fishing Compliance Act (16 U.S.C. 5501 et seq.)
- ◊ National Environmental Policy Act (42 U.S.C. 4321 et seq.)

Measuring Performance

As a science-based agency, NOAA depends on long-term, systematic research and development to meet its goals through incremental improvements in its products, services and science applications. Performance measures will be developed to help evaluate the attainment of the outcomes of this Plan to ensure our Nation remains resilient in the face of challenges, competitive in taking advantage of opportunities, and informed in assessing those challenges and opportunities presented for deep-sea coral and sponge ecosystems. Measures will incorporate mechanisms to ensure accountability and high quality, including rigorous and independent peer-review procedures.

Links to NOAA's Strategic Plans

NOAA's mission is to "understand and predict changes in the Earth's environment and conserve and manage coastal and marine resources to meet our Nation's economic, social and environmental needs." This strategy builds on NOAA's goal to protect, restore and manage the use of coastal and ocean resources through an ecosystem approach, and is designed to guide NOAA's research, management and international activities related to ecosystems containing deep-sea coral and sponges.

In 2008, NOAA published a research plan entitled **Research in NOAA, A Five-Year Plan: Fiscal Years 2008-2012**. The Plan links to the following priority research activity in **NOAA's Five-Year Research Plan:**

- Improve the understanding of deep-sea (or cold-water) coral and sponge ecosystems including their role and function in supporting various life stages of living marine resources, the factors controlling their distribution, and their potential as paleo-environmental indicators.

The projected outcomes of the *NOAA Deep-Sea Coral and Sponge Research and Management Strategic Plan* are also directly related to the outcomes for the NOAA Ecosystems Mission Goal as stated in the **NOAA Strategic Plan**:

- Healthy and productive coastal and marine ecosystems that benefit society.
- A well-informed public that acts as steward of coastal and marine ecosystems.

Furthermore, the activities recommended under this strategic plan address the following **NOAA Ecosystem Mission Goal Performance Objectives**:

- Increase number of regional coastal and marine ecosystems delineated with approved indicators of ecological health and socioeconomic benefits that are monitored and understood.
- Increase number of habitat acres conserved or restored.
- Increase portion of population that is knowledgeable of and acting as stewards for coastal and marine ecosystems.

Data Management and Reporting

Appropriate research and development is needed to maximize the quality and efficiency with which NOAA acquires, manages and distributes its data and associated products and services to ensure they are accurate, reliable, secure, understandable, timely, appropriate and readily accessible. To ensure that information from NOAA's exploration and research on deep-sea coral and sponge communities is available to the research and management communities, NOAA will take the following steps:

- Provide access to NOAA deep-sea coral and sponge data and information, including metadata, links to online data (i.e. regional map servers), products and

publications. Addresses *Deep Sea Coral Research and Technology Program* requirement (Appendix A: MSA Sec. 408(a)1).

- Prepare mandated biennial reports to Congress and the public on steps taken by NOAA to identify, monitor, and protect deep-sea coral areas, including summaries of the results of mapping, research, and data collection performed under the program. Addresses *Deep Sea Coral Research and Technology Program* requirement (Appendix A: MSA Sec. 408(b)).
- Develop and produce a quadrennial report on the State of Deep-sea Coral and Sponge Ecosystems of the United States.

NOAA's Deep-Sea Coral and Sponge Community Exploration and Research Strategy

NOAA, as the Federal agency responsible for managing marine living resources in the U.S., is well-positioned to locate, characterize, and conduct targeted exploration and research to improve the understanding of deep-sea coral and sponge ecosystems. Sound management of these ecosystems requires scientifically-based information on their condition, the causes and consequences of that condition, and the costs and benefits of possible management actions to maintain or improve their condition. The goal of NOAA's exploration and research on deep-sea coral and sponge ecosystems is to provide sound science to enable effective ecosystem-based management. To this end, NOAA, in consultation with the Councils, will engage other Federal, state, and local agencies; academia; the private sector; and the international community to address the following exploration and research objectives for deep-sea coral and sponge ecosystems.

NOAA's Deep-sea Coral and Sponge Exploration and Research Objectives:

1. Locate and characterize deep-sea coral and sponge habitats.
2. Understand the biology and ecology of deep-sea corals and sponges.
3. Understand the biodiversity and ecological function of deep-sea coral and sponge ecosystems.
4. Understand the extent and degree of impact caused by fishing and other human activities.
5. Understand the impacts of climate change and past oceanic conditions.

These objectives respond to NOAA's overall mandates and mission to conduct exploration and research as they apply to deep sea coral and sponge ecosystems, including the requirements of the Deep Sea Coral Research and Technology Program as authorized under MSA Section 408 (Appendix A). The priority exploration and research activities for the objectives include the specific actions required under the MSA. The linkages among these Objectives and the Management Objectives are shown in Appendix C.

Essential to addressing most of the stated exploration and research objectives for deep-sea corals and sponges is availability of and access to advanced underwater technologies. Deep-sea coral and sponge ecosystems exist at depths greater than 50 m. Thus, for scientists to study them, they require a ship outfitted with specialized, deep-sea capable technologies such as, human-occupied submersibles, remotely operated vehicles (ROVs), autonomous underwater vehicles (AUVs), and other relevant technologies.

1. LOCATE AND CHARACTERIZE DEEP-SEA CORAL AND SPONGE HABITATS

The first step in developing appropriate management strategies is to locate and characterize deep-sea coral and sponge communities. Despite an increase in research on deep-sea coral and sponge ecosystems in the past twenty years, there is still very little known about their distribution and extent. NOAA, working in collaboration with the Councils and other partners, will identify priority areas for habitat characterization by reviewing existing information (e.g., historical collection records, trawl and bycatch records, underwater video footage, and previous exploration and research results) and conduct surveys of areas suspected or known to contain deep-sea coral and sponge habitats.

Given the high costs associated with deep-sea habitat characterization surveys (which include mapping, filming, and collecting samples using submersibles, AUVs, ROVs, and other advanced undersea technologies), there is a continuing need to improve NOAA's ability to target areas suspected to contain deep-sea coral and sponge communities. Development of scientific modeling or other such methods will improve NOAA's ability to predict where deep-sea coral and sponge communities are likely to be present and prioritize research in these areas.

Priority exploration and research activities to meet this objective are:

1.1 Locate and conduct a baseline characterization of priority areas suspected or known to contain deep-sea coral and sponge habitats using appropriate survey technology including low-resolution, broad-scale surveys to identify potential targets and high-resolution surveys for creating detailed maps.

1.2 Characterize the abiotic and biotic aspects of deep-sea coral and sponge communities (e.g., salinity, temperature, dissolved oxygen, pH, current patterns, turbidity, topography, nutrients, and substrate type) and quantify the distribution of deep-sea coral and sponge species.

1.3 Create, test, evaluate, and refine models and survey methods that predict where deep-sea coral or sponge habitats are located using the best available scientific information on the type of deep-sea coral and sponge habitats present and their associated abiotic and biotic factors and records of bycatch of corals and sponges.

Anticipated deliverables from these efforts will include:

- Detailed maps showing the distribution of deep-sea coral and sponge communities, as well as substrate and geological features.
- Databases using Geographic Information System software that include the exact location (boundaries), spatial extent, and physical and biological characteristics of deep-sea coral and sponge habitat.
- Annotated video and still photography depicting deep-sea coral and sponge communities.
- Deep-sea coral and sponge samples and specimens.

- Models for predicting where deep-sea coral and sponge habitats are located.
- Maps of predicted distributions of deep-sea coral and sponge habitats and prioritized list of areas to direct research or conservation efforts.

2. UNDERSTAND THE BIOLOGY AND ECOLOGY OF DEEP-SEA CORALS AND SPONGES

Given the limited number of investigations, many deep-sea coral and sponge species that structure complex habitats are unknown or poorly understood. Even for described species, there is a lack of knowledge regarding their basic biology or life history (e.g., reproductive strategies, feeding habits and patterns, dispersal strategies, and recruitment) and impacts of stressors, which are critical to understanding their growth rates, resilience to stress, and rate of recovery from stress or damage. Understanding the relationships between deep-sea coral and sponge species and their environment is important for developing conservation management strategies for systems that are under stress or to determine remediation strategies to aid in the recovery of communities that have been damaged.

In addition to understanding the biology and ecology of deep-sea corals and sponges, there is a need to collect specimens for identification and curation, and to develop taxonomic expertise in deep-sea organisms. The study of taxonomy and systematic biology is a declining field of interest for young scientists and as such, threatens to hamper our future ability to properly identify organisms based on morphological characteristics. Taxonomists are a critical capacity gap needed to address this objective.

Priority exploration and research activities to meet this objective are:

2.1 Determine growth and mortality rates of structure-forming deep-sea coral and sponge species and investigate how abiotic and biotic factors influence their growth rates and development.
2.2 Investigate how species reproduce, disperse, and recruit and determine the influence of abiotic and biotic factors on these patterns and processes.
2.3 Determine larval source-sink patterns and gene flow among deep-sea coral and sponge populations at local, regional and ocean-basin scales.
2.4 Determine sources of food for deep-sea corals and sponges both spatially and temporally.
2.5 Determine the tolerance ranges of deep-sea coral and sponge species to environmental controlling factors and identify sources of stress.

Anticipated deliverables from these efforts will include:

- Deep-sea coral and sponge specimen banks, in partnership with existing institutions housing collections.
- Taxonomic descriptions of deep-sea coral and sponge species.

- Databases containing information on deep-sea coral and sponge taxonomy, life histories, genetic data, and environmental conditions (including tolerance limits).
- Annotated video and still photography describing reproductive behavior of deep-sea corals and sponges.
- Descriptions and models of larval distribution pathways for different deep-sea coral and sponge species.

3. UNDERSTAND THE BIODIVERSITY AND ECOLOGICAL FUNCTION OF DEEP-SEA CORAL AND SPONGE ECOSYSTEMS

Many deep-sea coral and sponge communities form three-dimensional structures that are used by a variety of fish and invertebrate species seeking shelter, food, and spawning areas. Such areas can be as small as a solitary deep-sea coral colony, or as large as a well-developed reef comprised of numerous colonies of multiple species extending for miles. Past investigations have identified such areas, and have begun to describe how these communities function ecologically. However, many questions remain concerning how the ecological function of these communities compare to other structurally complex, non-coral habitats such as rocky hard-bottom areas, and how these habitats might be used by associated species at different stages in their life history.

Priority exploration and research activities to meet this objective are:

3.1 Inventory species associated with deep-sea coral and sponge habitats.
3.2 Determine the role and function that deep-sea coral and sponges play in supporting various life stages of commercially and ecologically important species, including the habitat utilization patterns of species associated with deep-sea coral and sponge habitats, as well as other structurally complex, non-coral substrate.
3.3 Describe food web dynamics for deep-sea coral and sponge communities, including characterizing trophodynamics and benthic-pelagic interactions of organisms associated with these communities.
3.4 Determine the levels of biodiversity (i.e., genetic, species, and ecosystem diversity) associated with deep-sea coral and sponge ecosystems.
3.5 Determine the life histories of commercially or ecologically important species associated with deep-sea coral and sponge habitats at varying temporal and spatial scales.

Anticipated deliverables from these efforts will include:

- Inventory of species associated with deep-sea coral and sponge habitats and their habitat utilization patterns.
- Annotated video and still photography describing associative behavior.
- Specimen identification and stomach content data analyses.
- Descriptions and graphic depictions of trophic structures and food web models.
- Information to inform review and refinement of essential fish habitat designations for Federally-managed species.

- Information to inform required consultations for permitting energy exploration and production, cable laying, and other human disturbances.

4. UNDERSTAND THE EXTENT AND DEGREE OF IMPACT CAUSED BY FISHING AND OTHER HUMAN ACTIVITIES

Understanding the effects of human activities that may impact deep-sea coral and sponge ecosystems is a key priority for developing and implementing management strategies. Bottom trawling is currently the primary direct threat to these communities in areas where such fishing is allowed. However, other human activities, both at a local and broader scale may also contribute to the decline of deep-sea coral and sponge ecosystems. These activities include, but are not limited to, use of other bottom-set fishing gears, mineral resource exploration and extraction, energy exploration and production, cable laying, introduction of invasive species, marine debris, and harvesting. The extent and degree of impact caused by fishing and other human activities varies among regions under U.S. jurisdiction and not all threats listed are uniform across U.S. waters. (Note: impacts of climate change and ocean acidification are dealt with in Objective 5.)

Priority exploration and research activities to meet this objective are:

4.1 Determine the distribution of effort and intensity of use of specific gear types for commercial, recreational, and artisanal fisheries that occur in locations where deep-sea coral and sponge communities are known or likely to occur based on the best available information.[1]

4.2 Conduct cooperative research in cooperation with fishing industry participants and other stakeholders on deep-sea corals and sponges, and on survey methods.

4.3 Develop technologies and methodologies cooperatively with fishing industry participants and other stakeholders to reduce interactions between fishing gear and deep-sea corals and sponges.

4.4 Identify and characterize fisheries with high coral or sponge bycatch and areas with the highest concentrations of bycatch.

4.5 Identify mineral and energy exploration and extraction activities, cable routes, alternative energy infrastructure, or other activities occurring in the vicinity of, traversing, and/or impacting known deep-sea coral and sponge communities and collaborate with appropriate partners (e.g., U.S. Minerals Management Service) in their determination of impacts of these activities.

4.6 Identify potential invasive species and determine their distribution and impacts on deep-sea coral and sponge communities.

4.7 Determine habitat impact rates, sensitivity of habitat features to disturbance, and recovery rates following disturbance, including documentation of damaged habitat from human disturbances.

[1] NOAA will protect all confidential information (such as the location of fishing activity or mineral extraction) received, collected, maintained, or used by the agency as required by law.

4.8 Model habitat impacts to estimate the effects of human disturbances to deep-sea coral and sponge habitats.
4.9 Determine techniques, tools, and technologies to offset unavoidable impacts to deep-sea coral and sponge communities.

Anticipated deliverables from these efforts will include:

- Maps depicting the distribution and intensity of fishing and other human activities in areas known to contain deep-sea coral and sponge communities.
- Annotated video and still photography describing the condition of, and impacts to, these communities, as well as to serve as a baseline for studying ecosystem recovery.
- Technologies or methods designed to reduce interactions between fishing gear and deep-sea corals.

5. UNDERSTAND THE IMPACTS OF CLIMATE CHANGE AND PAST OCEANIC CONDITIONS

Similar to their shallow water counterparts, the skeletons of deep-sea corals are made up of calcium carbonate and other trace elements and isotopes. The trace elements and isotopes that are incorporated into their skeletons reflect the physical and chemical conditions present at the time the skeleton was formed. Thus, coral skeletons can be used as a proxy for determining past oceanic conditions. The worldwide distribution of many deep-sea corals and their age (i.e., a few deep-sea corals have been dated to be hundreds to thousands of years old) increase their potential as tools to discern and reconstruct past oceanic conditions and determine potential linkages to climate change.

Climate change, in particular increases in carbon dioxide levels primarily from the burning of fossil fuels, may impact deep-sea corals by causing changes in ocean carbonate chemistry that result in lower pH levels. This process is known as ocean acidification. The lowering of the seawater pH and the subsequent reduction in the availability of carbonate ions may reduce the calcification rates of deep-sea corals. The impacts of ocean acidification on deep-sea corals may be direct (e.g. decreased growth and recruitment) and indirect (e.g. changes to food supply). The degree and extent to which deep-sea corals are affected by ocean acidification will depend on their skeletal composition (aragonite vs. calcite), geographical location, and depth. Other changes associated with climate change, including changes in temperature and current patterns, may affect both deep-sea corals and sponges and their associated species.

Priority exploration and research activities to meet this objective are:

5.1 Provide information on past ocean and climate conditions derived from deep-sea corals to climate modelers to validate or refine existing climate change models or develop new models.
5.2 Reconstruct past oceanic conditions using deep-sea corals.

5.3 Investigate how increased ocean acidification may impact calcification rates of deep-sea coral species, and how this may subsequently affect growth and reproduction rates.

Anticipated deliverables from these efforts will include:

- Improve existing as well as contribute to developing climate change models.
- Estimated ages of various deep-sea corals.
- Reports on the potential effects of climate change (e.g. ocean acidification and hypoxia) on deep-sea coral and the communities they structure.

NOAA's Deep Sea Coral and Sponge Community Conservation and Management Strategy

NOAA is the lead Federal agency mandated to protect, restore and manage the nation's living marine resources, and as such, recognizes the need to conserve deep-sea coral and sponge communities within areas under its jurisdiction. The Strategic Plan sets out objectives and approaches that NOAA will undertake to enhance protection of these communities working with the Regional Fishery Management Councils (Councils), other Federal agencies and interested partners.

NOAA's Primary authorities for deep-sea coral and sponge protection addressed in this strategy (See also Appendix A for additional authorities):

- Magnuson-Stevens Fishery Conservation and Management Act (16 USC 1801 *et seq.*)
  - Conservation and management measures shall, to the extent practicable, (A) minimize bycatch and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch. (Title III, Sec. 301(a)(9)). *[Note: Bycatch of corals or sponges occurs in multiple fisheries. Avoiding bycatch is preferable to attempts to minimize mortality, since corals and sponges caught as bycatch are unlikely to reattach to the substrate upon their return to the ocean.]*
  - Minimize to the extent practicable adverse effects on essential fish habitat caused by fishing, and identify other actions to encourage the conservation of such habitat (Title III, Sec. 303(a)(7)). *[Note: Habitats where deep-sea corals or sponges occur have been identified as essential fish habitat for a number of fisheries.]*
  - *Discretionary provisions:*
    - Designate zones in areas where deep-sea corals are identified to protect deep-sea corals from physical damage from fishing gear, or to prevent loss or damage to such fishing gear from interactions with deep-sea corals (Title III, Sec. 303(b)(2)(b)).
    - Include management measures in the plan to conserve target and non-target species and habitats, considering the variety of ecological factors affecting fishery populations (Title III, Sec. 303(b)(12))
  - Conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery for the United States fishing industry. (Title III, Sec. 301(a)(1)). *[Note: In certain cases, deep sea corals or sponges may themselves be managed species (e.g., precious corals in the Western Pacific}*

- National Marine Sanctuary Act (16 USC 1431 *et seq.*). Maintain the natural biological communities in the national marine sanctuaries, and to protect, and where appropriate, restore and enhance natural habitats, populations and ecological processes (Sec. 301(b)(3)).

Most U.S. deep-sea coral and sponge communities occur in the EEZ, rather than in state waters. As NOAA, in partnership with the Councils, is the federal agency responsible for managing fisheries in the EEZ, managing fishing threats to these communities is a primary focus of this Strategic Plan. NOAA has determined that certain fishing practices, especially those using mobile bottom-tending gear (including beam and otter trawls, dredges, and other mobile fishing gear that is dragged along the ocean floor), may adversely affect deep-sea corals and sponges and the communities that depend upon them (70 FR 39,700, July 11, 2005). Bottom trawling is currently the major threat to these communities where such fishing is allowed (NRC 2002, UNGA 2006, Hourigan et al. 2007), though other bottom-tending gear, including bottom-set longlines and gill nets, and to a lesser extent traps, have also been identified as threats to deep-sea corals (Reviewed by Hourigan et al. 2007) and sponges (UNGA 2006, Krautter et al. 2001).

Current NOAA management and regulations have kept gear interactions with these communities from becoming a threat in certain regions. For example, in 1983, the Western Pacific Fishery Management Council recommended, and NOAA implemented a prohibition on the use trawl gear, bottom-set long lines, and bottom-set gill nets in the entire EEZ under the Council's jurisdiction. More recently, prohibitions on certain gears have also been implemented over large portions of other Council jurisdictions.

The Ocean Action Plan encourages all Councils to take action, where appropriate, to protect deep-sea corals when developing and implementing regional fishery management plans. NOAA's precautionary approach to reduce adverse impacts of fishing on deep-sea coral and sponge communities is contained in Management Objectives 1-3 and outlined graphically in Figure 2. All actions to protect deep-sea coral and sponge communities in the EEZ from the impacts of fishing gear will be carried out through established NOAA and Council processes.

NOAA's Deep-sea Coral and Sponge Management Objectives:

1. Protect areas containing major known deep-sea coral or sponge communities from impacts of bottom-tending fishing gear.
2. Protect habitat areas where mobile bottom-tending fishing gear has not been used recently as a precautionary measure.
3. Develop regional approaches to further reduce interactions between fishing gear and deep-sea corals and sponges.
4. Enhance conservation of deep-sea coral and sponge communities in national marine sanctuaries.
5. Assess and encourage avoidance or mitigation of adverse impacts of non-fishing activities on deep-sea coral and sponge communities.
6. Provide outreach to enhance public understanding of these resources.

In addition to fishing, oil, gas, and mineral exploration and extraction; submarine cable/pipeline deployment; and other human activities may adversely impact deep-sea

623 coral and sponge communities. NOAA, in partnership with co-trustees, can manage
624 these stressors directly within National Marine Sanctuaries (Objective 4). Elsewhere,
625 NOAA will encourage enhanced protection of these communities through partnerships
626 with applicable management agencies (Objective 5) and through outreach to the public
627 and resource users (Objective 6). The linkages among these Objectives and the
628 Exploration and Research Objectives are shown in Appendix C.
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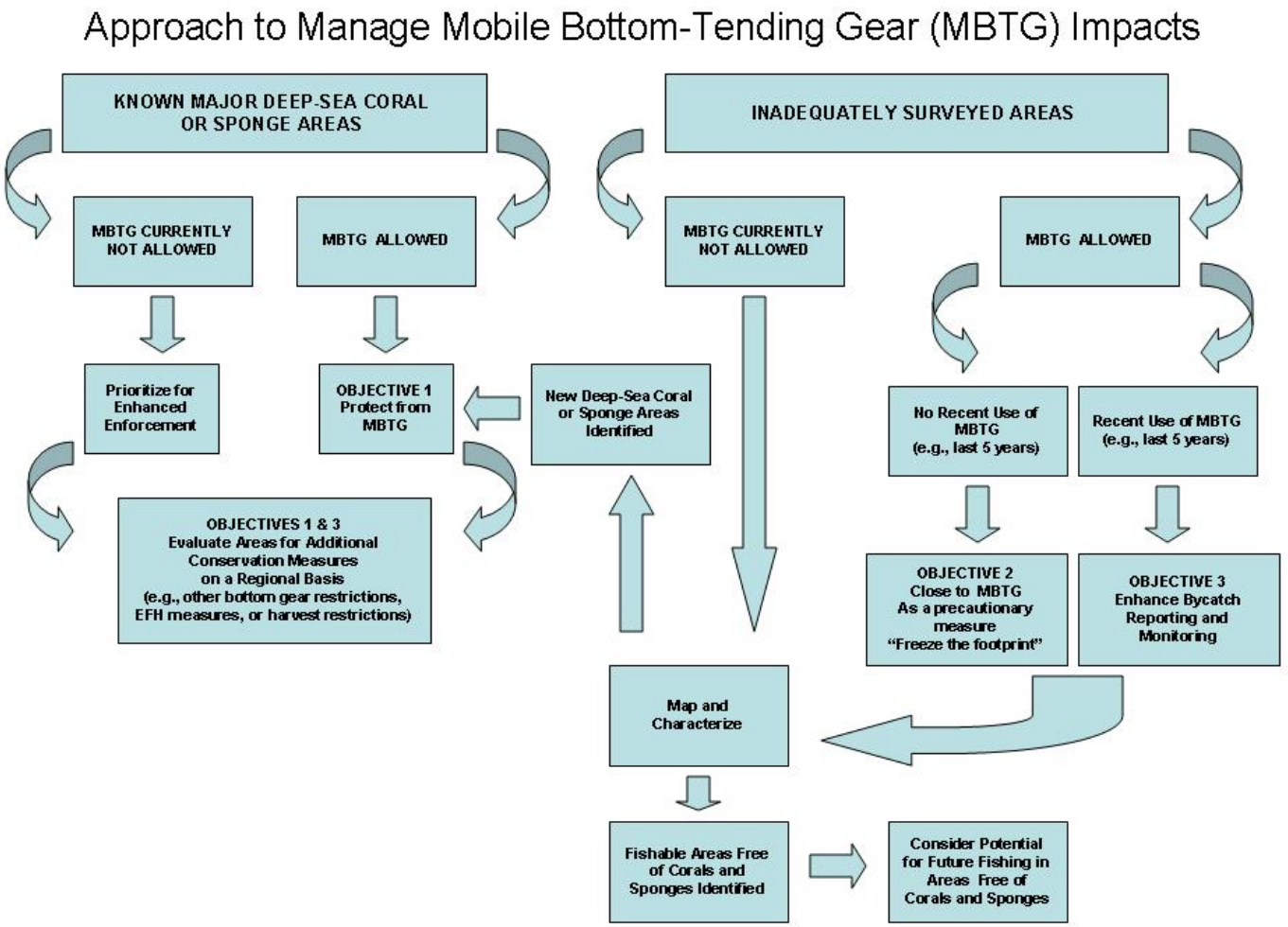
630


Approach to Manage Mobile Bottom-Tending Gear (MBTG) Impacts
KNOWN MAJOR DEEP-SEA CORAL OR SPONGE AREAS
INADEQUATELY SURVEYED AREAS
MBTG CURRENTLY NOT ALLOWED
MBTG ALLOWED
MBTG CURRENTLY NOT ALLOWED
MBTG ALLOWED
Prioritize for Enhanced Enforcement
OBJECTIVE 1 Protect from MBTG
New Deep-Sea Coral or Sponge Areas Identified
No Recent Use of MBTG (e.g., last 5 years)
Recent Use of MBTG (e.g., last 5 years)
OBJECTIVES 1 & 3 Evaluate Areas for Additional Conservation Measures on a Regional Basis (e.g., other bottom gear restrictions, EFH measures, or harvest restrictions)
OBJECTIVE 2 Close to MBTG As a precautionary measure "Freeze the footprint"
OBJECTIVE 3 Enhance Bycatch Reporting and Monitoring
Map and Characterize
Fishable Areas Free of Corals and Sponges Identified
Consider Potential for Future Fishing in Areas Free of Corals and Sponges

1. PROTECT AREAS CONTAINING MAJOR KNOWN DEEP-SEA CORAL AND SPONGE COMMUNITIES FROM IMPACTS FROM BOTTOM-TENDING GEAR

Research by NOAA and its partners has identified a number of major deep-sea coral and sponge communities within the U.S. EEZ. In many cases, NOAA and the Councils have already taken significant steps to protect known areas from impacts of fishing gear. However, new research is revealing additional deep-sea coral and sponge areas that are currently unprotected. Closures to mobile bottom-tending gear are particularly useful for protecting biogenic habitats such as deep-sea corals and sponges (NRC 2002). Under this objective, NOAA will work with the Councils to ensure that fisheries that may interact with identified major deep-sea coral and sponge communities are identified, monitored, and that these communities are adequately protected from impacts by fishing gear. For the purposes of this objective, "major known communities" refers to large aggregations or high concentrations of structure-forming deep-sea corals or deep-sea sponges and their associated fauna.

NOAA, in consultation with the Councils will:

1.1 Identify areas containing high concentrations of structure-forming deep-sea corals or sponges and their current level of protection from interactions with fishing gear. An initial list of such major deep-sea coral areas with limited or no protection from interactions with bottom-tending fishing gear is included in the first *Report to Congress on Implementation of the Deep Sea Coral Research and Technology Program* (NOAA 2008). NOAA will:

- Present this information to the appropriate NOAA programs involved in mapping and conservation, as well as to partners and Councils for consideration of measures to protect these areas.
- Develop standards for future identification of such areas under MSA Section 408.
- Improve and refine the list of major known areas, adding new areas, including sponge areas, as they are identified though research by NOAA and its partners.

1.2 Request Councils to evaluate these areas known to contain major deep-sea coral and sponge communities for adoption of measures, including closure to mobile bottom-tending gear, and as needed other bottom-tending gear, in order to:

- minimize bycatch of deep-sea corals and sponges,
- protect deep-sea coral areas pursuant to MSA Sec. 303(b).

1.3 In cases where corals or sponges have been identified as EFH, minimize to the extent practicable adverse effects on such habitat caused by fishing.

1.4 Enhance surveillance and enforcement, as needed, of areas closed for deep-sea coral and sponge protection.

Anticipated deliverables from these efforts will include:

- A current list of major deep-sea coral and sponge areas in each Council region.
- A list of areas that are likely to support deep-sea coral and sponge communities, but for which additional research is required to verify their existence
- Information on current levels of protection from fishing of major deep-sea coral and sponge communities to provide to Congress and the public.
- Standards developed for identification of areas containing high concentrations of deep-sea corals or sponges that may require enhanced protection in the future.
- Enhanced protection from fishing gear impacts of areas known to contain high concentrations of deep-sea corals or sponges.

2. PROTECT AREAS THAT MAY SUPPORT DEEP-SEA CORAL AND SPONGE COMMUNITIES WHERE MOBILE BOTTOM-TENDING FISHING GEAR HAS NOT BEEN USED RECENTLY AS A PRECAUTIONARY MEASURE

The expansion of fisheries using mobile bottom-tending gear beyond current areas is of management concern. Potentially, many undocumented and relatively pristine deep-sea coral and sponge communities may exist in untrawled (or relatively untrawled) and unmapped areas. This objective takes a precautionary approach to "freeze the footprint" of fishing using mobile bottom-tending gear in order to protect areas that are likely to support deep-sea coral or sponge communities until research surveys demonstrate that proposed fishing will not cause serious or irreversible damage to such communities in those areas. Special emphasis is placed on mobile bottom-tending gear (e.g., bottom trawling), as this gear is the most damaging to these habitats (NRC 2002). This objective only applies to areas where use of such gear is allowed. If subsequent surveys identify portions of these areas that do not contain deep sea corals or sponges, Councils may recommend that suitable these areas be opened for fishing using such gear.

NOAA, in partnership with the Councils, will:

2.1 Identify the current "footprint" of trawl and other bottom-tending fishing gear use.

2.2 Identify areas in each Council region that have not been subject to mobile bottom-tending gear (based on a review of recent and historic fishing patterns as appropriate, e.g., in the past 5 years) that have a reasonable expectation of supporting deep-sea coral or sponge communities.

2.3 Request Councils to evaluate and take action, where appropriate, to temporarily close such areas to fishing using mobile bottom-tending gear as a precautionary measure to avoid bycatch and protect deep-sea corals, until NOAA has determined through necessary surveys, mapping, and research that such fishing activities would not be likely to cause serious or irreversible damage to major deep-sea coral and sponge communities in these areas.

Anticipated deliverables from these efforts will include:

- Maps of areas that have and have not been subject to mobile bottom-tending gear over the past five years according to best estimates.
- Maps of recent fishing activities in Federally-managed fisheries within the EEZ by gear type.
- Areas recommended by the Councils for precautionary closure to mobile bottom-tending gear.

3. DEVELOP REGIONAL APPROACHES TO FURTHER REDUCE INTERACTIONS BETWEEN FISHING GEAR AND DEEP-SEA CORALS AND SPONGES

Management Objectives 1 and 2 identified NOAA's national efforts to gather and disseminate information needed by Councils and NOAA to address impacts of fishing gear in areas where there were known major deep-sea coral or sponge communities, or where mobile bottom-tending gear had not yet been widely used and information on the distribution of such habitats was lacking. There are other currently fished areas where deep-sea corals or sponges are likely to occur, but where there is insufficient information on their distribution, concentration or condition to merit immediate closure. Scientific modeling and fishery dependent data (e.g., bycatch) may be used to identify steps necessary for additional conservation of deep-sea coral and sponge resources in areas already fished using mobile bottom-tending gear. In addition, certain areas that have experienced historic impacts may now have patchy distributions of corals or sponges, but may still merit further protection to allow for recovery potential. There are also other management tools besides closure areas that may be appropriate to conserve deep sea corals and sponges. This objective provides a framework for the Councils and NOAA to utilize their management authorities and partnerships to enhance information on bycatch of corals and sponges and apply this information to better manage areas that are already under stress from fishing, balancing the importance of fishery resources on the continental shelf and slope to fishing communities. These issues are best addressed on a region-by region basis.

NOAA will:

3.1 Monitor fishing in locations where deep-sea corals and sponges are known or likely to occur, and enhance bycatch monitoring and reporting of corals and sponges. NOAA will:

- Establish targeted efforts to map the distribution and intensity of specific gears across broader management areas (e.g., through logbooks, permits or vessel monitoring systems) while ensuring appropriate confidentiality of fishing statistics.
- Enhance fishery observer training to collect coral and sponge bycatch information and supplement coverage on trawl vessels operating in areas of known or suspected deep-sea coral or sponge communities.

3.2 Develop or improve methodologies to utilize bycatch reports and research trawl information to identify new coral and sponge areas for protection.

3.3 Provide information to fishing industry participants to assist them to avoid areas of high bycatch and to identify gear or fishing methods that minimize bycatch of deep-sea corals and sponges.

3.4 Develop and implement regional implementation plans for mapping, monitoring, research, and additional management actions, where applicable.

3.5 Work with partners to implement regional plans through regulations and enhanced outreach and education efforts to fishery managers, scientists, fishermen, tribes, and other stakeholders in each region.

Anticipated deliverables from these efforts will include:

- Regional plans designed to reduce bycatch and other interactions between fishing gear and deep-sea corals and sponges.
- Recommendations to appropriate Councils (and national marine sanctuaries as applicable) that identified areas be closed year round to the use of mobile bottom-tending gear and be evaluated with regard to the need for protection from other bottom-tending gear.
- Fishery observer coverage and training on trawl vessels operating in areas of known or suspected deep-sea coral or sponge communities.
- Habitat maps of potential habitats of deep-sea coral and sponge communities, as well as maps of known deep-sea coral and sponge communities, the distribution of fishing effort and intensity.

Regional implementation planning will allow refinement of the research and management needs identified in the Strategic Plan to further focus limited funds, respond to emerging issues and

changing priorities, and take advantage of increasing knowledge developed during the next five years.

Planning for Regional Implementation:

Regional implementation planning represents a key element of the *Conservation and Management Strategy*. NOAA will develop national guidelines for criteria of vulnerability. NOAA regional teams, in cooperation with the Councils and with the input of stakeholders, will produce implementation plans, or incorporate this information into existing regional plans (e.g., bycatch reduction plans) based on assessments developed in response to this national strategy. Timelines will be developed in concert with national policy and guidance on deep-sea coral and sponge ecosystems. The timing of implementation will vary, depending on regional needs.

The approach could include:

- Criteria, consistent with national guidelines, for identifying "vulnerability" of deep-sea corals and sponge species to adverse impacts of bottom-tending gear.
- Application of those criteria to identify the most vulnerable deep-sea coral and sponge species and communities.
- Identification of serious impacts from fishing practices.
- Identification and evaluation of alternatives for reducing bycatch and other adverse impacts, including at least the elimination of bottom trawling in areas of concentrated deep-sea corals and sponges or in areas where rare or particularly vulnerable species of deep-sea corals or sponges are known to exist.
- Recommendations for modification of fishing gear and/or fishing practices.
- Recommendations for area restrictions on fishing as appropriate.

4. ENHANCE CONSERVATION OF DEEP-SEA CORAL AND SPONGE COMMUNITIES IN NATIONAL MARINE SANCTUARIES AND THE PAPAHANAUMOKUAKEA NATIONAL MARINE MONUMENT

The National Marine Sanctuaries Act (NMSA) authorizes NOAA to identify and protect nationally significant habitats and resources throughout U.S. waters. Deep-sea corals and sponges are known to exist within the boundaries of eight National Marine Sanctuaries with mandates that include their conservation: Stellwagen Bank, Florida Keys, Flower Garden Banks, Channel Islands, Monterey Bay, Gulf of the Farallones, Cordell Bank, and Olympic Coast. The Papahānaumokuākea Marine National Monument in the Northwestern Hawaiian Islands is the nation's largest comprehensively protected marine area. It is managed jointly by three co-trustees—the Department of Commerce; Department of the Interior and the State of Hawaii. The Monument contains rich deep-sea coral resources.

Each national marine sanctuary and the Marine National Monument will:

4.1 Evaluate the occurrence of deep-sea coral and sponge communities within their boundaries.

4.2 Make recommendations for the conservation of deep-sea coral and sponge communities under their jurisdiction in their management plans in consultation with the states and regional fishery management councils (NMSA section 304 (a) (5)), co-trustees, and other stakeholders as appropriate.

Anticipated deliverables from these efforts will include:

- Sanctuary and/or Monument management plans that incorporate conservation of deep-sea coral and sponge communities.
- Outreach and education materials that enhance the understanding of visitors about deep-sea coral and sponge communities within each sanctuary.

5. ASSESS AND ENCOURAGE AVOIDANCE OR MITIGATION OF ADVERSE IMPACTS OF NON-FISHING ACTIVITIES ON DEEP-SEA CORAL AND SPONGE COMMUNITIES.

In addition to fishing, other activities can have adverse impacts on deep-sea coral and sponge communities (e.g., dredging, cable and pipeline deployment, energy and mineral exploration and development activities). Outside of National Marine Sanctuaries and the Papahānaumokuākea Marine National Monument, and with the exception of approval of licenses for deep-seabed hard mineral exploration and development pursuant to the Deep-seabed Hard Mineral Resources Act (30 U.S.C. 1401, et seq.), NOAA does not have authority to directly regulate such non-fishing activities. However, NOAA is authorized to monitor activity in locations where deep-sea corals are known or likely to occur (MSA Sec. 408 (a) (3)) and information gathered through NOAA's research programs can assist in avoiding or mitigating impacts from these activities. In addition, in cases where corals and or sponges have been identified as EFH, any Federal agency that takes an action that may have an adverse effect on EFH must consult with NOAA Fisheries. NOAA Fisheries will then provide conservation recommendations to minimize or mitigate impacts of that action where it finds that such action would adversely affect EFH. NOAA can also comment through the National Environmental Policy Act (NEPA) process on other Federal actions that may affect these communities.

NOAA will:

5.1 Provide information on the location of deep-sea coral and sponge communities to other federal agencies, and work with them to identify current and potential impacts or stressors to these communities associated with non-fishing activities.

5.2 Work with industry and federal partners to utilize NOAA research to develop measures to avoid or minimize these impacts.

5.3 Consult with Federal agencies on their proposed actions that may adversely affect deep-sea coral or sponge habitats identified as EFH, and provide conservation recommendations for conserving those habitats.

Anticipated deliverables from these efforts will include:

- Maps of non-fishing activities that may adversely impact known or suspected deep-sea coral or sponge habitats.
- Development of best management practices for non-fishing activities that may impact deep-sea coral and sponge communities.

6. PROVIDE OUTREACH AND COORDINATED COMMUNICATION EFFORTS TO ENHANCE PUBLIC UNDERSTANDING OF THESE RESOURCES

Improving outreach and communication is central to helping people understand the value of deep-sea coral and sponge ecosystems and ways to avoid damaging them. Reducing human impacts on these ecosystems often requires changing behavior, beliefs, and decision making criteria. An informed, engaged public (including resource users, policymakers, industry representatives, nongovernmental organizations, and other stakeholders) is fundamental to achieving the goals of the Strategic Plan. People will be more likely to alter their actions and support conservation if they understand why these ecosystems are important, realize how their actions affect the condition of deep-sea coral and sponge communities. The need for effective outreach and education cuts across all goals of the *NOAA Deep-sea coral and Sponge Research and Management Strategic Plan,* and progress depends on fully integrating outreach and education into research and management initiatives.

NOAA will:

6.1 Develop outreach materials to enhance public understanding of deep-sea coral and sponge ecosystems and their conservation.

6.2 Work with partners to identify key stakeholders and develop targeted outreach and education materials tailored to increase their understanding of deep-sea coral and sponge ecosystems and specific actions that can enhance their conservation.

Anticipated deliverables from these efforts will include:

- Outreach materials to increase understanding of the public and key stakeholder groups about deep-sea coral and sponge ecosystems and their conservation.
- Recommendations for expanding education and outreach activities, with specific roles identified for NOAA's Office of Education, NOAA's Office of Communications, NOAA's Office of Ocean Exploration, National Marine Sanctuary Program and National Marine Fisheries Service.
- Biennial reports to Congress and the public on steps taken to identify, monitor, and protect deep-sea coral areas, including summaries of the results of mapping, research, and data collection performed.

NOAA's Deep-sea Coral and Sponge International Strategy

Since deep-sea coral and sponge communities occur both within and beyond national jurisdictions, effective and comprehensive research, conservation, and management measures will benefit from complementary national, regional and global initiatives. NOAA, in cooperation and consultation with the Department of State, Department of Interior and other relevant governmental agencies, participates in a number of international fora with the authority to manage activities impacting and/or conserving deep-sea corals and sponges. NOAA has and will continue to advance the United States' position on conserving and managing deep-sea ecosystems in these multilateral and bilateral arrangements.

NOAA's Strategic Objectives to Enhance International Conservation of Deep-sea Coral and Sponge Communities:

1. Promote international partnerships to conserve deep-sea coral and sponge ecosystems through the sustainable management of activities impacting those resources.
2. Ensure that international trade of deep-sea coral and sponge species is sustainable.
3. Increase international collaborative research and exploration of deep-sea coral and sponge ecosystems.

1. PROMOTE INTERNATIONAL PARTNERSHIPS TO CONSERVE DEEP-SEA CORAL AND SPONGE ECOSYSTEMS THROUGH THE SUSTAINABLE MANAGEMENT OF ACTIVITIES IMPACTING THOSE RESOURCES.

The decline of near shore fisheries and the advent of improved capacity of fishing vessels have led to increased fishing efforts in the deep seas. In some cases, the rate of expansion has surpassed our knowledge of the deep sea target species and their associated habitats. Many of these deep sea fish species may be especially vulnerable to fishing pressures as result of slower rates of growth and reproduction. Further, vulnerable benthic ecosystems, such as deep-sea corals, may take decades or longer to recover from the impacts of mobile bottom tending gears. The U.S has been an international leader for the protection of vulnerable habitats from destructive fishing practices, guided by President Bush's 2006 Memorandum to the Secretaries of State and Commerce, which highlights the importance of addressing destructive fishing practices that destroy the long-term natural productivity of fish stocks or habitats such as seamounts, corals, and sponge fields for short term gain,. The President directed the Department of State and NOAA to work diplomatically within international fora to promote sustainable fishing practices, and to call upon all nations to prohibit their vessels from engaging in destructive fishing practices on the high seas until appropriate conservation and management measures are in place.

The international community has acknowledged the need to sustainably manage deep sea fisheries and protect the associated vulnerable marine ecosystems (VMEs). Annually, all member States of the United Nations General Assembly (UNGA) negotiate a fisheries and an oceans related resolution that guides international policy and management on a range of marine issues, including issues that bear on the conservation of deep-sea corals and sponges. The 2006 UNGA sustainable fisheries resolution (A/Res/61/105) provides a framework for protecting vulnerable marine ecosystems (VMEs), such as seamounts, cold-water corals and hydrothermal vents, from significant adverse impacts of fishing on the high seas. States and Regional Fisheries Management Organization and Arrangements (RFMO/As), with guidance from the U.N. Food and Agriculture Organization (FAO), are currently in the process of developing management measures to fulfill this mandate.

The 2006 UNGA Sustainable Fisheries Resolution (A/Res/61/105) calls upon Regional Fisheries Management Organizations/Arrangements (RFMO/As) to:

- Assess whether individual bottom fishing activities would have significant adverse impacts on VMEs and, if so, manage such fishing to prevent such impacts or not authorize it to proceed;
- Identify where VMEs are and determine if bottom fishing would cause significant adverse impacts to the VMEs and long term sustainability of deep-sea fish stocks through, among others, scientific research, data collection and sharing, and new and exploratory fisheries;
- Close areas to bottom fishing if VMEs are present or are likely to be, based on the best available scientific information, and not allow such fishing to proceed unless conservation and management measures are in place to prevent significant adverse impacts on VMEs;
- Cease bottom fishing if a VME is encountered and report the location so that appropriate measures can be adopted with respect to the relevant site; and
- Make the relevant measures adopted in accordance with resolution 61/105 public.

The resolution calls for RFMO/As to comply with these provisions by December 31, 2008, and interim measures by December 31, 2007 for States participating in negotiations to establish new RFMO/As to regulate bottom fisheries. Further, States should adopt and implement the above measures or cease authorizing bottom fishing in areas where there is no competent RFMO/A or where no interim measures have been adopted in conjunction with new RFMO/A negotiations. Finally, States agreed to review actions taken in accordance with the resolution, and, if necessary, propose further recommendations at the 2009 UNGA fisheries resolution negotiations. The 2007 UNGA sustainable fisheries resolution (62/177) reaffirmed the call for RFMO/As and Flag States to implement these measures.

To this end, NOAA will take the following actions:

1.1. Support national implementation and multilateral cooperation for compliance with UNGA resolution 61/105

NOAA, in cooperation with the State Department, will work with international partners to promote compliance with UNGA resolution 61/105 through support of conservation and management measures to prevent significant adverse impacts to VMEs by the deadlines established in the resolution. NOAA will take needed steps to ensure compliance by its flag fisheries. Additionally, NOAA will support and participate in collaborative research on the identification of VMEs globally and the assessment of the impact of fishing on known VMEs.

Additionally, pursuant to the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006 (MSRA), NOAA Fisheries published the legislative definition of Illegal, Unreported and Unregulated (IUU) fishing, which includes fishing activities that have an adverse impact on seamounts, hydrothermal vents, and cold water corals located beyond national jurisdiction, for which there are no applicable conservation or management measures or in areas with no applicable international fishery management organization or agreement. The Department of Commerce is in the process of developing regulations to implement measures of the Act that will seek to address IUU fishing, and will work closely with our international partners in its application.

1.2. Promote compliance with the UNGA Fisheries resolution in RFMO/As with the competence to regulate bottom fisheries

NOAA shall, in collaboration with the Department of State, advance compliance with the 2006 UNGA fisheries resolution within those RFMOs with the authority to regulate bottom fisheries and within which the U.S. is a member. The 2006 UNGA fisheries resolution calls upon RFMO/As with the authority to regulate bottom fisheries, to adopt and implement relevant measures for their respective regulatory areas by December 31, 2008.

Currently, four RFMO/As have the competency to manage bottom fishing, the Northwest Atlantic Fisheries Organization (NAFO), North East Atlantic Fisheries Commission (NEAFC), South East Atlantic Fisheries Organization (SEAFO), and Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR). Of those, the United States is party to NAFO and CCAMLR. Through United States leadership, CCAMLR and NAFO adopted strong conservation and management measures that are consistent with UNGA resolution 61/105, including the identification of VMEs, assessment of bottom fishing activities and the adoption of subsequent management measures, if necessary, and the cessation of bottom fishing if a VME is encountered. The United States will continue to work with these organizations for the full and effective implementation of these guidelines.

1.3. Support negotiations for the development of new RFMO/As with the competence to regulate bottom fisheries

NOAA will, in cooperation with the Department of State, provide technical support and leadership during negotiations for the establishment of new RFMO/As in areas where no such organization or arrangement exists, and support, adoption and implementation of interim measures to prevent significant adverse impacts on VMEs. The 2006 UNGA fisheries resolution calls for States negotiating relevant new RFMO/As to adopt interim measures by December 31, 2007.

The U.S. is currently participating in negotiations to establish two new regional fisheries management organizations or arrangements to manage bottom fisheries: one in the Northwest Pacific and one in the South Pacific. In 2007, both organizations agreed to interim non-binding provisions that are fully consistent with UNGA resolution 61/105, as well as provisions for data collection and monitoring, and measures to freeze current bottom fishing both in terms of effort or catch and areas fished. As participants in the Mechanism for the Management of High Seas Bottom Fisheries in the Northwestern Pacific Ocean, the United States, Japan, the Republic of Korea and the Russian Federation, adopted these measures in February 2007, and refined them in October 2007. In the South Pacific RFMO, participants including Australia, Russian Federation, Japan, New Zealand and Chile, agreed to interim measures in May 2007. Participants further developed an interim benthic assessment framework, and an assessment process to assist flag States and the interim Scientific Working Group in its role to evaluate the assessments provided by States.

1.4. Support the United Nations Food and Agriculture Organization (FAO) development of technical guidance and assistance to address significant adverse impacts of fishing on vulnerable marine ecosystems (VMEs)

NOAA will promote and support FAO implementation of the relevant provisions of the 2006 UNGA fisheries resolution. NOAA will participate in the FAO process to develop management guidance for deep-sea fisheries, including criteria for the identification of vulnerable marine ecosystems (VMEs) and significant adverse impact on VMEs.

In August 2008, governments in cooperation with the FAO adopted a document entitled, "International Guidelines for the Management of Deep-Sea Fisheries in the High Seas," which includes standards and criteria for identifying vulnerable marine ecosystems beyond areas under national jurisdiction and the impacts of fishing activities on such ecosystems, in order to facilitate the adoption and the implementation of conservation and management measures by RFMO/As and flag States.

1.5 Review actions taken to implement the UNGA resolution and identify next steps.

NOAA, in coordination with the Department of State and other relevant government agencies, and with input from stakeholders, will review global and multilateral progress to implement the 2006 UNGA fisheries resolution, identify gaps in implementation and formulate strategies to address any such gaps in advance of the 2009 informal UNGA negotiations. NOAA will continue to work with these partners to regularly review subsequent progress to protect VMEs.

2. ENSURE THAT INTERNATIONAL TRADE OF DEEP-SEA CORAL AND SPONGE SPECIES, AND THEIR PARTS AND PRODUCTS, IS SUSTAINABLE

Certain deep-sea corals and sponges are traded internationally, and if not well managed, harvests to supply this trade result in habitat damage and threats to the species. These threats have been recognized internationally, particularly for coral species used in the jewelry trade. Black corals have been listed in Appendix II of the Convention on the International Trade in Endangered Species (CITES) since 1981. Under Appendix II, an export permit or re-export certificate issued the Management Authority of the State of export or re-export is required. An export permit may be issued only if the specimen was legally obtained and if the export will not be detrimental to the survival of the species. Given recent concern regarding the status of other deep-sea corals, three pink coral species (genus *Corallium*) have been listed by China on CITES Appendix III Appendix III lists those species included by the request of a Party State which needs help in regulating trade to prevent exploitation of that species.

The United States is a major importer of products made from precious corals. In light of the global concern over deep-sea corals and other VMEs, and because of the prominent role of the U.S. as a consumer of coral products, it is in the national interest of the U.S. to insure both sustainable collection and trade.

2.1 Support Convention on the International Trade in Endangered Species (CITES)Appendix II listing for precious coral (*Corallium*) species

NOAA, in collaboration with other governmental agencies, promoted the addition of precious coral (*Corallium*) species in Appendix II of CITES at the 14th Conference of the Parties, in May of 2007. While this measure did not pass, NOAA will work bilaterally and multilaterally to build support for their listing at the 15th Conference of the Parties to be held in 2010. NOAA will work with the U.S. Fish and Wildlife Service and other interested Parties and groups to explore whether other deep-sea coral species in trade with similar life-history characteristics may be appropriate for future listing proposals.

3. INCREASE INTERNATIONAL RESEARCH AND EXPLORATION OF DEEP-SEA CORAL AND SPONGE ECOSYSTEMS

NOAA has unique scientific expertise, programs, and technical and ship assets that can support or contribute to international research and exploration of deep-sea coral and sponge ecosystems. NOAA has and will continue to make a concentrated effort to work with the global community to identify critical information needs to increase our understanding of the distribution and ecological importance of deep-sea corals and sponges and collaborative efforts to fulfill these information needs. A particular focus of international cooperation in the next five years will be identification of deep-sea coral and sponge communities in areas beyond national jurisdiction that may contribute to potentially vulnerable marine ecosystems.

3.1 Coordinate bilateral and multilateral research, cruises and exploration.

3.2 Support inclusion of U.S. data on deep-sea coral and sponge species and communities in multilateral database efforts.

3.3 Support U.S. participation in international symposiums, conferences or other fora that facilitates information exchange.

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Glossary

azooxanthellate: Corals without symbiotic photosynthesizing algae.

biodiversity: The variability among living organisms from all sources including terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species, and of ecosystems (Convention on Biological Diversity).

bycatch: Marine organisms, which are harvested in a fishery, but which are not sold or kept for personal use, and includes economic discards and regulatory discards. In the context of this strategic plan it includes, in particular, deep-sea corals and sponges.

commercial fishing: Fishing in which the fish harvested, either in whole or in part, are intended to enter commerce or enter commerce through sale, barter, or trade.

coral: Species of the phylum Cnidaria having continuous or discontinuous calcium carbonate or horn-like skeletal elements (Cairns 2007), including: (A) all species of the orders Antipatharia (black corals), Scleractinia (stony corals), Gorgonacea (horny corals), , Alcyonacea (soft corals), Pennatulacea (sea pens) and Helioporacea (blue coral and lithotestelids), and species in the family Gerardiidae (gold corals) of the class Anthozoa; and (B) calcified species in the order Anthoathecatae (stylasterid corals and fire corals) or the family of the class Hydrozoa .

deep-sea coral communities: Habitats formed by azooxanthellate corals that occur deeper than 50 m and other species of organisms associated with these deep-sea coral habitats.

deep-sea sponge communities: Assemblages of structure-forming deep-sea sponges and other associated species below 50 m.

ecosystem: A geographically specified system of organisms, the environment, and the processes that control its dynamics. Humans are an integral part of an ecosystem.

essential fish habitat:	Those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. Essential fish habitat (EFH) is described and identified for Federally-managed fisheries species through fishery management plans prepared by the Councils or NOAA.
fish:	As defined under the MSA, "fish" includes finfish, mollusks, crustaceans, and all other forms of marine animal and plant life other than marine mammals and birds.
fishery:	One or more stocks of fish which can be treated as a unit for purposes of conservation and management and which are identified on the basis of geographical, scientific, technical, recreational, and economic characteristics. Also includes any fishing for such stocks.
marine protected area:	Any area of the marine environment that has been reserved by Federal, state, territorial, commonwealth, tribal, or local laws or regulations to provide lasting protection for part or all of the natural and cultural resources therein.
marine reserve:	An area protected from extractive uses (i.e., no-take area).
stakeholder:	An individual or a group with a particular interest, or stake, in the management and functioning of a given resource. Stakeholders in the context of deep-sea coral and sponge ecosystems may include fishers, other commercial or recreational users, researchers, and students. Also referred to as "constituent" or "user."
Structure-forming deep sponges: (sponges)	Any species Generally occurring at depths below 50 m that provide vertical structure above the sea floor and can occur at a density such that they promote the development of associated communities.
stressor:	A physical, chemical, or biological factor that adversely affects organisms; an agent, condition, or similar stimulus that causes stress to an organism.
Structure-forming deep-sea corals: (deep-sea corals)	Any colonial, azooxanthellate corals that provide vertical structure above the sea floor that can be utilized by other species. It includes both deep reef-building stony corals (e.g. *Lopheliapertusa*) as well as individual branching colonies of corals, such as gorgonians, black corals, etc. These are often referred to as habitat-forming deep-sea, deep-water, or cold-water corals. In contrast to shallow-water corals, deep-sea corals general occur at depths below 50 m.

twilight zone: Zone between 50 to 200 m. The corals that subsist in this environment are adapted to low light conditions and colder water. This is a transition zone between shallow-water corals and sponges and true deep-sea species. This zone may include both zooxanthellate and azooxanthellate corals.

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Appendices

Appendix A. NOAA Statutory Authorities and Executive Policy Authorities Specific to Research and Conservation of Deep-Sea Coral Communities

The following are statutory authorities and other policy authorities that apply to NOAA and make specific reference to deep-sea (or cold-water) corals.

Legislative Authorities:

Magnuson-Stevens Fishery Conservation and Management Act (16 USC 1801 *et seq.*)
The Magnuson-Stevens Fishery Conservation and Management Act (MSA) was reauthorized in 2006 and amended to two sections with specific references to management and research on deep-sea corals:

> **MSA Section 303(b). Discretionary Provisions.** Any fishery management plan which is prepared by any Council, or by the Secretary, with respect to any fishery, may—
>
> (2)(A) designate zones where, and periods when, fishing shall be limited, or shall not be permitted, or shall be permitted only by specified types of fishing vessels or with specified types and quantities of fishing gear;
>
> (B) designate such zones in areas where **deep sea corals** are identified under section 408, to protect **deep sea corals** from physical damage from fishing gear or to prevent loss or damage to such fishing gear from interactions with **deep sea corals**, after considering long-term sustainable uses of fishery resources in such areas.
>
> **MSA Section 408. Deep Sea Coral Research and Technology Program**
>
> (a) IN GENERAL- The Secretary, in consultation with appropriate regional fishery management Councils and in coordination with other federal agencies and educational institutions, shall, subject to the availability of appropriations, establish a program—
>
> (1) to identify existing research on, and known locations of, deep-sea corals and submit such information to the appropriate Councils;
> (2) to locate and map locations of deep-sea corals and submit such information to the Councils;
> (3) to monitor activity in locations where deep-sea corals are known or likely to occur, based on best scientific information available, including through underwater or remote sensing technologies and submit such information to the appropriate Councils;
> (4) to conduct research, including cooperative research with fishing industry participants, on deep-sea corals and related species, and on survey methods;
> (5) to develop technologies or methods designed to assist fishing industry participants in reducing interactions between fishing gear and deep-sea corals; and

(6) to prioritize program activities in areas where deep-sea corals are known to occur, and in areas where scientific modeling or other methods predict deep-sea corals are likely to be present.

(b) REPORTING- Beginning 1 year after the date of enactment of the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006, the Secretary, in consultation with the Councils, shall submit biennial reports to Congress and the public on steps taken by the Secretary to identify, monitor, and protect deep-sea coral areas, including summaries of the results of mapping, research, and data collection performed under the program.

High Seas Driftnet Fishing Moratorium Protection Act (16 U.S.C. 1826d *et seq*.)

The Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006, amended the High Seas Driftnet Fishing Moratorium Protection Act to include fishing activity that has an adverse impact on cold water corals (=deep-sea corals) under the definition of IUU fishing.

SEC. 609. Illegal, Unreported, or Unregulated Fishing….

(e) Illegal, Unreported, or Unregulated Fishing Defined-

(1) IN GENERAL- In this Act the term `illegal, unreported, or unregulated fishing' has the meaning established under paragraph (2).

(2) SECRETARY TO DEFINE TERM WITHIN LEGISLATIVE GUIDELINES- Within 3 months after the date of enactment of the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006, the Secretary shall publish a definition of the term `illegal, unreported, or unregulated fishing' for purposes of this Act.

(3) GUIDELINES- The Secretary shall include in the definition, at a minimum--

(A) fishing activities that violate conservation and management measures required under an international fishery management agreement to which the United States is a party, including catch limits or quotas, capacity restrictions, and bycatch reduction requirements;

(B) overfishing of fish stocks shared by the United States, for which there are no applicable international conservation or management measures or in areas with no applicable international fishery management organization or agreement, that has adverse impacts on such stocks; and

(C) fishing activity that has an adverse impact on seamounts, hydrothermal vents, and **cold water corals** located beyond national jurisdiction, for which there are no applicable conservation or management measures or in areas with no applicable international fishery management organization or agreement.

Other Policy Authorities:

U.S. Ocean Action Plan (December 2004)

Under the heading "Promote Coral Reef and Deep Coral Conservation and Education," the Ocean Action Plan recognizes that deep sea corals are related, but distinct from tropical coral reefs, and commits the administration to "Research, Survey, and Protect Deep-Sea Coral Communities."

Presidential Memorandum on Promoting Sustainable Fishing and Ending Destructive Fishing Practices

On October 2, 2006 President Bush issued a memorandum "Promoting Sustainable Fishing and Ending Destructive Fishing Practices" directing the Secretaries of State and Commerce to work with other countries, international organizations and Regional Fishery Management Organizations to implement five policies to reduce destructive fishing practices on the high seas. Destructive fishing practices are defined as those "practices that destroy the long term natural productivity of fish stocks or habitats such as seamount, **corals** and **sponge fields** for short term gain."

Appendix B. NOAA Statutory Authorities and Executive Policy Authorities Relevant to Research and Conservation of Deep-sea Coral and Sponge Communities

The following is a list of major Statutory Authorities and Executive Orders or other policy authorities that apply to NOAA research, conservation and management as they relate to deep-sea coral and sponges. A brief description for each authority and an explanation of its application to deep-sea coral and sponge communities is included.

Legislative Authorities:

Magnuson-Stevens Fishery Conservation and Management Act (16 USC 1801 *et seq.*)
The Magnuson-Stevens Fishery Conservation and Management Act (MSA) establishes exclusive federal management authority over fishery resources of the Exclusive Economic Zone. It is the principal Act governing U.S. fisheries policy, and the primary statutory authority for management actions under this Strategy. The MSA requires among other things, that conservation and management measures, to the extent practicable, (A) minimize bycatch and (B) to the extent that bycatch cannot be avoided, minimize the mortality of such bycatch (§ 301(a)(9)). It also requires the identification and conservation or enhancement of essential fish habitat for managed species (§ 305(b)).

In 2006, the Act was reauthorized and amended to include new discretionary authority for FMPs to designate zones for the protection of **deep sea corals** (§303(b)(2)(B) – See Appendix A), and to include other management measures to conserve target and non-target species and habitats, considering the variety of ecological factors affecting fishery populations (§303(b)(12). Also included was authorization for a **Deep-sea Coral Research and Technology Program (**§ 408 - See Appendix A).

National Marine Sanctuaries Act (Title III 16 USC 1431 *et seq.*)
The National Marine Sanctuaries Act (NMSA) authorizes the Secretary of Commerce to protect and manage the resources of significant marine areas of the United States. This authority has been delegated to NOAA. NOAA's administration of the marine sanctuary program involves designating marine sanctuaries and adopting management practices to protect the conservation, recreational, ecological, educational, and aesthetic values of these areas.

American Antiquities Act (16 USC 431-433)
The Antiquities Act gives the President authority to protect natural and cultural objects through designation of a national monument. Although this authority has been largely used to protect terrestrial resources, the President used it to designate the Papahanaumokuakea Marine National Monument (Presidential Proclamation 8031) on June 15, 2006

Endangered Species Act (16 USC 1531 *et seq.*)
The Endangered Species Act (ESA) requires that the Secretary of Commerce list any species that is threatened with extinction in all or a significant portion of its range and designate critical habitat for that species. At this time there are no deep-sea corals or sponges listed as threatened or endangered under the ESA, however, *Oculina varicosa* has been identified as a "species of concern" by NMFS. Endangered Hawaiian monk seals (*Monachus schauinslandi*) are known to forage in beds of precious coral below 300 m in the subphotic zone, which are habitat for known monk seal prey items such as eels (Parrish et al., 2002).

Fish and Wildlife Coordination Act (16 USC 661-666e)
The Act requires federal departments and agencies that undertake an action, or issue a federal permit or license that proposes to modify any stream or other body of water, to first consult with the U.S. Fish and Wildlife Service, Department of the Interior; the National Marine Fisheries Service, Department of Commerce; and appropriate state fish and wildlife agencies. The purpose of the Act is to ensure that wildlife conservation receives equal consideration, and be coordinated with other aspects of water resources development.

National Environmental Policy Act (42 USC 4321 *et seq.*)
The National Environmental Policy Act (NEPA) requires federal agencies to integrate environmental values into their decision making processes by considering the environmental impacts of their proposed actions and reasonable alternatives to those actions. To meet NEPA requirements federal agencies prepare a detailed statement known as an Environmental Impact Statement (EIS), and are required to consult with and obtain the comments of any Federal agency which has jurisdiction by law or special expertise with respect to any environmental impact involved.

American Fisheries Act (PL 105-277)
The American Fisheries Act (AFA) covers management of the pollock fishery in the Bering Sea and Aleutian Islands (BSAI) management area. It also covers the other groundfish fisheries in the BSAI, the groundfish fisheries in the Gulf of Alaska (GOA), the King and tanner crab fisheries in the BSAI, and the scallop fisheries off Alaska.

Deep-seabed Hard Mineral Resources Act (30 USC 1401 *et seq.*). The Deep Seabed Hard Mineral Resources Act establishes an interim domestic legal regime for deep seabed mining pending adoption of an acceptable international regime. The Act establishes a licensing regime that ensures protection of the marine environment, safety of life and property at sea, prevention of unreasonable interference with other uses of the high seas, and conservation of mineral resources. The Act encourages other nations that embark on ocean-mining ventures to manage their activities in a similar fashion, and to respect licenses and permits issued under the Act.

Other Policy Authorities:

Marine Protected Areas Executive Order (No. 13158)

Executive Order 13158 is intended to strengthen management and protection of marine protected areas (MPAs). The EO requires the Secretaries of Commerce and Interior, in consultation with other agencies and affected States and territories, to develop a national system of MPAs, to share information, to develop an MPA website, and to publish a list of MPAs. The EO also requires each federal agency to take appropriate steps to enhance protection for existing MPAs or to recommend, if appropriate, new MPAs.

Appendix C. Linkages between Research and Management Objectives

Management Objectives	Research Objectives						
	1) Locate and characterize habitats	2) Understand biology and ecology	3) Model distribution of habitats	4) Understand biodiversity and ecological function	5) Understand impacts: Fishing	5) Understand impacts: Other activities	6) Understand past oceanic conditions and impacts of climate change
1) Protect known deep-sea coral or sponge communities	X				X		
2) Freeze footprint of mobile bottom-tending fishing gear	X				X		
3) Develop regional plans	X	X	X	X	X		
4) Enhance conservation in national marine sanctuaries	X	X	X	X	X	X	
5) Address impacts of non-fishing activities	X	X	X	X	X	X	X
6) Outreach	X	X	X	X	X	X	X