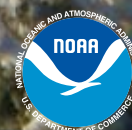


NOAA Strategic Plan for Deep-Sea Coral and Sponge Ecosystems

Research, Management, and International Cooperation



Cover caption: Squat lobster on a *Lophelia* reef on the North Carolina continental slope.

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NOAA Strategic Plan for Deep-Sea Coral and Sponge Ecosystems

Research, Management, and International Cooperation

Coral Reef Conservation Program
National Oceanic and Atmospheric Administration

2010



NOAA Technical Memorandum CRCP 11



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¹ Exploration and Research Strategy

² Conservation and Management Strategy

³ International Strategy

IMAGE CREDITS

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ACRONYMS

AUV	Autonomous underwater vehicle
BSAI	Bering Sea and Aleutian Islands
BTG	Bottom-tending gear
CCAMLR	Convention on the Conservation of Antarctic Marine Living Resources
CITES	Convention on the International Trade in Endangered Species
Council	Regional Fishery Management Council
EEZ	Exclusive economic zone
EFH	Essential fish habitat
E.O.	Executive Order
FAO	Food and Agriculture Organization
FMP	Fishery Management Plan
IUU Fishing	Illegal, unreported and unregulated fishing
MPA	Marine protected area
MSA	Magnuson-Stevens Fishery Conservation and Management Act as reauthorized in 2006
NAFO	Northwest Atlantic Fisheries Organization
NMSA	National Marine Sanctuaries Act
NOAA	National Oceanic and Atmospheric Administration
OTEC	Ocean Thermal Energy Conversion
RFMO/A	Regional Fisheries Management Organization or Arrangement
ROV	Remotely operated vehicle
UNGA	United Nations General Assembly
VME	Vulnerable marine ecosystems

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Paragorgia sp. colony weighted down by numerous shark egg cases, the basket star *Gorgonocephalus eucnemis* and the crinoids *Florometra serratissima*.



The background of the page features a detailed, close-up photograph of deep-sea coral and sponge ecosystems. The coral structures are intricate, with many fine, branching, and feathery parts. The colors range from light beige and cream to deep reds and oranges, set against a dark, almost black, background. The lighting highlights the texture and three-dimensional structure of the marine life.

Introduction

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

This document addresses an identified milestone in NOAA's five-year Research Plan for 2005-2009 to develop a NOAA-wide research plan for deep-sea corals; and a commitment by NOAA to develop a national strategy for research and conservation of deep-sea corals and sponges in response to a petition from Oceana to protect deep-sea corals and sponges.



Coral garden with several species of soft corals, hydrocorals, hydroids, and demosponges off Alaska's Aleutian Islands.

Overview of Deep-Sea Coral and Sponge Ecosystems

Complex seafloor habitats created by large sessile organisms are known to play an important role in marine ecosystems. In deep or cold oceanic waters, complex habitats are most often formed by species of corals and/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 ecosystems 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 ecosystems 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 attracted interest as vulnerable marine ecosystems (VME) and have been the focus of international efforts to address the impacts of fishing on them, especially in areas beyond national jurisdiction. The biology and importance of structure-forming deep-sea corals, the threats they face, and their distribution and conservation status in U.S. waters are reviewed in *The State of Deep Coral Ecosystems of the United States: 2007*.

Deep-Sea Coral and Sponge Definitions:

Structure-forming deep-sea corals:

*Any colonial, azooxanthellate corals generally occurring at depths below 50 m that provide vertical structure above the seafloor that can be utilized by other species. These include both deep reef-building stony corals (e.g., *Lophelia pertusa*), as well as individual branching colonies of corals (e.g., gorgonians and black corals). These are often referred to as habitat-forming deep-sea, deepwater, or cold-water corals.*

Structure-forming deep-sea sponges:

Any sponges generally occurring at depths below 50 m that provide vertical structure above the seafloor and can occur at a density such that they can be utilized by other species.

Deep-sea coral communities:

Habitats formed by structure-forming deep-sea corals and the other species associated with these habitats.

Deep-sea sponge communities:

Habitats formed by structure-forming deep-sea sponges and the other species associated with these habitats.

Deep-sea corals, also referred to as cold-water corals, are a taxonomically and morphologically diverse collection of organisms distinguished by their occurrence in deep or cold oceanic waters. The calcified skeletons of certain branching stony coral species form large reef-like structures in deepwater. 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 deep-sea 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 their energy needs. They generally grow much more slowly than their shallow-water counterparts.

Deep-sea sponges provide important three-dimensional structure to benthic habitats, and are thought to play ecological roles similar to deep-sea corals. In some areas, sponge-dominated habitats



Bouquet of *Corallium* with deep purple *Trachythela* gorgonians on the New England Seamount Chain.

may be more widespread than coral-dominated habitats. For example, in the northeast Pacific Ocean, glass sponges (Class: Hexactinellida) form unique sponge reefs up to 19 m high and many kilometers long. 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 undergoing pharmaceutical clinical trials.

The Importance of Deep-Sea Coral and Sponge Ecosystems

Humankind benefits from many resources and processes generated by marine ecosystems. These ecosystem services include the production of food and safeguards against uncertainty through the maintenance of diversity. The ecosystem services provided by deep-sea corals and sponges, although indirect, are important to humans. Deep-sea corals and sponges provide direct services to deep-sea biota by providing substrate for attachment, refuge for juveniles, aggregating places for spawning and feeding, and dissipation of water flow. Humans derive benefits from these ecosystems in the fish we extract and the bio-compounds we derive from both deep-sea corals and sponges.



The black coral divers of Lahaina, Maui.



Red tree corals (*Primnoa* sp.) are periodically caught with trawl gear in Alaskan waters. This specimen was caught during a NOAA Fisheries groundfish stock assessment survey in Dixon Entrance, Gulf of Alaska.

Threats to Deep-Sea Coral and Sponge Ecosystems

Deep-sea corals are generally slow-growing and fragile, making them and their associated organisms vulnerable to human-induced impacts, particularly from physical disturbances. With the exception of a few areas (e.g., the Oculina Banks off Florida), the full extent of habitat degradation resulting from these threats is largely unknown. Even 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 ecosystems from bottom-tending fishing gear, especially bottom-trawl gear, have been well documented where they have been studied in U.S. waters and in other regions around the world. Bottom trawling is widespread and considered the major threat to deep-sea corals in most U.S. regions where such fishing is allowed and overlaps with areas where deep-sea corals

are present. Studies of sponges indicate they too are subject to damage by bottom-trawl gear. In 2002, the National Research Council 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 ecosystems include other bottom-set fishing gears (e.g., bottom-set gillnets and bottom-set longlines); coral harvesting; oil, gas, and mineral exploration and extraction; marine debris; and submarine cable/pipeline deployment. Deep-sea sponge ecosystems 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.

Purpose

The NOAA Strategic Plan for Deep-Sea Coral and Sponge Ecosystems identifies goals, objectives, and approaches to guide NOAA's research, management, and international cooperation activities on deep-sea coral and sponge ecosystems for fiscal years 2010 through 2019. It is intended to identify and integrate research and conservation needs and to be a

flexible, evolving document that allows NOAA and its partners to address new management challenges and priorities as appropriate. The primary goal of this Strategic Plan is to improve the understanding, conservation, and management of deep-sea coral and sponge ecosystems.

Table 1. Summary of Strategic Plan objectives.

<p>Exploration and Research</p>	<ol style="list-style-type: none"> 1. <i>Locate and characterize deep-sea coral and sponge ecosystems.</i> 2. <i>Understand the biology and ecology of deep-sea corals and sponges.</i> 3. <i>Understand the biodiversity and ecology of deep-sea coral and sponge ecosystems.</i> 4. <i>Understand the extent and degree of impact to deep-sea coral and sponge ecosystems caused by fishing and other human activities.</i> 5. <i>Understand past oceanic conditions and predict the impacts of climate change using deep-sea corals.</i>
<p>Conservation and Management</p>	<ol style="list-style-type: none"> 1. <i>Protect areas containing known deep-sea coral or sponge communities from impacts of bottom-tending fishing gear.</i> 2. <i>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.</i> 3. <i>Develop regional approaches to further reduce interactions between fishing gear and deep-sea corals and sponges.</i> 4. <i>Enhance conservation of deep-sea coral and sponge ecosystems in National Marine Sanctuaries and Marine National Monuments.</i> 5. <i>Assess and encourage avoidance or mitigation of adverse impacts of non-fishing activities on deep-sea coral and sponge ecosystems.</i> 6. <i>Provide outreach and coordinated communications to enhance public understanding of these ecosystems.</i>
<p>International Cooperation</p>	<ol style="list-style-type: none"> 1. <i>Promote international partnerships to conserve deep-sea coral and sponge ecosystems through the sustainable management of deep-sea fisheries activities impacting those resources.</i> 2. <i>Ensure that international trade of deep-sea coral and sponge species, and their parts and products, is sustainable.</i> 3. <i>Increase international exploration and research of deep-sea coral and sponge ecosystems.</i>



(Top) A close-up of a gorgonian coral (*Iridogorgia* sp.) on a seamount off New England. The feeding polyps are all lined up on one side of the branches. (Bottom) Alfonsino (*Beryx decadactylus*) hovering around a large *Lophelia* coral. Many fishes use deep coral habitat in a similar way as fishes do in shallow coral systems.



Christmas tree coral (*Antipathes dendrochristos*) discovered in 2005. Photographed during Delta submersible surveys on deep water rocky banks off southern California.

Scope

The NOAA Strategic Plan for Deep-Sea Coral and Sponge Ecosystems is designed to guide NOAA activities for deep-sea coral and sponge ecosystems as they relate to (I) Exploration and Research, (II) Conservation and Management, and (III) International Cooperation. The Strategic Plan covers deep-sea coral and sponge ecosystems under the jurisdiction of the United States and international cooperation activities undertaken by the United States. It is written for a broad audience, including resource managers, scientists, policymakers, 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 products for each objective. The goal of NOAA's exploration and research on deep-sea coral and

sponge ecosystems is to provide decision-makers with sound scientific information that will enable effective ecosystem-based management decisions. Section II lays out objectives and approaches that NOAA will undertake to enhance protection of deep-sea coral and sponge ecosystems working with the Regional Fishery Management Councils (Councils), National Marine Sanctuary Advisory Councils, and other federal agencies and partners. NOAA's strategy for managing deep-sea coral and sponge ecosystems is centered on the authority provided to NOAA through the Magnuson-Stevens Fishery Conservation and Management Act (MSA) and the National Marine Sanctuaries Act (NMSA). Section III describes NOAA's participation in international activities to protect and/or conserve deep-sea coral and sponge ecosystems. These three sections and their associated objectives are summarized in Table 1.



The brisingid sea-star (*Novodinia antillensis*) is a large invertebrate that perches high in the coral branches (*Lophelia pertusa*) to filter feed. This photo from off North Carolina at about 370 m depth is far north of the known range of this species.

NOAA recognizes that other deep-sea species can form significant structural components on the seafloor. These biogenic habitats may include aggregations of emergent fauna where large sessile invertebrates (e.g., bryozoans, bivalves, tubeworms, and other species), or even aggregations of protozoans (xenophyophores). As with deep-sea corals and sponges, some of these habitats may be vulnerable to physical disturbance. This Strategic Plan does not deal explicitly with these habitats or make recommendations concerning their protection, except to the extent they are associated with deep-sea coral or sponge habitats or are included in international conservation efforts to protect VMEs. However, NOAA will look for opportunities to expand our knowledge of these habitats in the context of deep-sea coral and sponge exploration and research.

This Strategic Plan is not intended to address zooxanthellate coral ecosystems, including shallow coral reef and mesophotic coral ecosystems. NOAA's

approach to shallow coral reef ecosystems is laid out in *The National Action Plan to Conserve Coral Reefs*, the *NOAA Coral Reef Ecosystem Research Plan*, the *NOAA Coral Reef Conservation Program Goals and Objectives*, and the *NOAA Coral Reef Conservation Program International Strategy*. Mesophotic coral ecosystems are characterized by the presence of light-dependent coral and associated ecosystems typically found at depths ranging from 30–40 m to over 150 m in tropical and subtropical regions. While mesophotic and deep-sea coral ecosystems may overlap in tropical and subtropical regions, mesophotic coral ecosystems are light-dependent and considered to be extensions of shallow-water coral reef ecosystems. For more information on these ecosystems, see the *Mesophotic Coral Ecosystems Research Strategy* (2009, NOAA Technical Memorandum NOS NCCOS 98 and OAR OER 2), which identifies research priorities and management needs for these systems.

Authorities and Policy 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 *Report of the U.S. Commission on Ocean Policy* recommended that NOAA “serve as the lead agency for management of deep-water coral communities. In this role, NOAA should work with states, academic institutions, and others to enhance national capabilities

related to deep-water corals, including expanded surveys of their distribution and abundance and research on the major threats to their continued existence.” The authorities and policy drivers for this Strategic Plan are listed below (see Appendix A and B for additional information).

Authorities

Primary Authorities:

- **Magnuson-Stevens Fishery Conservation and Management Act (MSA, 16 U.S.C. 1801 et seq.) as amended by the 2006 Magnuson-Stevens Reauthorization Act (Public Law 109-479)**

NOAA manages fisheries in federal waters through fishery management plans (FMPs) developed in conjunction with the Councils. The following provisions of the MSA authorize research on deep-sea corals or may require or permit a Council or the Secretary of Commerce to include management measures for deep-sea coral and sponge ecosystems:

- Section 408 authorizes the establishment of a Deep Sea Coral Research and Technology Program.
- Section 303(b)(2)(b), permits Councils to include management measures in FMPs that protect deep-sea coral identified under the Section 408 Deep Sea Coral Research and Technology Program.
- Section 301(a)(9) requires Councils to include conservation and management measures that, to the extent practicable, minimize bycatch.
- Section 305(b), requires Councils to identify and describe essential fish habitat and minimize, to the extent practicable, the adverse effects on such habitat caused by fishing.
- Section 303(b)(12), authorizes Councils to include management measures in FMPs to conserve target and non-target species and habitats.

- **National Marine Sanctuaries Act (16 U.S.C. 1431 et seq.)**

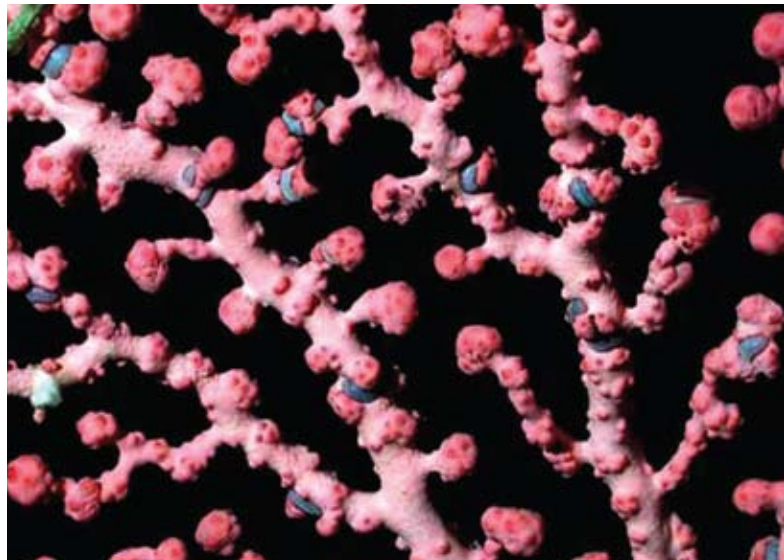
Authorizes NOAA to identify and protect nationally significant habitats and resources throughout U.S. waters. Deep-sea corals are known to exist within the boundaries of eight National Marine Sanctuaries: Channel Islands, Cordell Bank, Florida Keys, Flower Garden Banks, Gulf of the Farallones, Monterey Bay, Olympic Coast, and Stellwagen Bank.¹

- **Presidential Proclamation 8031: Establishment of the Northwestern Hawaiian Islands Marine National Monument (2006)**
- **Presidential Memorandum on Promoting Sustainable Fishing and Ending Destructive Fishing Practices (2006)**
- **Presidential Proclamations 8335, 8337, and 8386: Establishment of the Marianas Trench, Pacific Remote Islands, and Rose Atoll Marine National Monuments (2009)**

¹ Gray's Reef National Marine Sanctuary is shallower than 25 m; however, several corals and sponges that are common in deeper water are also found within the sanctuary. The area encompassed by the Hawaiian Islands Humpback Whale National Marine Sanctuary also includes deep-sea coral habitat, but this Sanctuary's mandate currently is limited to sustaining a safe and healthy habitat for the North Pacific stock of humpback whales that seasonally visit the area.



Collected brittle star, *Asteroschema*, with a parmurid coral.



Paragorgia arborea, or bubblegum corals, grow to over 2.5 m tall. On Davidson Seamount, where this close up photo was taken, they are found primarily on the highest elevations.

Additional Authorities:

- American Fisheries Act (P.L. 105-277)
- Convention on International Trade in Endangered Species of Wild Fauna and Flora
- Deep Seabed Hard Mineral Resources Act (30 U.S.C. 1404 et seq.)
- Endangered Species Act (16 U.S.C. 460 et seq.)
- Executive Order 13158: Marine Protected Areas (2000)
- Fish and Wildlife Coordination Act (16 U.S.C. 1531 et seq.)
- Government Result and Performances Act of 1993 (31 U.S.C. 1115 et seq.)
- High Seas Driftnet Fishing Moratorium Protection Act (16 U.S.C. 1826d 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.)
- NOAA Undersea Research Program Act of 2009 (P.L. 111-11)
- Ocean Exploration Act (P.L. 111-11)
- Ocean Thermal Energy Conversion Act (42 U.S.C. 9101 et seq.)

The MSA directly references “deep sea corals” under Sections 303(b)(2)(b) and 408 while the High Seas Driftnet Fishing Moratorium Protection Act references “cold water corals” under Section 609. None of NOAA’s authorities use the term “deep sea sponges.” It is important to note, however, that the authorities identified above require or permit the protection of a variety of species and habitats, including deep-sea corals and sponges. For example, because corals and sponges are included in the MSA definition of “fish,” Councils may be required to include conservation and management measures in an FMP that will minimize bycatch of these species. This Strategic Plan seeks to integrate both mandatory and permissive habitat and species protection authorities to maximize NOAA’s efforts to conserve deep-sea coral and sponge ecosystems and is not limited to MSA Sections 303(b) and 408.

Policy Drivers

NOAA's Strategic Plan

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." The Strategic Plan for Deep-Sea Coral and Sponge Ecosystems 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 deep-sea coral and sponge ecosystems.

The projected outcomes of the NOAA Strategic Plan for Deep-Sea Coral and Sponge Ecosystems are directly related to the outcomes for the NOAA Ecosystems Goal:

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

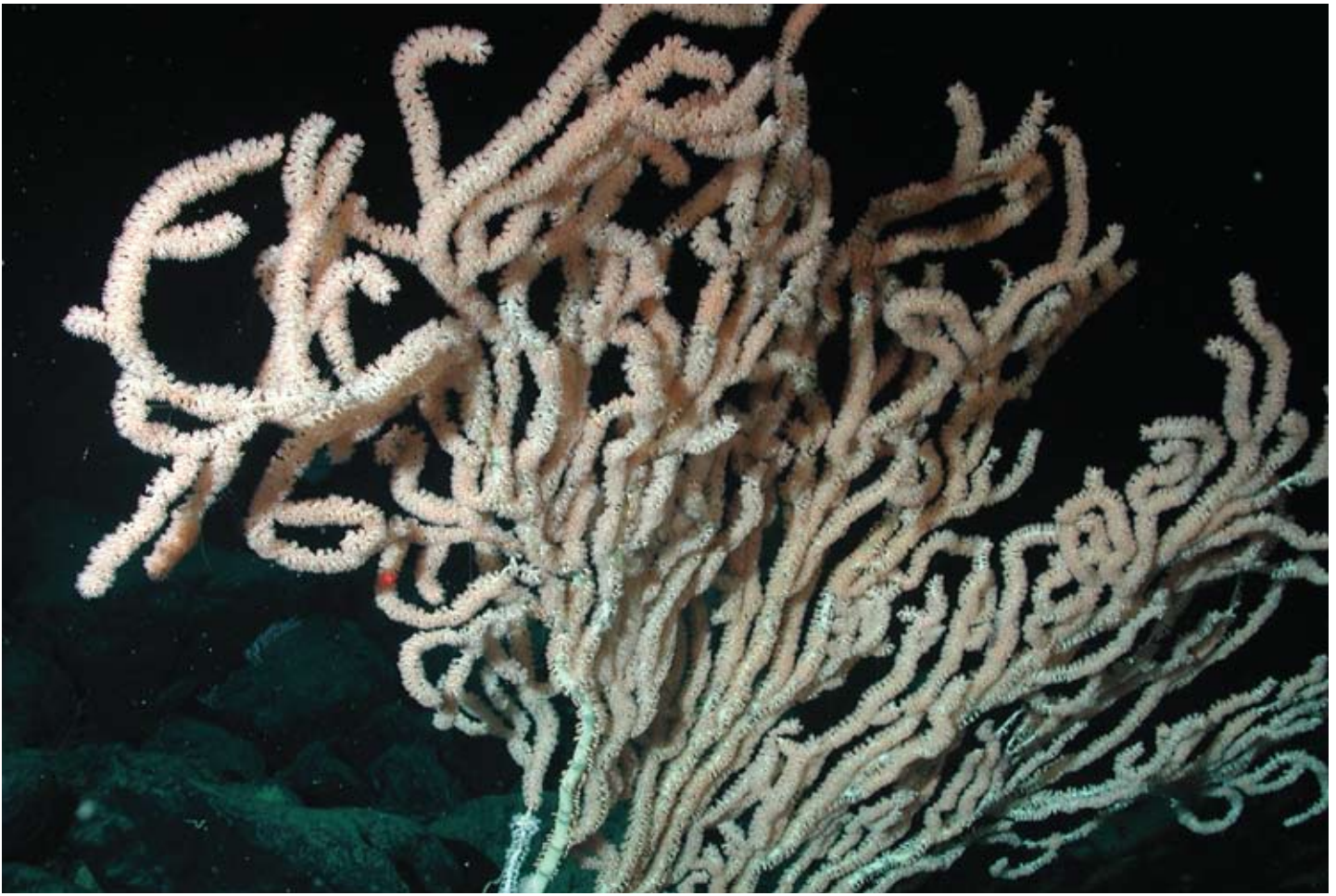
Furthermore, the activities recommended under this Strategic Plan address the following NOAA Ecosystems Goal performance objectives:

- Improve ecosystem health through conservation and restoration of habitat.
- Advance understanding and characterization of coastal, marine, and Great Lakes ecosystem health and associated socioeconomic benefits, and develop forecasting capabilities to meet management needs.
- Provide tools, technologies, and information services that are effectively used by NOAA partners and customers to improve ecosystem-based management.
- Improve public understanding and stewardship so that ecosystem and sustainable development principles are incorporated into planning, management, and use of coastal and marine resources.

NOAA's Research Plan

In 2008, NOAA published *Research in NOAA, A Five-Year Plan: Fiscal Years 2008-2012*. The Strategic Plan for Deep-Sea Coral and Sponge Ecosystems links to the following priority research activity in NOAA's 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.



Bamboo coral, *Karatoisis* sp., on Davidson Seamount. The age estimates for this coral colony exceed 200 years.

Implementing the Strategic Plan

This Strategic Plan provides guidance for all NOAA programs supporting research, management, and international cooperation activities on deep-sea coral and sponge ecosystems. NOAA's Coral Reef Conservation Program implements the congressionally-mandated Deep Sea Coral Research and Technology Program and provides a mechanism for coordination and communication for NOAA's other deep-sea coral activities. The Coral Reef Conservation Program is a matrix program consisting of four NOAA line offices—the National Ocean Service; National Marine Fisheries Service; National Environmental, Satellite, Data, and Information Service; and Office of Oceanic and Atmospheric Research.

Over the next 10 years, NOAA, through the Coral Reef Conservation Program, will develop implementation plans identifying specific activities that address priority information needs and allow for the refinement of the objectives and approaches identified in this Strategic Plan. The annual implementation plans will account for fiscal constraints, respond to emerging issues and priorities, and take advantage of technologies developed to better understand and manage deep-sea coral and sponge ecosystems.



A colorful sea whip found in an area called the Coral Garden in the Green Canyon, Gulf of Mexico.



Basket stars, crinoids, anemone and crab on rock outcropping in Atwater Valley region in the Gulf of Mexico.

Data Management and Reporting

Data management and reporting are critical for ensuring that information acquired is accurate, reliable, secure, understandable, timely, appropriate, and readily accessible. To ensure that information from NOAA's exploration and research activities relating to deep-sea coral and sponge ecosystems is available to researchers and managers, NOAA will take the following steps:

- Provide access to NOAA deep-sea coral and sponge data and information including metadata, links to online data (e.g. regional map servers), products, and publications.
- 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 Deep Sea Coral Research and Technology Program.
- Develop and produce a quadrennial report on the State of Deep-Sea Coral and Sponge Ecosystems of the United States.



View from inside the *Johnson Sea-Link* submersible near the top of a deep-sea coral mound off Cape Lookout, North Carolina (depth of 370 m).



I. Exploration and Research Strategy

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

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

As the federal agency responsible for managing the Nation's marine living resources, NOAA 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.



Black coral at approximately 100 m depth over-grown with the invasive snowflake coral *Carijoa riisei*.

To this end, NOAA, in consultation with the Regional Fishery Management Councils (Council), will engage other federal agencies; academia; the private sector; state, territorial, commonwealth, local, and tribal governments; and the international community to address the exploration and research objectives for deep-sea coral and sponge ecosystems stated herein.

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 authorized under the Magnuson-Stevens Fishery Conservation and Management Act Section 408 (See Appendix A). The linkages among these objectives and the Conservation and Management objectives are shown in Appendix C.

Essential to addressing the stated exploration and research objectives for deep-sea coral and sponge ecosystems is availability of and access to advanced underwater technologies and the ships to support them. Deep-sea coral and sponge ecosystems exist at depths greater than 50 m. Thus, scientists need 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.

Each exploration and research objective and the activities necessary to meet it are discussed below.

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

The first step in developing appropriate management strategies is to locate and characterize deep-sea coral and sponge ecosystems. Despite an increase in research on deep-sea coral and sponge ecosystems in the past 20 years, very little is 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 corals and sponges.

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 underwater 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 corals and sponges are likely to occur and prioritize research in these areas.

Priority exploration and research activities to meet this objective are:

- 1.1 Locate and characterize priority areas suspected or known to contain deep-sea corals and sponges using appropriate survey technologies, 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 associated with deep-sea coral and sponge ecosystems.
- 1.3 Develop, test, evaluate, and refine survey methods and models to predict where deep-sea corals or sponges are most likely to occur.

Anticipated products from these efforts will include:

- Detailed maps showing the distribution of deep-sea corals and sponges, and associated substrate and geological features.
- Databases using Geographic Information System software that include the location (boundaries) and spatial extent of deep-sea coral and sponge habitat.
- Annotated video and still photography depicting deep-sea coral and sponge ecosystems.
- Regional species identification catalogs.
- Models and maps predicting where deep-sea coral and sponge habitats are likely to occur and a prioritized list of areas to direct research and conservation efforts.



The *Pisces IV*, a 3-person, 2,000 m capable submersible, shown collecting a scientific sample of black coral, *Anitpathes grandis*.

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

Our understanding of the biology and ecology of many structure-forming deep-sea coral and sponge species is limited, largely because few investigations have been conducted. In general, we lack knowledge regarding their basic biology or life history (e.g., age and growth, feeding habits and patterns, and reproductive, dispersal, and recruitment strategies) and impacts of stressors on them. Without this type of information, it is difficult to determine the resilience of deep-sea coral and sponge species to stress or their potential rate of recovery from stress or damage. By improving our understanding of the relationships between deep-sea corals and sponges and their environment,

important conservation and management strategies can be developed and implemented for ecosystems that are under stress.

In addition to information on the biology and ecology of deep-sea corals and sponges, specimen collection and identification are needed to develop taxonomic expertise for these organisms. The study of taxonomy and systematic biology has been a declining field of interest for young scientists and has hampered our future ability to properly identify organisms based on morphological characteristics. Lack of taxonomists is a capacity gap in addressing the stated exploration and research objectives.



Sea star feeding on a deep-sea coral.



(Top) A close-up of a sea anemone. (Bottom) Habitat and fish associated with the *Oculina* Habitat Area of Particular Concern off Florida.

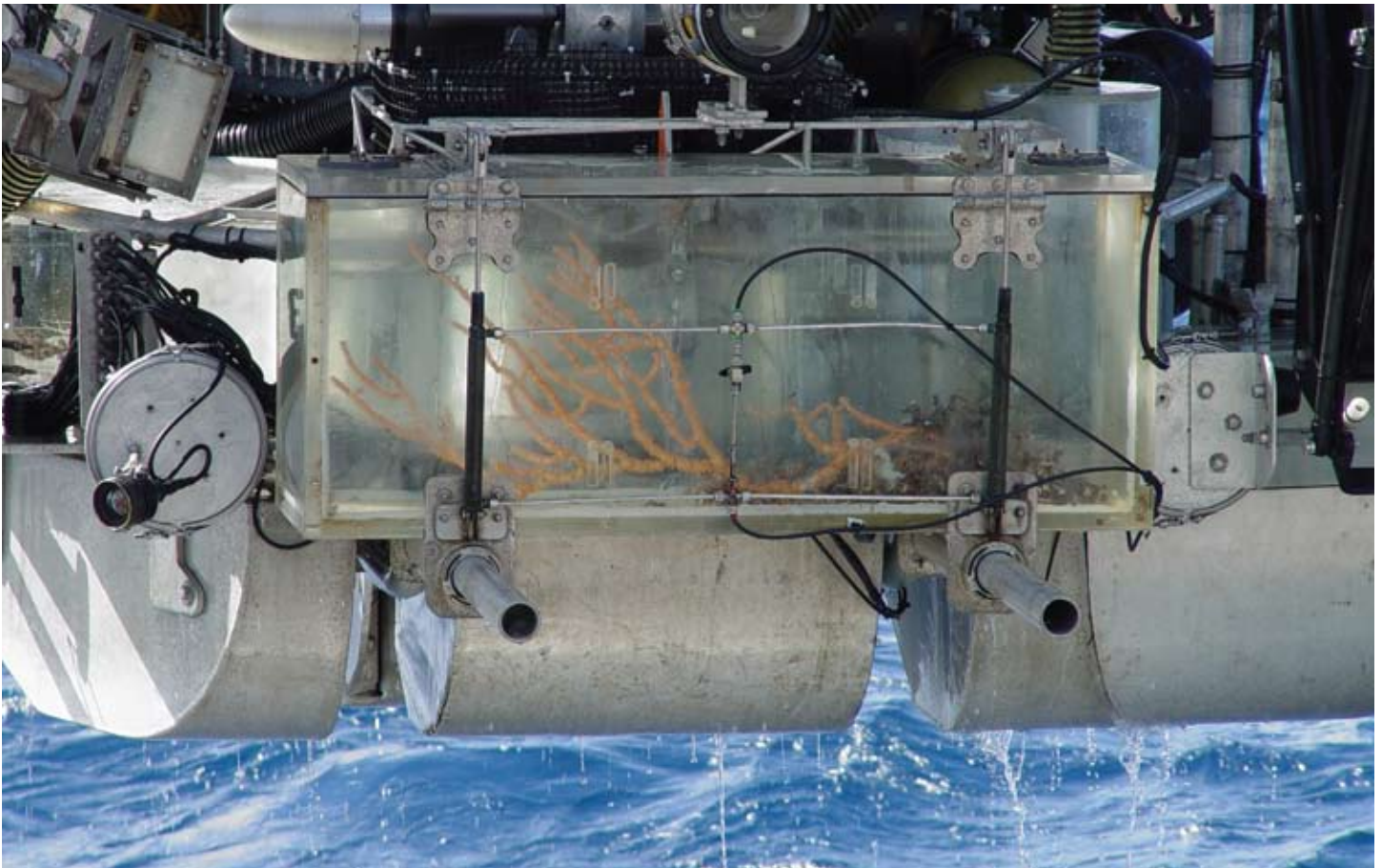
Priority exploration and research activities to meet this objective are:

- 2.1 Investigate and document demographic patterns and processes for structure-forming deep-sea coral and sponge species and how these are influenced by environmental factors and stressors, including species tolerance ranges.
- 2.2 Investigate reproduction, dispersal, and recruitment for deep-sea coral and sponge species and determine the influence of abiotic and biotic factors (including microbes) and stressors on these patterns and processes.
- 2.3 Determine connectivity (e.g., larval source-sink patterns and gene flow) among deep-sea coral and sponge populations at local, regional, and ocean-basin scales.
- 2.4 Determine spatial and temporal sources of food for deep-sea corals and sponges.

- 2.5 Develop condition indices (e.g., lipid/protein content, fecundity, skeletal density, and disease status) for structure-forming species.

Anticipated products from these efforts will include:

- Taxonomic descriptions of deep-sea coral and sponge species.
- Databases containing information on deep-sea coral and sponge taxonomy, growth rates, life histories, genetic data, and responses to environmental conditions (including tolerance limits) that are useful for, but not limited to, testing of models, research analyses, and hypothesis development.
- Descriptions and models of larval distribution pathways for different deep-sea coral and sponge species.



A specimen of *Keratoisis* bamboo coral inside the collection box of the *Johnson-Sea-Link* submersible.

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

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

Priority exploration and research activities under this objective are:

- 3.1 Inventory species associated with deep-sea coral and sponge ecosystems.
- 3.2 Determine the role and function of deep-sea corals and sponges in supporting various life stages of commercially and ecologically important species, including identifying habitat utilization patterns of associated species in comparison to their usage of other structurally complex, abiotic habitats (e.g., rocky hard-bottom areas).
- 3.3 Describe food web dynamics for deep-sea coral and sponge ecosystems.



(Top) Octocorals have eight pinnate tentacles, whereas scleractinian corals have six non-pinnate tentacles. The “pinnae” are seen here in the small projections along each tentacle of this *Swiftia* polyp. (Bottom) *Paragorgia arborea pacifica* found in the Olympic Coast National Marine Sanctuary.

The pencil urchin, *Cidaris* sp., is a common sea urchin member of the deep-sea coral community.

- 3.4 Determine the levels of biodiversity (i.e., genetic, species, and ecosystem diversity) associated with deep-sea coral and sponge ecosystems, including microbes.
- 3.5 Describe the life histories and population dynamics of commercially or ecologically important species associated with deep-sea coral and sponge ecosystems.

Anticipated products from these efforts will include:

- Inventory of species associated with deep-sea corals and sponges and their habitat utilization patterns.
- Lists of characteristic species found within each ecosystem type by region.
- Annotated video and still photography documenting associative behavior.
- Stomach content data analyses for selected species.
- Descriptions and graphic depictions of trophic structures and food web models.
- Information needed for review and refinement of essential fish habitat designations for federally managed species.
- Information needed for required consultations for permitting mineral and energy exploration and production, cable laying, and other human activities.



Coral rubble, likely a result of trawling through *Oculina* coral reefs.

4. UNDERSTAND THE EXTENT AND DEGREE OF IMPACT TO DEEP-SEA CORAL AND SPONGE ECOSYSTEMS 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 ecosystems in areas where they occur and such fishing is allowed. However, other human activities, both at local and broader scales, may also contribute to the decline of deep-sea coral and sponge ecosystems, including 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 vary among regions and not all threats listed are uniform across U.S. waters. (Note: impacts of climate change and ocean acidification are addressed 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, tribal, and artisanal fisheries that occur in locations where deep-sea corals and sponges are known or likely to occur.²

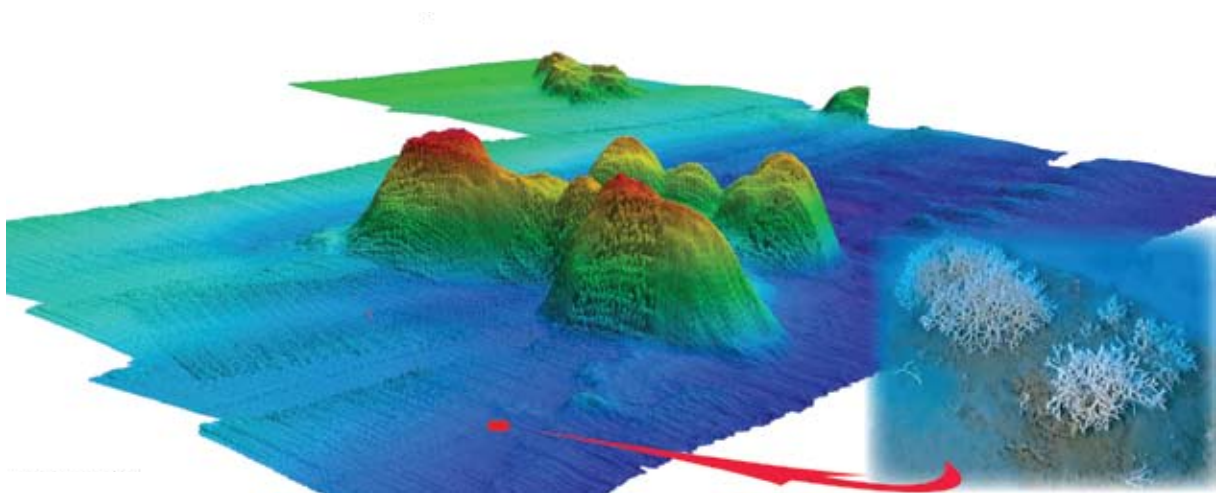
² NOAA will protect all confidential information (such as the location of fishing activity or mineral extraction) received, collected, maintained, or used by the agency as required by law.

- 4.2 Develop, test, evaluate, and refine technologies to reduce interactions between fishing gear and deep-sea corals and sponges.
- 4.3 Conduct cooperative research with fishing industry participants and other stakeholders on deep-sea corals and sponges, and on survey methods.
- 4.4 Identify and characterize fisheries and areas with high bycatch of deep-sea coral and/or sponge species.
- 4.5 Identify mineral and energy exploration and extraction activities and infrastructure, cable routes, alternative energy infrastructure, or other activities occurring in the vicinity of, traversing, and/or impacting known deep-sea coral and sponge ecosystems and identify potential techniques, tools, and technologies to offset unavoidable impacts (i.e., compensate for ecosystem functions) to deep-sea coral and sponge ecosystems in collaboration with the appropriate management entities.
- 4.6 Document the presence and impacts, if any, of non-native species on deep-sea coral and sponge ecosystems.

- 4.7 Document impacts to deep-sea coral and sponge ecosystems, assess their sensitivity to disturbance, and determine their recovery potential once damaged.
- 4.8 Model impacts to deep-sea coral and sponge ecosystems to determine the effects of human disturbances.

Anticipated products 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 ecosystems, or where such ecosystems are likely to be present.
- Annotated video and still photography describing the condition of, and impacts to, these ecosystems, 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.
- Areas recommended for future designation of Deep Sea Coral Zones, Habitat Areas of Particular Concern, bycatch reduction, or other marine protected areas.



3-D colored bathymetry of Chapman's Reef, from 2005 survey done with multibeam sonar from *R/V Cape Fear* by Seafloor Systems, Inc.



Squat lobsters, *Eumunida picta*, are a common invertebrate in the southeastern U.S. deep-sea coral habitats at depths greater than 200 m.

5. UNDERSTAND PAST OCEANIC CONDITIONS AND PREDICT THE IMPACTS OF CLIMATE CHANGE USING DEEP-SEA CORALS

Deep-sea corals are long-lived, slow-growing organisms with wide geographic and depth distributions. These characteristics increase their usefulness as tools to discern and reconstruct past oceanic conditions and determine potential linkages to climate change. Similar to their shallow-water counterparts, their skeletons consist of carbonaceous or proteinaceous materials, which incorporate trace elements, and isotopes that reflect the physical and chemical conditions present at the time the skeleton was formed. Thus, coral skeletons may be used as a proxy for determining past oceanic conditions.

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 versus calcite), geographical location, and depth.

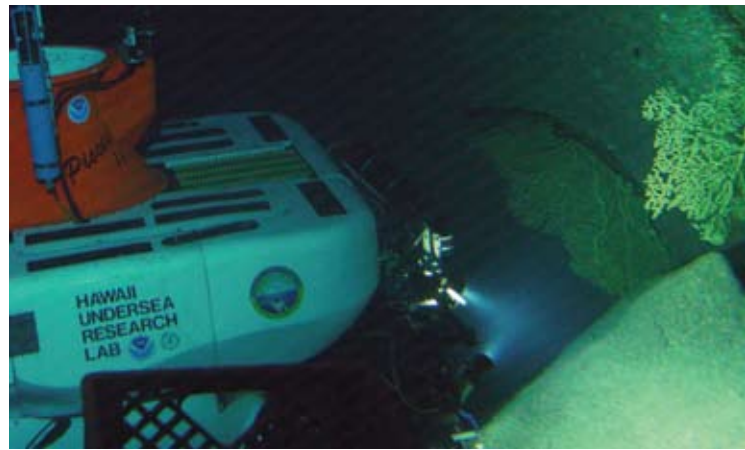


The coral species *Callogorgia americana delta* is abundant in the Gulf of Mexico.

Other issues associated with climate change include changes in temperature and current patterns, which 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 oceanic and climatic conditions derived from deep-sea corals to climate modelers to develop, validate, or refine new or existing climate change models.
- 5.2 Reconstruct past oceanic conditions using deep-sea coral species.
- 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.



(Top) The *Eagle Ray*, a deep-water AUV, provides vivid bathymetric imagery of the ocean floor down to depths of 2,200 m using multi beam sonar technology. (Bottom) The *Pisces IV*, a 3-person, 2,000 m capable submersible, shown preparing to collect a deep-sea coral sample.

- 5.4 Determine long-term temporal (decadal to epochal scales) relationships between deep-sea coral population structure and distribution to the overlying hydrodynamic regime.

Anticipated products from these efforts will include:

- Records of past ocean conditions, which can contribute to development of improved climate change models.
- Estimated ages for selected deep-sea coral species.
- Reports on the potential effects of climate change (e.g., ocean acidification and hypoxia) on deep-sea corals and the ecosystems they structure.



Large primnoid coral with associated brittle stars on Dickinson Seamount, Gulf of Alaska.



II. Conservation and Management Strategy

NOAA's Deep-Sea Coral and Sponge Conservation and Management Objectives:

1. Protect areas containing known deep-sea coral or sponge communities from impacts of bottom-tending fishing gear.
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.
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 ecosystems in National Marine Sanctuaries and Marine National Monuments.
5. Assess and encourage avoidance or mitigation of adverse impacts of non-fishing activities on deep-sea coral and sponge ecosystems.
6. Provide outreach and coordinated communications to enhance public understanding of these ecosystems.



Diverse deep-sea coral habitat found off Florida.



Habitat and fish associated with the Oculina Habitat Area of Particular Concern off Florida.

NOAA is the lead federal agency mandated to protect, restore, and manage the Nation's living marine resources. In carrying out this mission, NOAA recognizes the need to conserve deep-sea coral and sponge ecosystems within areas under its jurisdiction. This Strategic Plan sets out objectives and approaches NOAA will undertake to enhance protection of these ecosystems, working with the Regional Fishery Management Councils (Councils), other federal agencies, and partners.

Most U.S. deep-sea coral and sponge ecosystems occur in the exclusive economic zone (EEZ) rather than in state waters. Because NOAA, in partnership with the Councils, is the federal agency responsible for managing fisheries in the EEZ, managing fishing threats to these ecosystems is one of the primary focuses 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 Federal Register 39700, July 11, 2005). Bottom trawling is currently the major threat to these ecosystems where such fishing is allowed, although 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 and sponges.³ In areas where corals or sponges occur, but where mobile bottom-tending fishing gears are not used or are not allowed, bottom-set fixed gears may be more likely to adversely impact these resources.

Current NOAA management measures and regulations have kept gear interactions with these ecosystems 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 of bottom trawl gear, bottom-set longlines, 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.

³ For further information on threats to deep-sea coral ecosystems, see *The State of Deep Coral Ecosystems of the U.S.: 2007*, Chapter 1.

Box 1. NOAA's primary authorities for deep-sea coral and sponge protection addressed in this Strategic Plan (see Appendix A and B for additional authorities):

Magnuson-Stevens Fishery Conservation and Management Act (MSA - 16 U.S.C. 1801 et seq.). The following Sections of the MSA require or permit NOAA and Regional Fishery Management Councils to include management measures that protect deep-sea corals and sponges in fishery management plans.

Sections that may require protective management measures:

- 301(a)(9) – 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.

Note: Bycatch of corals or sponges occurs in multiple fisheries. Avoiding bycatch is preferable to attempts to minimize mortality, since deep-sea corals and sponges caught as bycatch are unlikely to reattach to the substrate upon their return to the ocean.

- 303(a)(7) – Minimize to the extent practicable adverse effects on essential fish habitat (EFH) caused by fishing, and identify other actions to encourage the conservation of such habitat.

Note: Habitats where deep-sea corals or sponges occur have been identified as EFH for a number of fisheries.

- 303(a)(1) – 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.

Note: In certain cases, deep-sea corals or sponges may themselves be managed species (e.g., precious corals in the Western Pacific).

Sections that authorize protective management measures:

- 303(b)(2)(B) – 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.
- 303(b)(12) – Include management measures in the plan to conserve target and non-target species and habitats, considering the variety of ecological factors affecting fishery populations.

National Marine Sanctuaries Act (NMSA - 16 U.S.C. 1431 et seq.). The NMSA provides NOAA with the authority to identify areas of the marine environment that are of special national significance and designate them as national marine sanctuaries. The following Sections of the NMSA are among those that permit NOAA to implement management measures that protect deep-sea corals and sponges within sanctuaries.

- Section 301(b)(3) – Identifies that a purpose and policy of the Act is to maintain the natural biological ecosystems in the national marine sanctuaries, and protect, and where appropriate, restore and enhance natural habitats, populations and ecological processes.
- Section 308 – Provides the National Marine Sanctuaries Program with the authority to issue regulations for each sanctuary and the system as a whole. These regulations can, among other things, specify the types of activities that can and cannot occur within the sanctuary.
- Section 304(d) – Requires federal agencies whose actions are “likely to destroy, cause the loss of, or injure a sanctuary resource,” to consult with the program before taking the action. The National Marine Sanctuaries Program is, in these cases, required to recommend reasonable and prudent alternatives to protect sanctuary resources.



Bamboo corals on Miami Terrace Reef 15 miles off the coast of Miami, Florida.

NOAA's precautionary approach to reduce adverse impacts of fishing on deep-sea coral and sponge ecosystems is contained in Objectives 1–3 and depicted in Figure 1. In general, it is expected that the implementation of Objectives 1 and 2 will involve, but not be limited to, area closures to specific bottom-tending fishing gears likely to damage, or result in bycatch of, deep-sea corals or sponges in order to protect these resources within such areas. Year-round area closures to bottom-tending fishing gear represent one subset of management measures that fall under the general category known as marine protected areas (MPAs). To the extent that such areas meet established criteria, they may represent important components of the evolving National System of MPAs of the United States. This spatial approach to management is compatible with, and supportive of, comprehensive marine spatial planning efforts. Objective 3 allows

management approaches to be further refined on a regional basis.

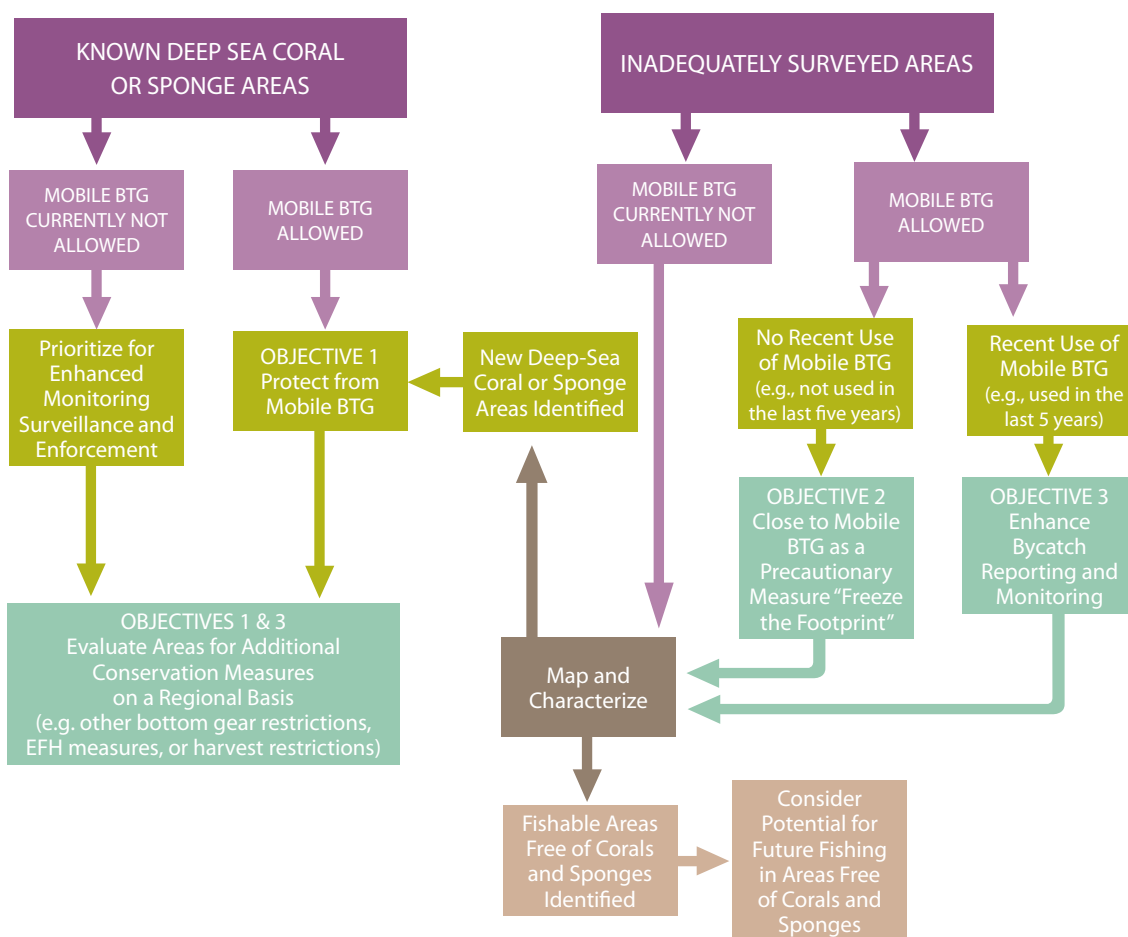
All conservation measures to protect deep-sea coral and sponge ecosystems in the EEZ from the impacts of fishing gear will be evaluated within the context and consistent with the priorities of existing law, and will be implemented through established NOAA and Council processes. Information on NOAA's existing measures and efforts to protect, conserve, and manage deep-sea coral resources is included in *The State of Deep Coral Ecosystems of the United States: 2007* and the *Reports to Congress on the Implementation of the Deep Sea Coral Research and Technology Program (2008 and 2010)*.

In addition to fishing, other human activities may adversely impact deep-sea coral and sponge ecosystems, including oil, gas, and

mineral exploration and extraction; submarine cable/pipeline deployment; and deep-water placement or anchoring of renewable energy facilities. Research activities, including research bottom trawls or collections; anchoring of instruments/buoys; and groundings of research vehicles may also be of concern. NOAA, in partnership with co-trustees, can manage these stressors directly within National Marine Sanctuaries

(Objective 4). Elsewhere, NOAA will encourage enhanced protection of these ecosystems through partnerships with applicable management agencies (Objective 5) and through outreach to the public, resource users, and the research community (Objective 6). The linkages among these Objectives and the Exploration and Research Objectives are shown in Appendix C. Each conservation and management objective is further elaborated below.

Figure 1. NOAA's precautionary approach to manage bottom-tending gear (BTG), especially mobile BTG and other adverse impacts of fishing on deep-sea coral and sponge ecosystems.





Discarded fishing gear caught on *Solenosmillia* sp. and *Lophelia pertusa* scleractinian corals.

1. PROTECT AREAS CONTAINING KNOWN DEEP-SEA CORAL OR SPONGE COMMUNITIES FROM IMPACTS OF BOTTOM-TENDING FISHING GEAR

Research by NOAA and its partners has identified a number of important deep-sea coral and sponge ecosystems 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. Under this objective, NOAA will work with the Councils to ensure that fisheries that may interact with identified deep-sea coral and sponge ecosystems are identified, monitored, and

that these ecosystems are adequately protected from impacts by fishing gear. Areas that NOAA will ask the Councils to consider for additional protection will be identified on a case-by-case based on factors such as large size of the aggregations or high concentrations of structure-forming deep-sea corals and/or deep-sea sponges, the occurrence of rare species, or the importance of the habitat for managed species or other associated fauna. NOAA will also work with the tribes, as appropriate, with reference to areas where deep-sea corals and/or sponges are identified that occur in treaty secured “usual and accustomed” fishing areas.



Steel pots are used to harvest many species of crabs in Alaska. Some pots, such as this one, measure 2 x 2 x 1 m and may weigh more than 300 kg. This pot was derelict for some time and has been heavily colonized by soft corals.



Fragments of coral skeletons (*Lophelia pertusa*). Note the live corals (white) in the foreground and dead corals (brown) in the background.

Priority conservation and management activities under this objective to be addressed in consultation with the Councils are:

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.⁴

NOAA will:

- Present this information to the appropriate NOAA programs involved in management 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 Magnuson-Stevens Fishery Conservation and Management Act (MSA) Section 408.
- Improve and refine the list of known areas, adding new areas, including sponge areas, as they are identified through exploration and research activities.

- Analyze the applicability of predictive models or other methods that may aid in predicting areas where deep-sea corals or sponges are likely to be present.
- 1.2 Request the Councils (and tribes, if applicable) evaluate the areas identified in Objective 1.1 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 corals from physical damage from fishing gear by including management measures in fishery management plans under MSA Section 303 (b)(2)(B).

⁴ An initial list of areas known to contain aggregations of deep-sea corals with limited or no protection from interactions with bottom-tending fishing gear is included in *NOAA's Report to Congress on the Implementation of the Deep Sea Coral Research and Technology Program (2008)*.

- 1.3 In cases where corals or sponges have been identified as essential fish habitat (EFH), minimize to the extent practicable adverse effects on such habitat caused by federally managed fishing.
- 1.4 Enhance monitoring, control, surveillance, and enforcement, as needed, of areas closed for deep-sea coral and sponge protection.
- 1.5 Evaluate the progress by NOAA and the Councils to adequately protect the identified known deep-sea coral and sponge areas from impacts of fishing gear. Identify and implement more effective management measures to reduce bycatch and report on the evaluation and progress in biennial reports to Congress and the public on the implementation of the Deep Sea Coral Research and Technology Program.

Anticipated products from these efforts will include:

- A current list of known deep-sea coral and sponge areas in each Council region.
- A list of areas likely to support deep-sea coral and sponge ecosystems, but for which additional research is required to verify their existence.
- Information on current levels of protection from fishing of known deep-sea coral and sponge areas to provide to Congress and the public.
- Standards developed for identification of areas containing high concentrations of deep-sea corals and/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.



A hexactinellid sponge. Small juvenile amphipods enter the sponge and become captive as they grow too large to escape from inside the sponge's chambers.

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 has the potential to damage additional deep-sea coral and sponge habitats. Potentially, many undocumented and relatively pristine deep-sea coral and sponge ecosystems may exist in unmapped areas untouched, or relatively untouched, by mobile bottom-tending gear. This objective takes a precautionary approach to “freeze the footprint” of fishing that uses mobile bottom-tending gear in order to protect areas likely to support deep-sea coral or sponge ecosystems until research surveys demonstrate that proposed fishing will not cause serious or irreversible damage to such ecosystems 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. This objective applies to areas where use of such gear is allowed or might be allowed in the future. If subsequent surveys identify portions of these areas that do not contain deep-sea corals or sponges, NOAA may recommend that suitable areas be opened for fishing using such gear.

Priority conservation and management activities under this objective to be addressed in consultation with the Councils are:

- 2.1 Identify the current “footprint” of mobile bottom-tending fishing gear use.
- 2.2 Identify areas in each Council region that have a reasonable expectation of supporting deep-sea coral or sponge ecosystems and that have not been subject to mobile bottom-tending gear based on a review of recent and historic fishing patterns (e.g., in the past 5 to 20 years or other appropriate period).
- 2.3 Request that Councils 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 and sponges 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 deep-sea coral and sponge ecosystems in these areas.
- 2.4 Evaluate the steps taken to prevent expansion of mobile bottom-tending gear into areas likely to contain deep-sea coral or sponge ecosystems, and report on the evaluation and progress in biennial reports to Congress and the public on the implementation of the Deep Sea Coral Research and Technology Program.

Anticipated products from these efforts will include:

- Maps of areas that have and have not been subject to mobile bottom-tending gear over an appropriate period of time (e.g., the past 5 years) according to best estimates.
- Maps of recent bottom-tending 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.



Rockfish take refuge in a primnoid octocoral in Olympic Coast National Marine Sanctuary.



In 2006, the cup coral, *Desmophyllum* sp., was documented for the first time in the Olympic Coast National Marine Sanctuary.

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

Conservation and Management Objectives 1 and 2 identified NOAA's national efforts to gather and disseminate information needed by the Councils and NOAA to address impacts of fishing gear in areas where there were known deep-sea coral or sponge ecosystems, or where mobile bottom-tending gear had not yet been widely used and information on the distribution of such habitats was lacking. In some other currently fished areas, deep-sea corals or sponges are likely to occur but 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 habitats 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

increase recovery potential. Other management tools instead of or in addition to closure areas may be appropriate to conserve deep-sea corals and sponges (e.g., fishing effort reductions and modification of gear design or gear type). 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 to apply this information to better manage areas already under stress from fishing, balancing conservation with consideration of the long-term sustainable uses of fishery resources by fishing communities. These issues are best addressed on a region-by-region basis. Regional implementation planning (see Box 2) will allow refinement of the research and management needs identified in this Strategic Plan to further focus limited funds, respond to emerging issues and changing priorities, and take advantage of increasing knowledge developed during the next 10 years.

Box 2. Planning for Regional Implementation:

Regional implementation planning represents a key element of this Conservation and Management Strategy for deep-sea coral and sponge ecosystems. NOAA will evaluate the need for developing national guidelines for criteria of vulnerability. Within each region, NOAA, in consultation with the appropriate 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 Strategic Plan. 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 coral and sponge species to adverse impacts from bottom-tending gear.
- Application of those criteria to identify the most vulnerable deep-sea coral and sponge species and ecosystems.
- 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.
- Recommendations on minimum thresholds of coral or sponge bycatch above which new areas should be ‘identified’ as potential deep-sea coral or sponge areas.
- Recommendations on monitoring, control, surveillance and enforcement needs (e.g., including the need for vessel monitoring systems, observers, or other monitoring techniques).

Priority conservation and management activities under this objective, to be addressed in consultation with the Councils are:

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 include collecting coral and sponge bycatch information and increase observer coverage (as appropriate in the context of overall bycatch reduction goals) on mobile bottom-tending fishing vessels operating in areas of known or suspected deep-sea coral or sponge ecosystems.



An example of deep coral habitat (showing octocorals, antipatharians, echninoderms, sponges and deepwater fishes) found in Flower Garden Banks National Marine Sanctuary, in the northwestern Gulf of Mexico.

- 3.2 Develop or improve methodologies to utilize bycatch reports and information from research trawl surveys to identify new coral and sponge areas for protection.
- 3.3 Provide information to fishing industry participants to help them 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 institute 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 products 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) on additional measures to conserve deep-sea coral and sponge ecosystems.
- Fishery observer coverage and training on bottom trawl vessels operating in areas of known or suspected deep-sea coral or sponge ecosystems.
- Maps of potential and known deep-sea coral and sponge habitats, with overlays of the distribution of fishing effort and intensity.

4. ENHANCE CONSERVATION OF DEEP-SEA CORAL AND SPONGE ECOSYSTEMS IN NATIONAL MARINE SANCTUARIES AND MARINE NATIONAL MONUMENTS

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: Channel Islands, Cordell Bank, Florida Keys, Flower Garden Banks, Gulf of the Farallones, Monterey Bay, Olympic Coast, and Stellwagen Bank.⁵ In addition to the sanctuaries, NOAA is a co-trustee in four Marine National Monuments in the Pacific: the Papahānaumokuākea Marine National Monument in the Northwestern Hawaiian Islands, the Nation's largest comprehensively protected marine area; the Marianas Trench Marine National Monument; the Pacific Remote Islands Marine National Monument; and the Rose Atoll Marine National Monument. The Marine National Monuments are known, or are likely, to contain rich deep-sea coral and sponge resources.

Priority conservation and management activities to meet this objective are:

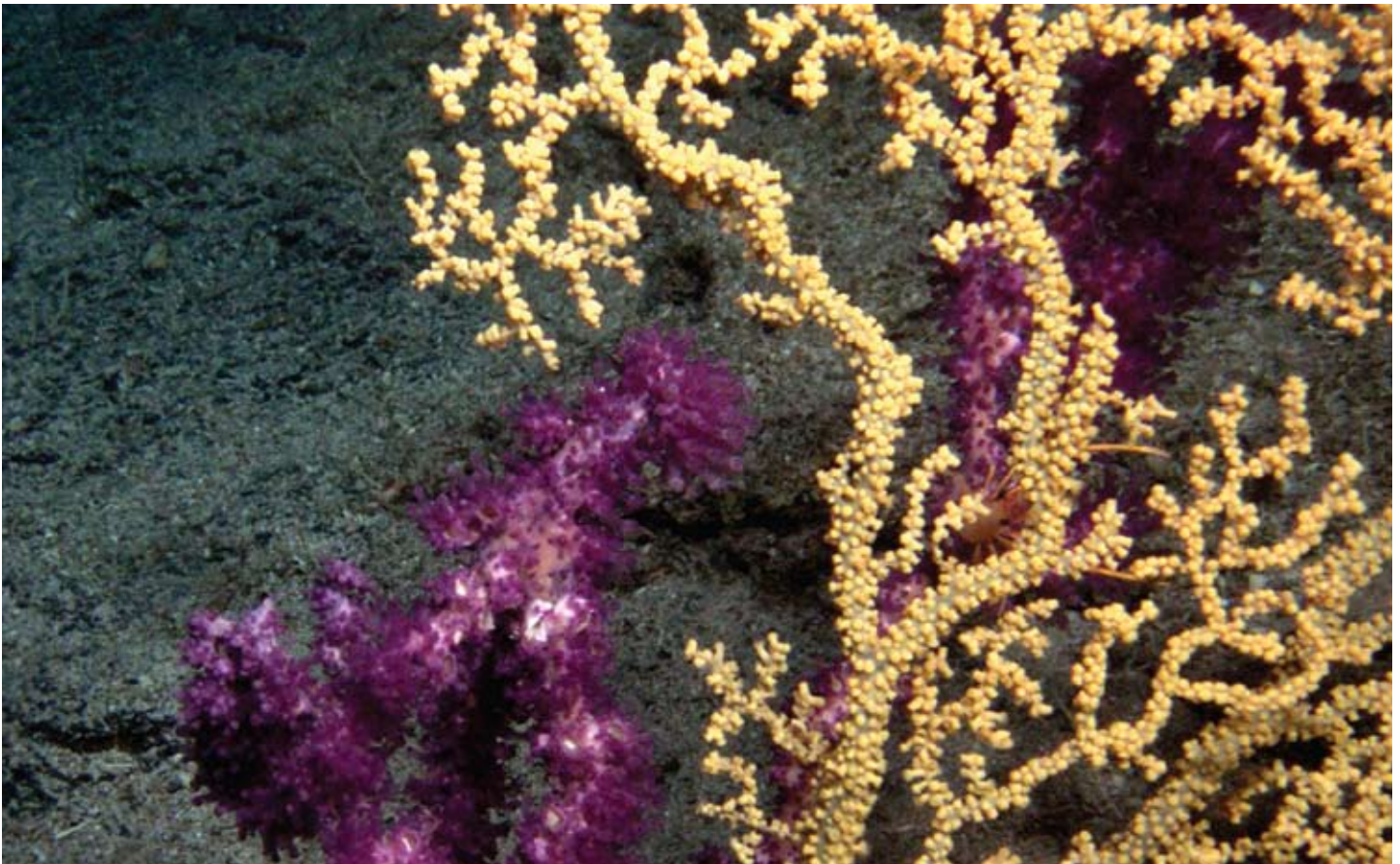
- 4.1 Evaluate the occurrence of deep-sea coral and sponge ecosystems within National Marine Sanctuary or Marine National Monument boundaries, giving priority to areas where there are likely specific threats to these ecosystems that can be addressed by the Sanctuary or Monument.

- 4.2 Recommend specific actions for implementation by marine Sanctuaries and Monuments in their jurisdictions, such as closures, restrictions, or other actions needed to eliminate activities, including but not limited to destructive fishing practices, that may adversely affect deep-sea coral and sponge ecosystems, in consultation with the states, Councils, other fisheries management authorities, co-trustees, tribes, and other stakeholders, as appropriate.

Anticipated products from these efforts will include:

- Sanctuary and/or Monument management plans that incorporate conservation of deep-sea coral and sponge ecosystems.
- Enhanced protection (from all known impacts) of areas known to contain high concentrations of deep-sea corals or sponges.
- Outreach and education materials that enhance the public's understanding of deep-sea coral and sponge ecosystems within each Sanctuary or Monument.

⁵Gray's Reef National Marine Sanctuary is shallower than 25 m; however, several corals and sponges that are common in deeper water are also found within the sanctuary boundaries. The area encompassed by the Hawaiian Islands Humpback Whale National Marine Sanctuary also includes deep-sea coral habitat, but this Sanctuary's mandate currently is limited to sustaining a safe and healthy habitat for the North Pacific stock of humpback whales that seasonally visit the area.

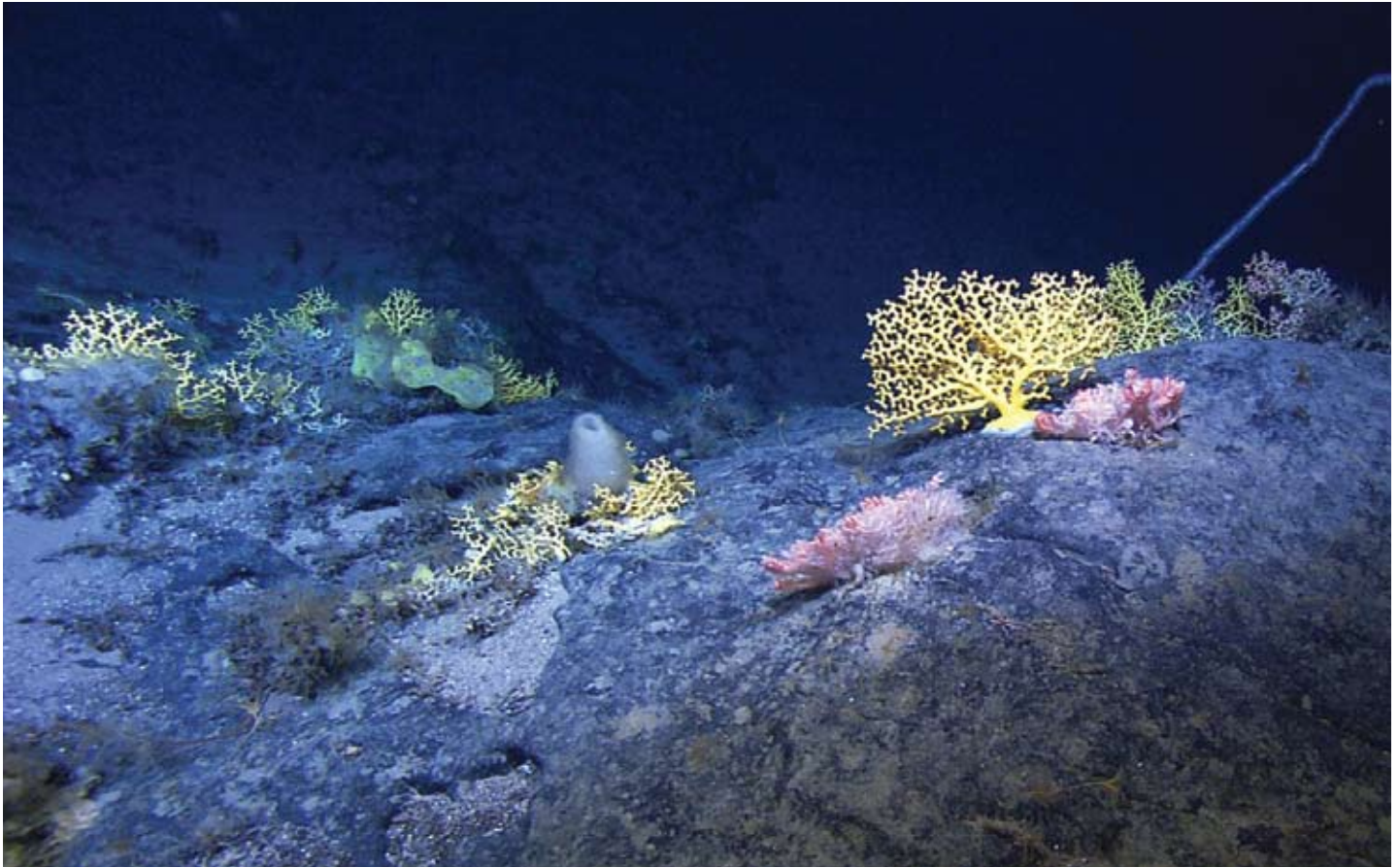


The purple octocoral *Clavularia grandiflora* shown with a gold coral colony (*Gerardia* sp.).

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

In addition to fishing, other activities can have adverse impacts on deep-sea coral and sponge ecosystems (e.g., dredging, cable and pipeline deployment, and energy and mineral exploration and development activities). Outside of National Marine Sanctuaries and the Marine National Monuments, 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.) and facilities for ocean thermal energy conversion under the Ocean Thermal Energy Conversion Act (42 U.S.C. 9101 et seq.), NOAA has no authority to directly regulate such activities. However,

under the MSA, 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 exploration and research activities can assist in avoiding or mitigating impacts from these activities. In addition, for certain federally managed fisheries, deep-sea corals or sponges have been identified as EFH. Federal agencies that authorize, fund, or undertake, or propose to authorize, fund, or undertake any action that may have an adverse effect on EFH must consult with NOAA's National Marine Fisheries Service. Through this consultation, NOAA's National Marine Fisheries Service must provide conservation



Field of yellow *Enallopsammia* stony coral and pink *Candidella* octocoral, with various sponges, whip coral, and brittle stars.

recommendations to minimize or mitigate any adverse effects of the action on EFH. NOAA can also comment through the National Environmental Policy Act process on other federal actions that may affect these ecosystems.

Priority conservation and management activities to meet this objective are:

- 5.1 Provide information on the location of deep-sea coral and sponge ecosystems to other federal agencies, and work with them to identify current and potential impacts or stressors to these ecosystems associated with non-fishing activities.
- 5.2 Work with industry and federal partners to utilize NOAA information 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 recommendations for conserving those habitats.

Anticipated products 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 ecosystems.



Large *Paragorgia* coral with galatheid crabs on Pratt Seamount at 800 m depth.

6. PROVIDE OUTREACH AND COORDINATED COMMUNICATIONS TO ENHANCE PUBLIC UNDERSTANDING OF THESE ECOSYSTEMS

Improved 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 this Strategic Plan. People are more likely to alter their actions and support conservation if they understand why these ecosystems are important

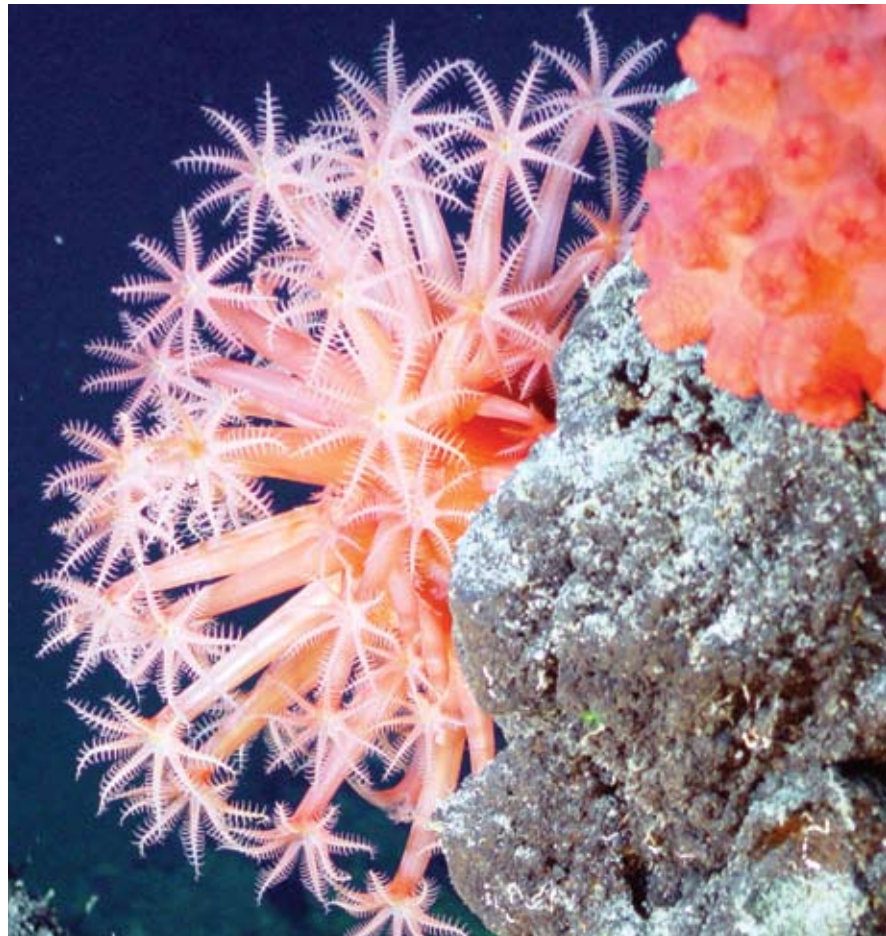
and how their actions affect the condition of deep-sea coral and sponge ecosystems. The need for effective outreach and education cuts across all sections of this Strategic Plan, and progress depends on fully integrating outreach and education into research and management activities.

Priority conservation and management activities to meet this objective are:

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



(Top) Black coral (*Leiopathes* sp.). (Bottom) Close-up of *Lophelia pertusa* calyx with its polyp retracted.



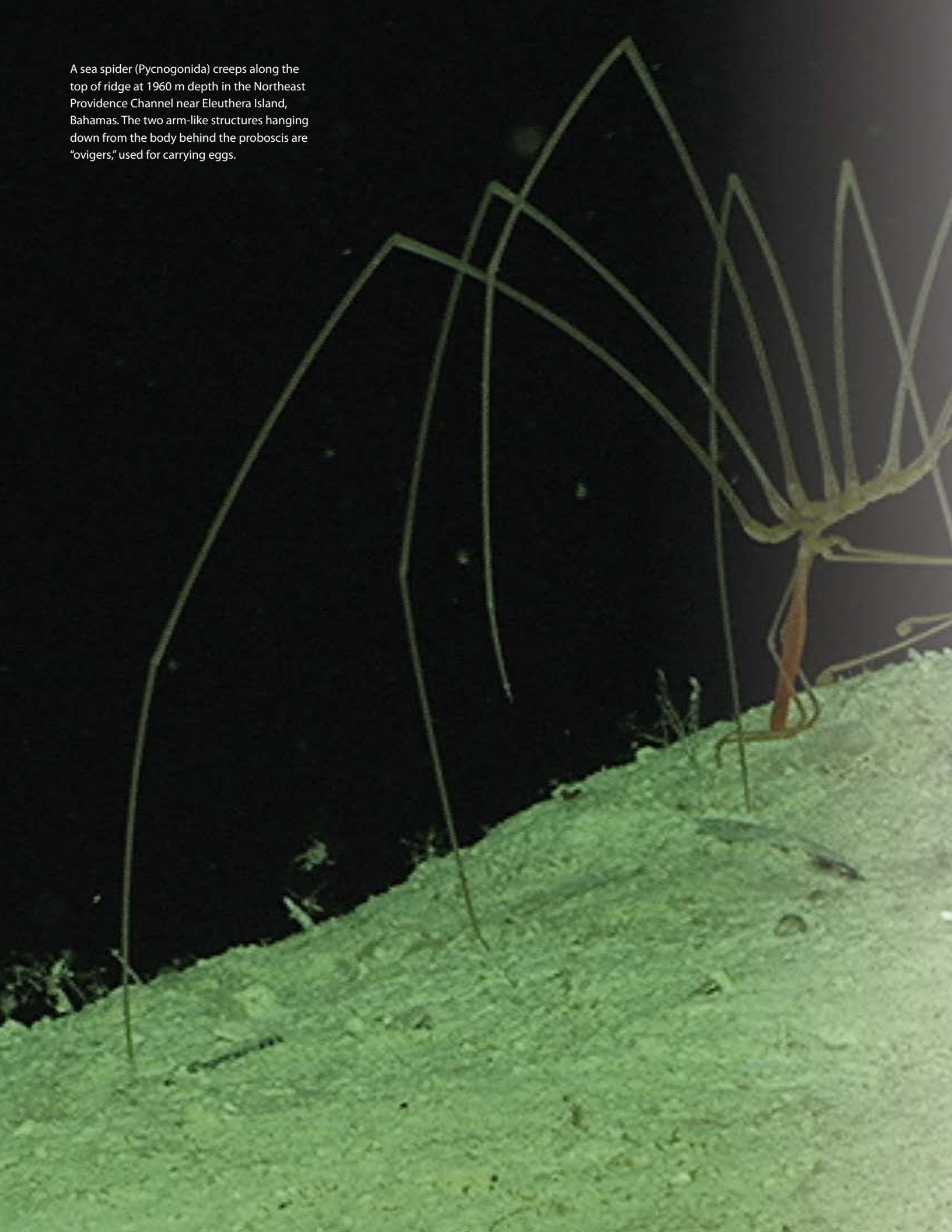
These deep-sea soft corals (Octocorallia: Alcyonacea) sometimes go by the common name "mushroom coral." As with other cnidarians, the mushroom coral has stinging cells or nematocysts within its flashy tentacles that are used to capture minute prey.

- 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.
 - 6.3 Incorporate information on deep-sea coral and sponge ecosystems into formal educational materials and lesson plans.
- Recommendations for expanding education and outreach activities.
 - 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 collections performed.

Anticipated products from these efforts will include:

- Outreach materials that increase the understanding of the public and key stakeholder groups about deep-sea coral and sponge ecosystems and their conservation.

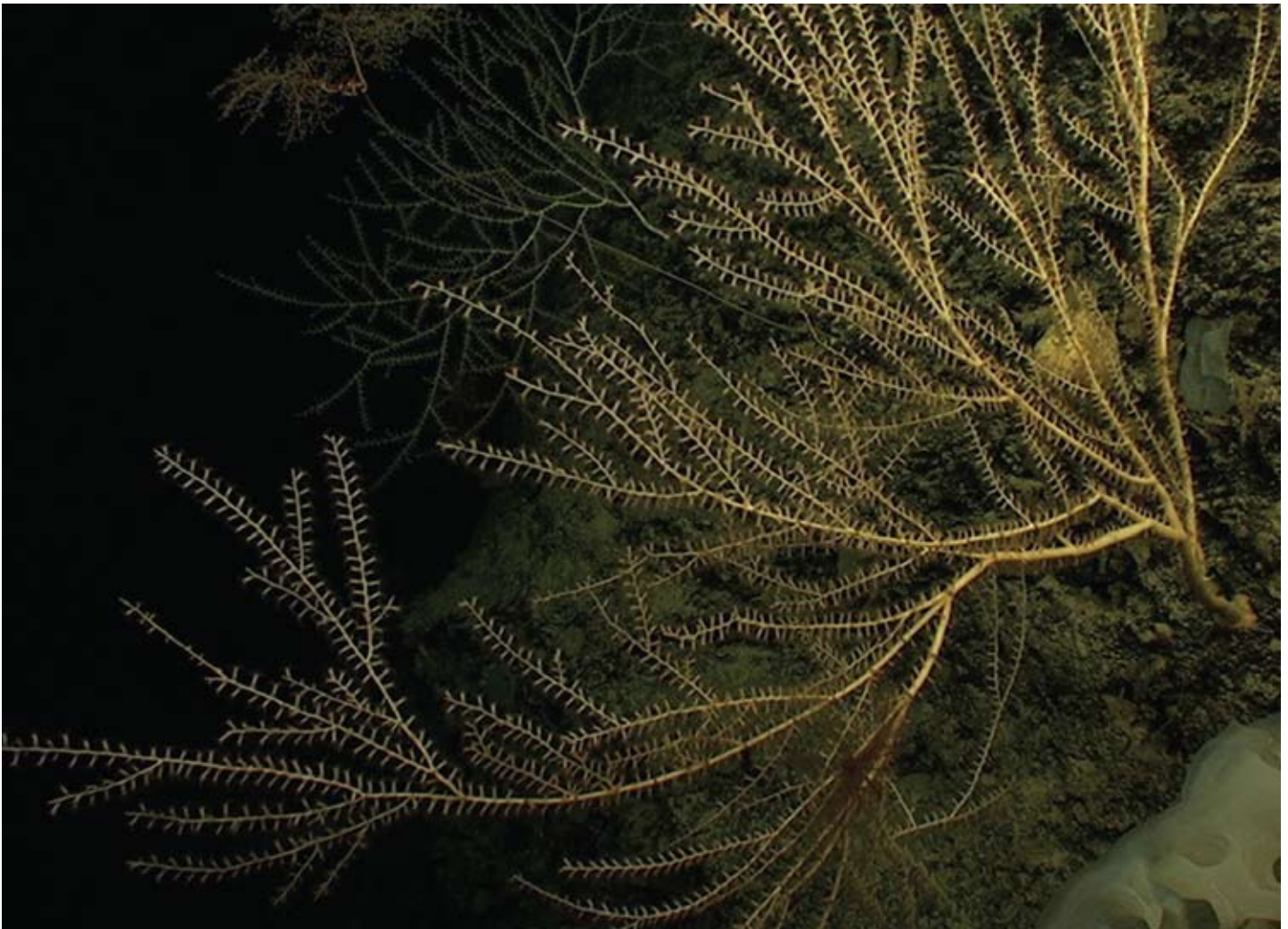
A sea spider (Pycnogonida) creeps along the top of ridge at 1960 m depth in the Northeast Providence Channel near Eleuthera Island, Bahamas. The two arm-like structures hanging down from the body behind the proboscis are "ovigers," used for carrying eggs.



III. International Strategy

NOAA's 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 deep-sea fisheries 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 exploration and research of deep-sea coral and sponge ecosystems.



Large branching bamboo corals flank a delicate chrysogorgiid coral, *Metallogorgia melanotrichos*.

Because 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. Similar to domestic management issues, human activities in areas beyond national jurisdiction may also impact deep-sea coral and sponge ecosystems. Potential threats could include deep-sea bottom fishing, mining of cobalt-rich crusts on seamounts, deployment of submarine cables, and vessel discharges and anchoring. For non-fishery-based impacts, NOAA, where appropriate and in coordination and cooperation with other relevant government entities, will support U.S.

multilateral efforts to address the impacts of these activities. For high-seas bottom fisheries activities and international trade that have an impact on deep-sea corals and sponges, NOAA—in cooperation and consultation with the Department of State, Department of the Interior, and other relevant government agencies—will continue to participate in international fora to ensure the long term sustainability of coral and sponge resources. NOAA has and will continue to advance the United States' position on conserving and managing deep-sea ecosystems in these multilateral and bilateral arrangements.

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

The decline of near-shore fisheries and the advent of improved fishing vessel capacity have led to increased fishing efforts in the deep seas. In some cases, the rate of this expansion has surpassed our knowledge of bottom fisheries target species and their associated habitats. Many of these deep-sea fish species may be especially vulnerable to fishing pressures because of their slower rates of growth and reproduction. Furthermore, vulnerable benthic ecosystems, such as deep-sea corals, may take decades or longer to recover from the impacts of mobile bottom-tending gears.

The United States has been a leader internationally for the protection of vulnerable habitats from destructive fishing practices, as illustrated in President Bush's 2006 Memorandum to the Secretaries of State and Commerce. The memo highlights the importance of ending 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. In the memo, 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.

NOAA continues to support strong action to end destructive fishing practices on the high seas. Under the Magnuson-Stevens Fishery and Conservation Act (MSA), NOAA published the regulatory definition of Illegal, Unreported and Unregulated (IUU) fishing (72 Federal Register 18405-5, April 12, 2007), 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 Regional Fisheries Management Organizations or Arrangements (RFMO/As). The Department of Commerce is developing regulations to implement measures of the MSA that will seek to address IUU fishing, and will work closely with our international partners in its application.

To that end, 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 sustainable fisheries and oceans-related resolution that guides international policy and management on a range of marine issues. The 2006 UNGA sustainable fisheries resolution (A/Res/61/105) provides a framework for protecting VMEs such as seamounts, cold-water corals, and hydrothermal vents from significant adverse impacts of fishing on the high seas, as summarized in Box 3. States and RFMO/As, with guidance from the United Nations Food and Agriculture Organization (FAO), are currently developing, adopting, and implementing management measures to fulfill this mandate.

Currently, four RFMO/As have the competency to manage bottom fishing: the Northwest Atlantic Fisheries Organization (NAFO), North East Atlantic Fisheries Commission, South East Atlantic Fisheries Organization, and Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR). Of these, the United States is party to NAFO and CCAMLR. Through U.S. leadership, CCAMLR

Box 3. The 2006 UNGA Sustainable Fisheries Resolution (A/Res/61/105) calls upon 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 whether bottom fishing would cause significant adverse impacts to the VMEs and long-term sustainability of deep-sea fish stocks through, among other means, scientific research, data collection and sharing, and new and exploratory fisheries.
- Close areas to bottom fishing if VMEs are present or are likely to occur, 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.
- Make public the relevant measures adopted in accordance with resolution 61/105.

The resolution calls for RFMO/As to comply with these provisions by December 31, 2008, and for States participating in negotiations to establish new RFMO/As to regulate bottom fisheries to expedite such negotiations and, no later than December 31, 2007, to adopt and implement interim measures that comply with these provisions. 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 (A/Res/62/177) reaffirmed the call for RFMO/As and flag States to implement these measures.



Whip-like black coral, *Stichopathes* sp.



White ruffle sponge, *Ferrea* sp., blankets large areas at or near the crest of Davidson Seamount.



Brittle stars are invertebrates often associated with deep-sea corals.

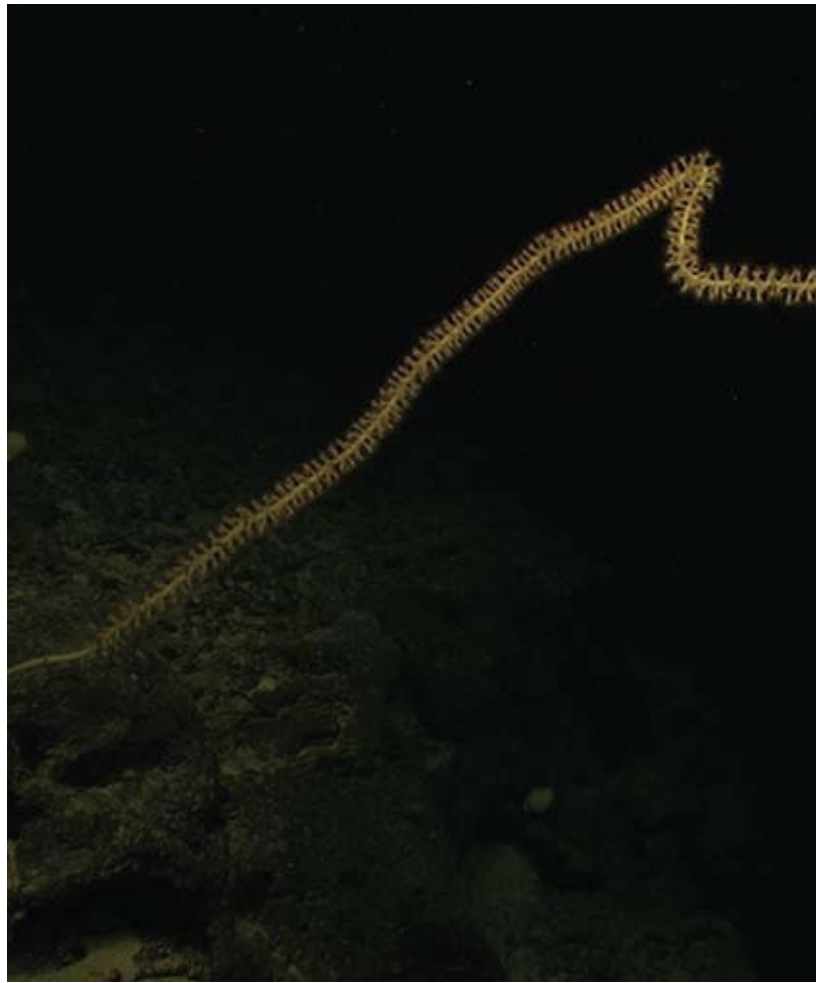
and NAFO in 2008 adopted, and have since implemented, conservation and management measures consistent with UNGA resolution A/Res/61/105, including the identification of VMEs; assessment of bottom fishing activities and the adoption of subsequent management measures, if necessary to prevent significant adverse impacts; and the cessation of bottom fishing if evidence of a VME is encountered.

The United States is currently participating in negotiations to establish new RFMO/As to manage bottom fisheries in the Northwest Pacific and the South Pacific. In 2007, both organizations agreed

to interim non-binding provisions that are fully consistent with UNGA resolution A/Res/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, Republic of Korea, and Russian Federation adopted these measures in February 2007 and refined them in October 2007. In the international consultations on the establishment of a South Pacific RFMO, participants—including Australia, the Russian Federation, Japan, New Zealand,



Deep-sea *Paragorgia* coral covered in zoanths and a sea star demonstrates the beauty and diversity of life on the New England Seamounts.



A whip-like colony of a bamboo coral extends more than 2 m from the face of a ledge at 1700 m depth.

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. Both organizations are currently in negotiations to develop final convention text, and permanent conservation and management measures.

The 2006 UNGA fisheries resolution identified a number of activities for FAO in support of States and RFMOs to protect VMEs and ensure sustainable deep-sea fisheries on the high seas. In August 2008, governments, fostered by 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 VMEs beyond areas under national jurisdiction and methods to determine 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.

Priority international activities under this objective, to be addressed in coordination and cooperation with the Department of State and other relevant government agencies, are:

- 1.1. Support the development and implementation of U.S. policies and management measures to end destructive fishing practices on the high seas.



Yellow Picasso sponge, *Staurocalyptus* sp.

- Update relevant regulations for U.S. flagged fishing vessels that would serve to protect VMEs on the high seas.
 - Develop regulations and measures relevant to MSA that address IUU fishing, working closely with our international partners.
- 1.2. Promote implementation of UNGA Sustainable Fisheries resolution A/Res/61/105 with the authority to regulate bottom fisheries and where the United States is a member.
 - 1.3. Support negotiations for the development of new RFMO/As where appropriate with the competence to regulate bottom fisheries and the implementation of interim measures to prevent significant adverse impacts on VMEs as outlined in UNGA resolution A/Res/61/105.
 - 1.4. Support FAO implementation of technical guidance and assistance to address significant adverse impacts of fishing on VMEs.
 - 1.5. Working in coordination and cooperation with the State Department, review progress in implementing the 2006 and 2009 UNGA fisheries resolutions.

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 could result in habitat damage and threats to the species. These threats have been recognized internationally, particularly for coral species used in the jewelry trade. The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is a multilateral agreement designed to ensure that international trade in specimens of wild animals and plants does not threaten their survival. Black corals have been listed in CITES Appendix II since 1981, and in 2008, three pink coral species (*Corallium* spp.) were listed by China under CITES Appendix III.⁶

The U.S. 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 United States as a consumer of coral products, it is in the national interest of the United States to ensure both sustainable collection and trade.

NOAA, in collaboration with other government agencies, promoted the addition of precious corals (*Corallium* spp.) under CITES Appendix II at the 15th Conference of the Parties, 2007 and 2010. Although these measures did not pass, NOAA will continue to work bilaterally and multilaterally to build support for their listing in the future. 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.

Priority international activities to meet this objective are:

- 2.1 Support CITES Appendix II listing for precious coral species (*Corallium* spp.).

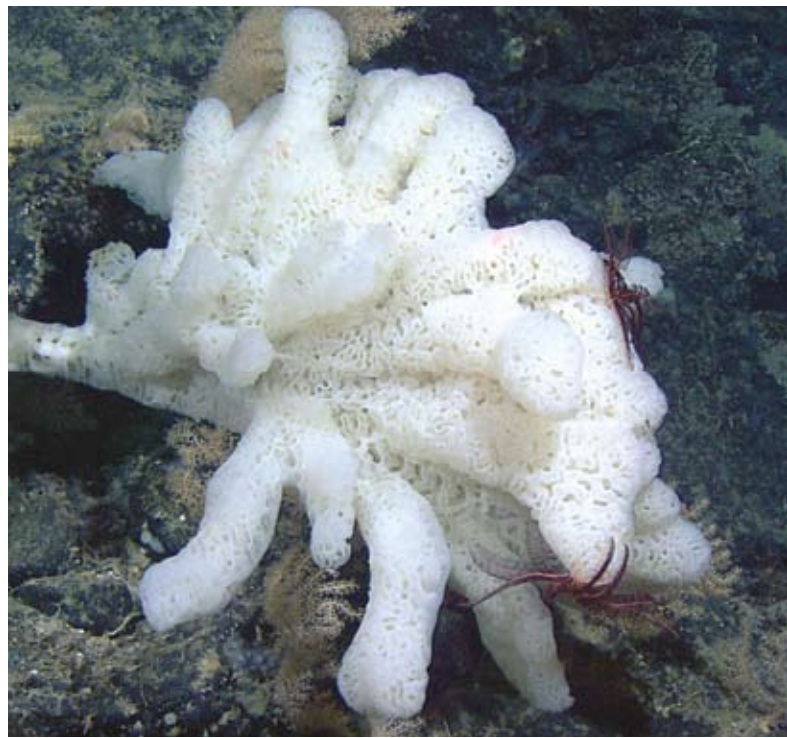


Pink coral necklaces for sale in Japan.

⁶ Under Appendix II, an export permit or re-export certificate issued by 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. Appendix III lists those species included by the request of a Party State needing help in regulating trade to prevent exploitation of that species.



The ROV *Jason* surfaces from a dive on a deep-sea coral research expedition.



A white sponge with purple crinoids.

3. INCREASE INTERNATIONAL EXPLORATION AND RESEARCH 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 exploration and research of deep-sea coral and sponge ecosystems. NOAA has made 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 protecting VMEs.

Priority international activities to meet this objective are:

- 3.1 Coordinate bilateral and multilateral exploration and research activities.
- 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 symposia, conferences, or other fora that facilitate information exchange.
- 3.4 Ensure that international research is shared and reflected in U.S. domestic and international management measures.
- 3.5 Support and participate in collaborative research on the identification of VMEs globally and the assessment of the impact of fishing on VMEs.

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Glossary

azooxanthellate	Lacking symbiotic photosynthesizing algae (zooxanthellae).
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).
bottom-tending gear	Gear that is towed (mobile bottom-tending gear) or rests (fixed bottom-tending gear) upon the bottom (seafloor) during fishing operations. Fixed bottom-tending gear includes traps or pots (either single or multiple), bottom-set gillnets (sink gillnets), and bottom-set longlines. Fixed gear rests on the bottom while fishing and may be pulled across the bottom for short distances during retrieval or storms. (See also mobile bottom-tending gear.)
bottom trawl	A type of mobile bottom-tending gear consisting of a cone- or funnel-shaped net that is towed through the water by one or more vessels and is designed to be dragged along the bottom in order to capture fish. This definition includes beam trawls (trawl with a fixed net opening utilizing a wood or metal beam), otter trawls (trawl with a net opening controlled by devices commonly called otter doors), and pair trawls (trawl dragged between two vessels). It does not include pelagic trawls that do not have chafe protection gear attached to the footrope or fishing line.
bycatch	Marine organisms harvested in a fishery but not sold or kept for personal use, includes economic discards and regulatory discards. In the context of this Strategic Plan bycatch 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, 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, structure forming	Any colonial, azooxanthellate corals generally occurring at depths below 50 m that provide vertical structure above the seafloor that can be utilized by other species. These include both deep reef-building stony corals (e.g., <i>Lophelia pertusa</i>), as well as individual branching colonies of corals (e.g., gorgonians and black corals). These are often referred to as habitat-forming deep-sea, deepwater, or cold-water corals.

deep-sea coral communities	Habitats formed by structure forming deep-sea corals and the other species associated with these habitats.
deep-sea sponge communities	Habitats formed by structure-forming deep-sea sponges and the other species associated with these habitats.
deep-sea sponge, structure-forming	Any sponges generally occurring at depths below 50 m that provide vertical structure above the seafloor and can occur at a density such that they can be utilized by other species.
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 is described and identified for federally managed fisheries species through fishery management plans prepared by the Regional Fishery Management Councils or NOAA.
fish	As defined by the Magnuson-Stevens Fishery Conservation and Management Act, "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 that can be treated as a unit for purposes of conservation and management and that 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).
mesophotic coral ecosystems	Mesophotic coral ecosystems are characterized by the presence of light-dependent corals and associated communities typically found at depths ranging from 30–40 m to over 150 m in tropical and subtropical regions. The dominant communities providing structural habitat in the mesophotic zone can be comprised of coral, sponge, and algal species.
mobile bottom-tending gear	Any fishing gear that is towed behind one or more vessels and is designed to be dragged along the bottom in order to capture fish. This includes non-pelagic trawl, dredge, or dinglebar gear, or other mobile gear that has chafe protection gear attached to the footrope or fishing line. (Also referred to as mobile bottom-contact gear.)
sponge	Any species in the Phylum Porifera generally occurring at depths below 50 m.
stressor	A physical, chemical, or biological factor that adversely affects organisms; an agent, condition, or similar stimulus that causes stress to an organism.

A. Appendix

NOAA Requirement and Policy Drivers with Specific Reference to Deep-Sea Corals

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

Statutory Authorities:

Magnuson-Stevens Fishery Conservation and Management Act (MSA 16 U.S.C. 1801 et seq.)

In 2006, the MSA was reauthorized. In reauthorizing the MSA, Congress added two sections that specifically reference management and research of deep-sea corals — Sections 303(b)(2)(B) and 408. Additionally, Congress amended the High Seas Driftnet Fishing Moratorium Protection Act to require the Secretary of Commerce, acting through NOAA, to issue a definition of Illegal, Unreported and Unregulated (IUU) fishing that includes fishing for cold-water 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

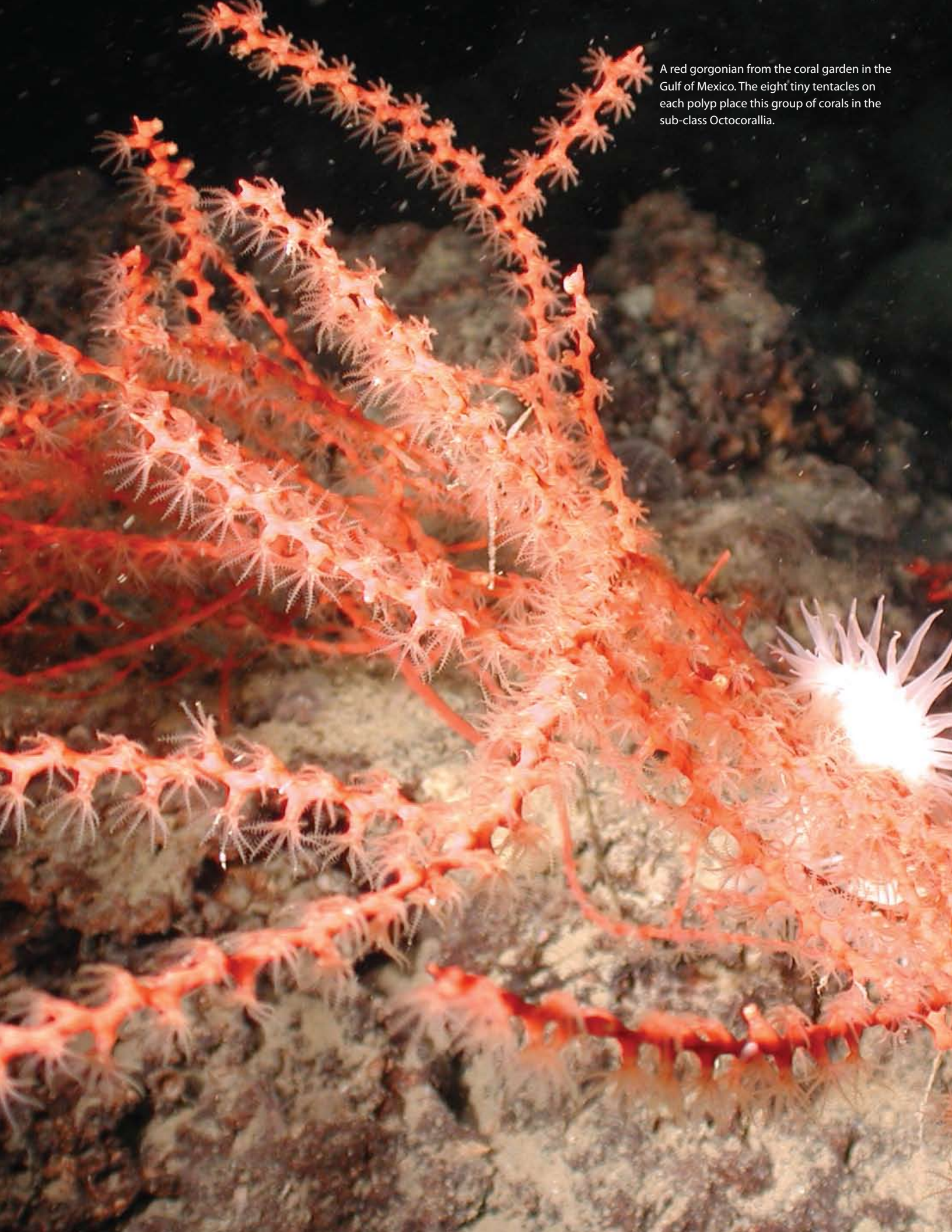
(e) Illegal, Unreported, or Unregulated Fishing Defined—

- (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 Drivers:

Presidential Memorandum on Promoting Sustainable Fishing and Ending Destructive Fishing Practices (2006)

On October 2, 2006, President Bush issued a memorandum directing the Secretaries of State and Commerce to work with other countries, international organizations, and Regional Fisheries Management Organizations and Agreements (RFMO/As) 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.”



A red gorgonian from the coral garden in the Gulf of Mexico. The eight tiny tentacles on each polyp place this group of corals in the sub-class Octocorallia.

B. Appendix

NOAA Authorities and Policy Drivers Relevant to Research and Conservation of Deep-Sea Coral and Sponge Ecosystems

The following is a list of major statutory authorities and Executive Orders (E.O.) or other policy drivers that apply to NOAA's research, conservation, and management of deep-sea coral and sponge ecosystems. A brief description for each authority and an explanation of its application to deep-sea coral and sponge ecosystems is included below.

Primary Authorities and Policy Drivers:

Magnuson-Stevens Fishery Conservation and Management Act (MSA, 16 U.S.C. 1801 et seq.)

The MSA establishes exclusive federal management authority over fishery resources of the exclusive economic zone. It is the principal Act governing U.S. fisheries policy. Fishery management plans (FMP) prepared by any Regional Fishery Management Council (Council) or NOAA under the MSA may, in some cases, require conservation and management measures for deep-sea corals and sponges. The MSA requires FMPs to include conservation and management measures that, to the extent practicable, (a) minimize bycatch and (b) to the extent that bycatch cannot be avoided, minimize the mortality of such bycatch, [Sec. 301(a)(9)]. In addition, the MSA requires FMPs to identify and describe essential fish habitat (EFH), and, to the extent practicable, to include management measures that minimize the adverse effects of fishing on EFH. FMPs must also identify other actions to encourage conservation and management of EFH [Sec. 305(b)].

In addition to the MSA bycatch and EFH provisions, Councils may have authority to include management measures for these habitats under the Act's discretionary provisions. The MSA authorizes Councils to designate zones for the protection of deep-sea corals [Sec. 303(b)(2)(B) – see Appendix A].

Councils may also include management measures in any FMP to conserve target and non-target species and habitats, considering the variety of ecological factors affecting fishery populations [Sec. 303(b)(12)].

National Marine Sanctuaries Act (NMSA Title III 16 U.S.C. 1431 et seq.)

The 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 National Marine Sanctuaries Program involves designating marine sanctuaries and adopting

management practices to protect the conservation, recreational, ecological, educational, and aesthetic values of these areas. The NMSA provides the authority to issue regulations addressing threats to the resources of individual sanctuaries or the entire system. Among other things, regulations control or prohibit specific types of activities known to harm resources. Sanctuary management plans guide day-to-day operations, which include programs for characterization, monitoring, research, education, outreach, enforcement, incident response, restoration, and training.

Presidential Memorandum on Promoting Sustainable Fishing and Ending Destructive Fishing Practices (2006)

On October 2, 2006, President Bush issued a memorandum directing the Secretaries of State and Commerce to work with other countries, international organizations, and Regional Fisheries Management Organizations and Agreements 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."

Presidential Proclamation: Establishment of the Northwestern Hawaiian Islands Marine National Monument (2006)

Presidential Proclamation 8031 established Papahānaumokuākea Marine National Monument, the single largest conservation area under the U.S., and one of the largest marine conservation areas in the world, encompassing 139,797 square miles in the Pacific Ocean. The Marine National Monument contains deep-sea coral and sponge resources, as well as extensive shallow coral reefs.

Presidential Proclamations: Establishment of the Marianas Trench, Pacific Remote Islands, and Rose Atoll Marine National Monuments (2009)

Three separate proclamations were issued on January 6, 2009, establishing the Marianas Trench (Proclamation 8335), Pacific Remote Islands (Proclamation 8336), and the Rose Atoll (Proclamation 8337) Marine National Monuments. All three Marine National Monuments are located in the Pacific Ocean and are known, or are likely, to contain rich deep-sea coral and sponge resources.

Additional Relevant Authorities:

American Fisheries Act (P.L. 105-277)

The American Fisheries Act 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 and the Gulf of Alaska, the king and tanner crab fisheries in the BSAI, and the scallop fisheries off Alaska.

Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

CITES is a multinational agreement that entered into force in 1975 to prevent species from becoming endangered or extinct because of international trade. Under this treaty, countries work together to ensure that international trade in animal and plant species is not detrimental to the survival of wild populations by regulating the import, export, re-export, and introduction from the sea of certain animal and plant species. The goal is to ensure that international trade in specimens of wild animals and plants does not threaten their survival. The United States became a Party to CITES in 1975 and implements it through the Endangered Species Act. Three pink coral species (*Corallium* spp.) are listed by China under Appendix III.

Deep Seabed Hard Mineral Resources Act (30 U.S.C. 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.

Endangered Species Act (16 U.S.C. 1531 et seq.)

The Endangered Species Act requires that the Secretary of Commerce list any species threatened with extinction in all or a significant portion of its range and designate critical habitat for that species. At this time, no deep-sea corals or sponges are listed as threatened or endangered under the Act; however, *Oculina varicosa* has been identified as a “species of concern” by NOAA. Endangered Hawaiian monk seals, *Monachus*

schauinslandi, are known to forage in beds of precious coral below 300 m, which are habitat for known prey items such as eels. The Endangered Species Act also serves as the implementing legislation for U.S. participation in CITES.

Executive Order 13158: Marine Protected Areas

E.O.13158 is intended to strengthen management and protection of marine protected areas (MPAs). The E.O. requires the Secretaries of Commerce and the 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 E.O. also requires each federal agency to take appropriate steps to enhance protection for existing MPAs or to recommend, if appropriate, new MPAs.

Fish and Wildlife Coordination Act (16 U.S.C. 661-666e)

The Fish and Wildlife Coordination 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 is coordinated with other aspects of water resources development.

Government Performance and Results Act of 1993 (31 U.S.C. 1115 et seq.)

The Government Performance and Results Act holds federal agencies accountable for using resources wisely and achieving program results. The Act requires agencies to develop plans for what they intend to accomplish, measure how well they are doing, make appropriate decisions based on the information they have gathered, and communicate information about their performance to Congress and the public.

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

The High Seas Driftnet Fishing Moratorium Protection Act guides U.S. implementation associated with the United Nations resolutions and decisions establishing and reaffirming a global moratorium on large-scale driftnet fishing on the high seas. It defines illegal,

unreported and unregulated (IUU) fishing and prohibits the United States from entering into international agreements that would prevent the full implementation of the moratorium. In 2006, the MSA amended the definition of IUU fishing to include “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.”

High Seas Fishing Compliance Act (16 U.S.C. 5501 et seq.)

The High Seas Fishing Compliance Act implements the Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas, adopted by the Conference of the United Nations Food and Agricultural Organization in 1993, and establishes a system of permitting, reporting, and regulation for vessels of the United States fishing on the high seas. Any regulations governing U.S. flagged vessels designed to implement protection of vulnerable marine ecosystems on the high seas would be implemented under this Act.

National Environmental Policy Act (42 U.S.C. 4321 et seq.)

The National Environmental Policy Act 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 the Act’s requirements, federal agencies prepare a detailed Environmental Impact Statement and are required to consult with and obtain the comments of any federal agency having jurisdiction by law or special expertise with respect to any environmental impact involved.

NOAA Undersea Research Program Act of 2009

(P.L. 111-11, Title XII, Subtitle A, Part II)

The NOAA Undersea Research Program Act of 2009 authorizes NOAA to conduct research, exploration, education and technology programs based on national and regional undersea research priorities; develop, test, and transition advanced undersea technologies associated with ocean observatories, submersibles, advanced diving technologies, remotely operated vehicles, autonomous underwater vehicles, and new sampling and sensing technologies; and conduct studies on natural resources and products from the sea.

Ocean Exploration Act (P.L. 111-11, Title XII, Subtitle A, Part I)

The Ocean Exploration Act authorizes NOAA to conduct interdisciplinary voyages or other scientific activities to explore and survey little-known areas of the marine environment; inventory, observe, and assess living and nonliving marine resources; and enhance the technical capability of the U.S. marine science community by promoting the development of improved oceanographic research, communication, navigation, and data collection systems, as well as underwater platforms, sensors, and autonomous underwater vehicles. The Act gives priority attention to deep ocean regions, with a focus on deep-water marine systems that hold potential for important scientific discoveries.

Ocean Thermal Energy Conversion Act (42 U.S.C. 9101 et seq.)

With regard to alternative energy sources from the ocean, the Ocean Thermal Energy Conversion Act (OTEC) established a licensing program for facilities and plantships that would convert thermal gradients in the ocean into electricity. The Act directed the Administrator of NOAA to establish a stable legal regime to foster commercial development of OTEC. The Act also assigned responsibilities to the Secretary of the department in which the U.S. Coast Guard is operating, the Secretary of State and the Secretary of Energy regarding OTEC plants. There has been a low level of activity under the Act since its passage in 1980.

C.Appendix

Linkages between Exploration & Research and Conservation & Management Objectives

Conservation and Management Objectives	Exploration and Research Objectives					
	1. Locate and characterize deep-sea coral and sponge ecosystems	2. Understand biology and ecology of deep-sea corals and sponges	3. Understand biodiversity and ecology of deep-sea coral and sponge ecosystems	4. Understand impacts		5. Understand past oceanic conditions and predict impacts of climate change using deep-sea corals
				Fishing	Other human activities	
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 approaches	X	X	X	X		
4. Enhance conservation in National Marine Sanctuaries & Marine National Monuments	X	X	X	X	X	X
5. Address impacts of non-fishing activities	X	X	X		X	X
6. Outreach and coordinated communications	X	X	X	X	X	X

<http://coralreef.noaa.gov/>

