Agenda Item E.1
Situation Summary
November 2010

CURRENT HABITAT ISSUES

The Habitat Committee (HC) will meet on Wednesday and Thursday, November 3-4, 2010. At this meeting, the HC will discuss salmon, groundfish, and coastal pelagic species essential fish habitat, ecosystem-based management, and other issues. In addition, the HC has prepared a letter to the Bureau of Reclamation (BOR) asking for clarification of some issues related to Central Valley water issues in preparation for a presentation from the BOR to the HC in March 2011. That letter is attached (Attachment 1).

Council Action:

1. **Consider comments and recommendations developed by the HC at its November 2010 meeting.**

Reference Materials:

1. Agenda Item E.1.a, Attachment 1: Letter to Bureau of Reclamation.
2. Agenda Item E.1.b, Supplemental HC Report.

Agenda Order:

a. Agenda Item Overview **Jennifer Gilden**
b. Report of the Habitat Committee **Joel Kawahara**
c. Reports and Comments of Advisory Bodies and Management Entities
d. Public Comment
e. **Council Action:** Consider Habitat Committee Recommendations

PFMC
10/13/10

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Donald R. Glaser
Regional Director
Bureau of Reclamation
Mid-Pacific Regional Office
2800 Cottage Way
Sacramento, California 95825-1898

November 5, 2010

Dear Mr. Glaser:

The Pacific Fishery Management Council (Council) appreciated your July 2, 2010 response to our May 19, 2010 letter.

We would like to invite the Bureau of Reclamation (BOR) to attend our Habitat Committee meeting in March 2011 to facilitate further discussion of the b(2) water allocation and receive updated information from you. Council staff will contact you to schedule such a briefing.

In the interim, our Habitat Committee is revisiting the National Academy of Science Report and the b(2) water accounting details that you referenced. In preparation for that meeting, we would appreciate additional clarification from you on a few points:

1. 1. How, specifically, is BOR using b(2) water (or other tools) under the Central Valley Project Improvement Act (CVPIA) to improve conditions for smolts emigrating from their natal streams to the ocean? Will additional flows be utilized in the upcoming outmigration period (December 2010-June 2011) to improve in-river conditions? The Council is particularly concerned about the flow and temperature requirements of smolts transiting the Delta. What volume of water is allocated and when is it delivered, to assist safe passage? Does the BOR collect data to assess the effectiveness of BOR water management measures? Are adaptive management procedures in place to allow changes to enhance effectiveness?

2. 2. How is BOR implementing the reforms outlined in the 2008 independent review of the CVPIA fisheries program? We are interested in learning about the initiatives/projects that respond to this review and receiving a status update on each, a project contact, and a projected completion date.

3. Is b(2) water being used in a manner that will maintain the natural variability inherent in the flow regime? Such changes to the flow regime are critical cues to returning adults. Can you provide more details on adult-specific measures?

Thank you for any clarification that you can provide in the interim. We look forward to meeting

with you in March.

Sincerely,

HABITAT COMMITTEE REPORT ON CURRENT HABITAT ISSUES

Bureau of Reclamation Letter

The Habitat Committee (HC) discussed the letter to the Bureau of Reclamation (BOR) (Agenda Item E.1.a, Attachment 1) regarding water allocations in California's Central Valley. The letter is meant to allow the BOR adequate time to prepare responses to questions the HC plans to ask when the BOR presents to the HC next spring. Since it has taken a long time to arrange this meeting, the HC wants the BOR to know where to focus their attention during their presentation. The BOR is expecting this response letter, and it is timely, given how BOR operations will affect 2010/2011 Central Valley salmon spawners and emigrants. The HC did not make any edits to the letter in the briefing book.

Salmon Essential Fish Habitat

In September, the HC requested another opportunity to comment on the Pacific coast salmon essential fish habitat (EFH) five-year review process at this meeting. The HC discussed the need to augment the water quality information in the report, and the potential revision of the impassable barrier list based on the proposed implementation of fish passage projects. The Pacific coast salmon EFH five-year review Oversight Panel is accepting comments through December 3, 2010, and members of the HC will likely follow up on these issues and provide more specific information prior to that deadline.

In addition, it is unclear at this point to what extent EFH conservation recommendations will be addressed during this review process. However, it will be important to solicit assistance from agency and tribal representatives with expertise in salmon habitat whenever EFH conservation recommendations are revised or developed.

Groundfish Essential Fish Habitat

The HC received an update on the groundfish EFH five-year review from representatives from the National Marine Fisheries Service (NMFS) Northwest Fisheries Science Center, Northwest Region, and Council staff. Representatives from the two science centers, the regions and Council staff worked together to develop a proposal to the NMFS Office of Habitat Conservation to fund a position for a person to identify, gather, summarize, and develop a report on data that are relevant to the five-year review. The resulting report would focus on information that has become available since initial EFH designation in 2006, and would be made available prior to the Council soliciting proposals for additional EFH designations. If the funding proposal is successful, the schedule for awarding the grant would depend on the FY2011 Federal funding cycle, which is currently operating under a continuing resolution. NMFS expects to hear about the grant award early in 2011. In September, the HC and others asked the Council to consider postponing the request for groundfish EFH proposals until relevant and available new data are summarized, which would occur near the end of 2011.

The Groundfish EFH Review Committee is scheduled to meet on December 20th.

The HC recommends the two Science Centers actively ask agencies, tribes, academia and members of the public for data and references on groundfish EFH and hold this data in an online repository until, and if, a contractor is hired. The data could be used to refine descriptions of groundfish EFH, include descriptions of larval and juvenile distribution, seafloor mapping, etc. Creating a repository for this data would require minimal staff labor, as the data would not be processed or summarized at this stage.

The HC suggests that the potential contractor's report summarizing this data be submitted before the EFH process begins, so that it can be used to inform EFH proposals by individuals and organizations.

Olympic Coast National Marine Sanctuary Management Plan Review

The HC heard a presentation from Dr. Lisa Wooninck of the West Coast regional office of the National Marine Sanctuaries, and Mr. Joel Kawahara, Olympic Coast National Marine Sanctuary (OCNMS) Advisory Council, on the status of the OCNMS Management Plan Review. The OCNMS plans to issue a Federal Register notice of the draft management plan and draft National Environmental Protection Act (NEPA) analysis in mid-January 2011, with a 60-day comment period. The HC developed a process to generate a draft comment letter for Council consideration at the March 2011 meeting, allowing for comments on the draft documents to occur within one Council meeting.

The HC believes the draft documents will contain no regulatory changes or other plans that will immediately affect Council-managed fisheries. If this is the case, the Council may consider forwarding their comments within the 60-day review period. OCNMS is well aware of the request to allow for the 60-day comment period to cover a week past the March 2011 meeting to allow for Council staff to incorporate any changes to the draft comment letter developed by the HC.

Ecosystem Based Management

A discussion between some members of the Ecosystem Plan Development Team (EPDT) and HC occurred in October to explore how the HC could help the EPDT with their ecosystem management plan development.

As part of its approach, the EPDT plans to review each Fishery Management Plan (FMP) to determine where the plans already encompass ecosystem management measures. Because the HC looks at EFH across multiple plans, the HC can help by identifying overlapping EFH issues among the various FMPs, such as food web interactions, forage species, EFH threats, designated and potential HAPCs, and information gaps. The HC will begin cataloguing these items.

Mapping Trawl Activity off California

The HC received a presentation from Ms. Janet Mason of the Southwest Fisheries Science Center entitled "Mapping trawl activity off California." The analysis focused on mapping and characterizing trawl effort and locations of deep sea corals and sponges, and compared trawl activity during 1997-1999 with activity during 2006-2009. Main conclusion of the presentation was that the trawl footprint has not changed significantly in the time period, though trawl effort has decreased.

The HC found the presentation informational for purposes of the groundfish EFH five-year review and the deep sea coral and sponge research program. A broader coast-wide analysis of trawl effort beyond California is in its draft stages, and finalizing that analysis would be useful for the purposes of the EFH review.

PFMC
11/04/10

Agenda Item E.2
Situation Summary
November 2010

DEEPWATER CORAL INFORMATION REPORT

The National Oceanic and Atmospheric Administration Deep-Sea Coral Research and Technology Program (DSCRTP) conducted the first season of west coast deep-sea coral research during summer of 2010. This research is aimed at providing improved understanding of the distribution, density, abundance, and biology of corals and sponges; and ultimately will help to inform management decisions in west coast waters. NOAA allocated $800,000 in FY 2010 to this research. Two more years are planned, subject to available funding. The Council's Habitat Committee received a briefing on this topic in October, 2009; and Council staff attended a workshop in January, 2010, and provided input to the development of research priorities.

A representative of the National Marine Fisheries Service will provide a preliminary report on this year's research.

Council Action:

Council Discussion.

Reference Materials:

1. Agenda Item E.2.a, Attachment 1, West Coast Deep-Sea Coral Workshop Report.
2. Agenda Item E.2.a, Attachment 2, Report to Congress on Implementation of the Deep Sea Coral Research and Technology Program (Available electronically only, on the Council's website).
3. Agenda Item E.2.a, Attachment 3, NOAA Strategic Plan for Deep-Sea Coral and Sponge Ecosystems (Available electronically only, on the Council's website).
4. Agenda Item E.2.b, NMFS Report on 2010 deep-sea corals research off the U.S. West Coast.
5. Agenda Item E.2.c, Supplemental Habitat Committee Report.

Agenda Order:

a. Agenda Item Overview **Kerry Griffin**
b. Report on Recent Coral Research Activities **Elizabeth Clarke**
c. Reports and Comments of Advisory Bodies and Management Entities
d. Public Comment
e. Council Discussion

PFMC
10/18/10

NOAA Deep-Sea Coral and Sponge Ecosystems Exploration and Research Priorities Workshop for the U.S. West Coast

Portland, Oregon – January 20-21, 2010

Introduction

On January 20-21, 2010, scientists and resource managers met in Portland, Oregon to further define the exploration and research priorities laid out in the *NOAA Strategic Plan for Deep-Sea Coral and Sponge Ecosystems*, and to identify critical information needs for deep-sea coral and sponge ecosystems off the U.S. West Coast. The ultimate goal of the workshop was to identify steps to improve the understanding, conservation, and management of these ecosystems. Workshop participants represented a broad range of stakeholders including the Federal government, the Pacific Fishery Management Council, tribes, academia, private industry, and nongovernmental organizations (See Appendix C for a list of participants).

The NOAA Strategic Plan for Deep-Sea Coral and Sponge Ecosystems

The NOAA Strategic Plan for Deep-Sea Coral and Sponge Ecosystems identifies national-level goals, objectives, and approaches to guide NOAA's research, management, and international cooperation activities on deep-sea coral and sponge ecosystems for 2010 through 2019. The primary goal of the Strategic Plan is to improve the understanding, conservation, and management of deep-sea coral and sponge ecosystems. 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.

The Strategic Plan is divided into three sections: (I) Exploration and Research, (II) Conservation and Management, and (III) International Cooperation.

> Section I identifies the role of research in management, including NOAA's priorities and objectives for research and exploration of deep-sea coral 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, National Marine Sanctuaries (NMS), 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 and the National Marine Sanctuaries Act.

Section III describes NOAA's participation in international activities to protect and/or conserve deep-sea coral and sponge ecosystems.

The Strategic Plan provides guidance for all NOAA programs supporting research, management, and international cooperation activities on deep-sea coral and sponge ecosystems. Within NOAA, these activities are coordinated through the Coral Reef Conservation Program (CRCP), a matrix program consisting of four NOAA line offices – the National Ocean Service (NOS); National Marine Fisheries Service (NMFS); National Environmental, Satellite, and Data Information Service (NESDIS); and Office of Oceanic and Atmospheric Research (OAR).

NOAA, through the CRCP, will implement the national Strategic Plan by further refining the objectives and approaches stated therein to address issues at the regional level. This workshop focuses on further refining Section I: Exploration and Research of the Strategic Plan to identify critical information needs for the U.S. West Coast region, which encompasses waters under U.S. jurisdiction off the coast of the States of California, Oregon, and Washington.

About the Workshop

The goal of the workshop was to develop a three-year exploration and research priorities plan, commencing in Fiscal Year (FY) 2010 for deep-sea coral and sponge ecosystems off the U.S. West Coast that address resource management needs. Unfortunately, the timing of the workshop and the need to plan for FY 2010 did not coincide. Thus, the plan developed by the workshop participants will inform only FY 2011-2012. The workshop was organized by NOAA's CRCP and Northwest Fisheries Science Center. A Steering Committee consisting of representatives from NOAA (OAR, NMFS, and NOS) presided over the development of the workshop's goals, objectives, schedule, and final summary.

The workshop consisted of presentations highlighting national and regional plans; breakout groups to identify and refine critical information needs, and plenary discussions (See Appendix A: Workshop Agenda).

National and Regional Plans: To set the context for identifying critical information needs, several presentations were given to provide an overview of national and regional plans. The presentations included an overview of NOAA's Strategic Plan for Deep-Sea Coral and Sponge Ecosystems: Research, Management, and International Cooperation; research priorities identified in the State of the Deep Coral Ecosystems of the United States: 2007; Pacific Fishery Management Council Reports; priorities identified by the National Marine Sanctuaries on the West Coast for research on deep-sea corals; and the NMFS Habitat Assessment Improvement Plan. Additionally, an overview was provided on NOAA FY10 Plans for deep-sea coral and sponge research activities off the West Coast and the academically-driven bamboo corals and paleoclimate research off the U.S. West Coast.

Breakout Groups: On Day 1, workshop participants were divided into four separate breakout groups (See Appendix B for the Breakout Group Participation List) and tasked with identifying a list of critical information needs based on the NOAA Strategic Plan for Deep-Sea Coral and Sponge Ecosystems, information on the Reauthorized Magnuson-Stevens Fishery Conservation and Management Act that established the Deep Sea Coral Research and Technology Program and the National Marine Sanctuaries Act. Each group then presented their critical information needs list in plenary discussions and agreed on a "Top 10" list of critical information needs.

On Day 2, each breakout group was tasked with further refining the "Top 10" list by identifying and prioritizing activities for the list over the next three years. Two of the four groups assessed the odd numbered items on the "Top 10" list while the other two groups addressed the even numbered items on the "Top 10" list. Breakout groups identified activities based on whether they addressed a critical information need; addressed a management need; were financially feasible; and whether they had the potential for leveraging funds and/or collaborating with other funded programs.

Plenary Discussions: During plenary sessions on Day 1, workshop participants were provided the opportunity to discuss, refine, and prioritize critical information needs identified by the individual breakout groups. The participants narrowed the critical information needs down to ten items and to determine the highest priority, each participant was given four dots and asked to place the dots on (or vote for) the critical information needs that they believed to be the highest priority. The results of the group prioritization exercise are in Table 1.

In plenary discussions on Day 2, workshop participants presented activities for the "Top 10 list. A summary of activities identified by participants is provided below under the NOAA Strategic Plan Objectives.

Table 1. Prioritized needs identified by the participants.

Critical Information Need	**Participants Prioritization (# of votes)**	**Addresses NOAA Strategic Plan for Deep-Sea Coral and Sponge Ecosystems Objective**
1) Identify deep-sea coral species distribution, abundance, densities, and diversity throughout the California Current Large Marine Ecosystem.	33	Locating and characterizing deep-sea coral and sponge ecosystems.
2) Determine the ecological roles of deep-sea corals and sponges (nature of associations between deep-sea corals and sponges and other species (invertebrates and fishes)).	29	Understanding the biodiversity and ecology of deep-sea coral and sponge ecosystems.
3) Understand the basic biology of deep-sea corals, including taxonomy, age structure, growth, gender, population connectivity, and life histories.	22	Understanding the biology and ecology of deep-sea corals and sponges.
4) Understand abiotic and biotic habitat	18	Locating and characterizing deep-

requirements and suitability (e.g., role of methane seeps); geologic context and drivers of deep-sea coral habitat; variables to be used as habitat proxies; and water-column - physical, chemical, and biological parameters of deep-sea coral habitats.		sea coral and sponge ecosystems.
5) Understand anthropogenic and natural impacts on deep-sea coral ecosystems. Develop baseline conditions (indices of health and condition at both species and community level).	17	Understanding the extent and degree of impacts caused by fishing and other human activities. Understand past oceanic conditions and predict the impacts of climate change using deep-sea corals.
6) Synthesize and understand existing information on deep-sea corals and develop a deep-sea coral data management plan.	10	Locating and characterizing deep-sea coral and sponge ecosystems. Understanding the biology and ecology of deep-sea corals and sponges. Understanding the biodiversity and ecology of deep-sea coral and sponge ecosystems. Understanding the extent and degree of impacts caused by fishing and other human activities. Understand past oceanic conditions and predict the impacts of climate change using deep-sea corals.
7) Understand deep-sea corals' ability to recover from a variety of stressors.	7	Understanding the extent and degree of impacts caused by fishing and other human activities. Understand past oceanic conditions and predict the impacts of climate change using deep-sea corals.
8) Utilize deep-sea corals to discern past climate conditions.	6	Understand past oceanic conditions and predict the impacts of climate change using deep-sea corals.
9) Evaluate the efficacy of existing management measures.	4	Understanding the extent and degree of impacts caused by fishing and other human activities
10) Improve tools and methods for studying deep-sea corals (develop new technologies and applications for existing technologies in novel ways and develop best practices for deep-sea coral research).	4	Locating and characterizing deep-sea coral and sponge ecosystems. Understanding the extent and degree of impacts caused by fishing and other human activities

Critical Information Needs

During the two-day workshop, considerable progress was made to identify and prioritize exploration and research information needs. Each participant was placed in one of the four breakout groups. The product from each breakout group consisted of a list of critical exploration and research information needs and activities to be conducted to address those needs. In plenary sessions, workshop participants prioritized the critical information needs and discussed activities (see section on plenary discussions for information on how the prioritization was done). The three highest priorities identified by the participants were:

- Identify deep-sea coral species distribution, abundance, densities, and diversity throughout the California Current Large Marine Ecosystem (LME).
- Determine the ecological roles of deep-sea corals and sponges (nature of associations between deep-sea corals and sponges and other associate species (invertebrates and fishes)).
- Understand the basic biology of deep-sea corals, including taxonomy, age structure, growth, gender, population connectivity, and life histories.

In addition to the list of "Top 10" critical information needs, participants at the workshop recognized during initial group discussions that the inventorying and analysis of existing data was a critical need and in many instances a requirement to adequately address the critical information needs. Participants identified the need for better cooperation in sharing data, the importance of making others aware of the expertise and resources available within the region, suggested steps be taken in order to catalog existing information, and agreed that it was critical for NOAA to have a person with geographical information systems (GIS) and database skills, as well as an understanding of deep-sea corals to assist with the coordination of regional activities. Workshop participants also agreed that climate change and ocean acidification are a serious threat, but lacked the expertise at the workshop to fully address this need.

The following section represents a summary of the critical information needs developed by the participants. The section presents NOAA's Strategic Plan for Deep-Sea Coral and Sponge Ecosystems objectives for exploration and research; lists the "Top 10" critical information needs identified by the workshop participants as they relate to that objective to help NOAA meet its overarching goals; and describes activities identified by the workshop participants needed to implement the critical information need.

NOAA Strategic Plan Objective #1: Locating and characterizing deep-sea coral and sponge ecosystems

The Pacific waters off the States of Washington, Oregon, and California are part of the California Current LME. Records of deep-sea corals in the region come from a variety of sources including taxonomic literature, catch records from regional bottom trawl surveys, bycatch data collected by fishery observers and observations from underwater vehicles [i.e. submersibles, remotely operated vehicles (ROVs) and autonomous underwater vehicles (AUVs)] with varying degrees of reliability. However, only small portions of the coast have been adequately mapped and characterized.

Given the limitations of existing information off the U.S. Pacific coast, it is clear that more targeted data collections and mapping efforts are needed. Because many collections are made from long trawls that can traverse several habitats, it is impossible to determine specifically the habitat from which these species were collected. Therefore, to date, it is difficult to map corals at the regional scale showing the appropriate habitat associations.[1]

Critical Information Needs:

Workshop participants identified the following critical information needs as they relate to this NOAA objective.

- 1) Identify deep-sea coral species distribution, abundance, densities, and diversity throughout the California Current LME.
- 4) Understand abiotic and biotic habitat requirements and suitability (e.g., role of methane seeps); geologic context and drivers of deep-sea coral habitat; variables to be used as habitat proxies; and water-column - physical, chemical, and biological parameters of deep-sea coral habitats.
- 6) Synthesize and understand existing information on deep-sea corals and develop a deep-sea coral data management plan.
- 10) Improve tools and methods for studying deep-sea corals (develop new technologies and applications for existing technologies in novel ways and develop best practices for deep-sea coral research).

Activities:

Workshop participants identified the following activities as they relate to this NOAA objective.

[1] Introductory material was taken, with slight modifications, from the Pacific Coast Chapter of the *State of Deep Coral Ecosystems of the United States: 2007*.

Mapping and site characterization:

1. Document deep-sea coral distribution, abundance, densities, and diversity.
    - Inventory existing data including trawl surveys, observer bycatch data, underwater observations (from submersibles, towed cameras, ROVs and AUVs), museum records, and records from marine debris removal programs.
    - Conduct field surveys.
        - The size of the California Current LME should be broken down into smaller subregions based on oceanographic features to ensure that efforts are spread evenly throughout the LME:
            1. Southern California to Point Conception;
            2. Point Conception to Monterey Bay;
            3. Monterey Bay to Point Arena;
            4. Point Arena to Columbia River; and,
            5. Columbia River to British Columbian border with Washington.
        - Depth range of surveys should cover from 50 meters to 2,000 meters and be further divided by technology limitations into:
            1. Upper shelf slope (including upper parts of canyons); and
            2. Deeper water areas (offshore seamounts)
        - Site selection should consider the following criteria:
            1. Is it within a sanctuary?
            2. Do benthic habitat maps already exist?
            3. Are there known abiotic variables (i.e. substrate types or bottom currents)?
            4. Is it a sensitive area?
            5. Does it have the potential to be a long-term monitoring site?

NOAA Strategic Plan Objective #2: Understanding the biology and ecology of deep-sea corals and sponges

Several coral taxa in the region are designated as "habitat forming," meaning they are known to provide vertical structure above the seafloor that can be utilized by other invertebrates or fish. Off the West Coast of the continental U.S. the deep-sea corals known to have the highest overall rating of structural importance and abundance are *Lophelia pertusa, Antipathes dendrochristos, Paragorgia arborea,* and *Primnoa pacifica.* Information on the relative abundance of these coral species were compiled from taxonomic records, in situ photographic surveys, and to a lesser extent bottom trawl surveys. [2]

Critical Information Needs:

Workshop participants identified the following critical information needs as they relate to this NOAA objective.

- 3) Understand the basic biology of deep-sea corals, including taxonomy, age structure, growth, gender, population connectivity, and life histories.
- 6) Synthesize and understand existing information on deep-sea corals and develop a deep-sea coral data management plan.

Activities:

Workshop participants identified the following activities as they relate to this NOAA objective.

Biology:

1. Describe the basic biology or life history of structure-forming corals including taxonomy, age structure, growth, reproduction, and population connectivity.
2. Develop taxonomic experts to identify and classify specimen on regional surveys.
3. Standardize surveys and sample collections for comparability.
   - Utilize the NOAA coral collection protocols.
4. Compare the basic biology of West Coast *Lophelia* with that of the Southeast.
5. Conduct genetic analysis of samples.
6. Determine the abiotic and biotic habitat requirements and suitability.
   - Determine variables to be used as deep-sea coral habitat proxies.
   - Identify the physical, chemical, and biological parameters of deep-sea coral habitats.
7. Collect oceanographic conditions with in situ instrumentation (e.g. benthic landers).

[2] Introductory material was taken, with slight modifications, from the Pacific Coast Chapter of the *State of Deep Coral Ecosystems of the United States: 2007*.

NOAA Strategic Plan Objective #3: Understanding the biodiversity and ecology of deep-sea coral and sponge ecosystems.

Several studies both in the region and elsewhere in the north Pacific report fine-scale associations between demersal fishes, deep-sea corals and other structure-forming invertebrates and some studies have even investigated the nature of those relationships. Because little is known about the nature of relationships between deep-sea corals, other invertebrates and demersal fishes off the Pacific coast, there is a need to quantify those relationships. To date, few studies in the region have examined the nature of relationships between deep-sea corals, other structure-forming invertebrates and fishes, though analysis of recent surveys is ongoing. In order to evaluate the importance of deep-sea corals to their benthic communities, future in situ surveys will need to incorporate a more holistic investigation of species relationships and habitat characteristics. [3]

Critical Information Needs:

Workshop participants identified the following critical information needs as they relate to this NOAA objective.

- 2) Determine the ecological roles of deep-sea corals and sponges (nature of associations between deep-sea corals and sponges and other species (invertebrates and fishes)).
- 6) Synthesize and understand existing information on deep-sea corals and develop a deep-sea coral data management plan.

Activities:

Workshop participants identified the following activities as they relate to this NOAA objective.

Ecosystem Function:

1. Determine the ecological roles of deep-sea corals and sponges and their associations with other fish and invertebrates.
    - Conduct laboratory-based experiments, controlled experiments and field research to understand how deep-sea corals function as habitat.

[3] Introductory material was taken, with slight modifications, from the Pacific Coast Chapter of the *State of Deep Coral Ecosystems of the United States: 2007*.

NOAA Strategic Plan Objective #4: Understanding the extent and degree of impact caused by fishing and other human activities

Compared to other regions in the U.S., the Pacific coast from California to Oregon has a narrow continental shelf, which may result in deep-sea coral communities here being more susceptible to coastal activities. Bottom trawls are the most widely used fishing gear off the U.S. Pacific coast. They are used off Oregon and in federal waters off Washington and California to target numerous species of demersal fishes, shrimp, prawns, sea cucumbers and sea urchins. In addition, sedimentation caused by oil and gas development has been shown to be detrimental to deep-sea corals in the region. Other activities that may adversely affect deep-sea corals include coral harvesting, communication cables, and marine pollution. Unfortunately, the extent of impact from these activities varies and little is known about the potential recovery rates of deep-sea corals. [4]

Critical Information Needs:

Workshop participants identified the following critical information needs as they relate to this NOAA objective.

- 5) Understand anthropogenic and natural impacts on deep-sea coral ecosystems. Develop baseline conditions (indices of health and condition at both species and community level).
- 6) Synthesize and understand existing information on deep-sea corals and develop a deep-sea coral data management plan.
- 7) Understand deep-sea corals' ability to recover from a variety of stressors.
- 9) Evaluate the efficacy of existing management measures.
- 10) Improve tools and methods for studying deep-sea corals (develop new technologies and applications for existing technologies in novel ways and develop best practices for deep-sea coral research).

Activities:

Workshop participants identified the following activities as they relate to this NOAA objective.

Human Impacts:

1. Identify areas with existing baseline information.
2. Determine the footprint of the sources of impact (e.g., trawl fishery).
3. Evaluate the effectiveness of existing management measures.

[4] Introductory material was taken, with slight modifications, from the Pacific Coast Chapter of the *State of Deep Coral Ecosystems of the United States: 2007*.

    - Investigate recovery rates of deep-sea corals and their habitats from stressors including identification of areas with existing baseline data that have since been closed.
    - Validate closure areas adherence by mapping fishing effort.
    - Develop recovery potential models.
4. Establish baseline conditions and monitor sites.
    - Conduct comparative studies at disturbed and undisturbed sites of deep-sea corals.
5. Improve communication and coordination between federal state, tribes, and local agencies.
    - Define criteria for evaluating the need for management response.

NOAA Strategic Plan Objective #5: Understand the impacts of climate change and past oceanic conditions.

Evidence suggests that global climate change may pose other threats to deep-sea corals. Deep-sea corals are most likely feeding on suspended organic matter that rains down from the surface or is transported by currents. Because many of the organisms that comprise this source of organic material (e.g., coccolithophores, foraminiferans, pteropods) use carbonate to form protective shells, reduced carbonate concentrations (e.g. ocean acidification) may impact nutrient availability for deep-sea corals or their skeletal development. In addition, rising atmospheric carbon dioxide is increasing deep-sea water temperatures and altering salinities, which may in turn cause changes in thermohaline circulation. Because deep-sea corals have evolved in a steady-state, nutrient-rich environments, they may be particularly susceptible to such changes in environmental conditions. [5]

Critical Information Needs:

Workshop participants identified the following critical information needs as they relate to this NOAA objective.

- 5) Understand anthropogenic and natural impacts on deep-sea coral ecosystems. Develop baseline conditions (indices of health and condition at both species and community level).
- 6) Synthesize and understand existing information on deep-sea corals and develop a deep-sea coral data management plan.
- 7) Understand deep-sea corals ability to recover from a variety of stressors.
- 8) Utilize deep-sea corals to discern past climate conditions.

Activities:

Workshop participants identified the following activities as they relate to this NOAA objective.

Past Climate Conditions

1. Collect information on climate conditions that can be derived from deep-sea corals.
    - Provide deep-sea coral samples for analysis.

[5] Introductory material was taken, with slight modifications, from the Pacific Coast Chapter of the *State of Deep Coral Ecosystems of the United States: 2007*.

Conclusion

The Deep-Sea Coral and Sponge Ecosystems Exploration and Research Priorities Workshop provided an opportunity for scientists and resource managers to identify and prioritize critical information needs to increase our understanding of deep-sea coral and sponge ecosystems in the West Coast region. Workshop participates approached each critical information need and focused on applied research activities that would address current and future management needs.

Participants were mindful of developing activities on an appropriate timescale, building on existing known activities and developing collaborations. They discouraged focusing on manipulative experiments, remarking that those would be better suited for National Science Foundation proposals. In addition, participants agreed that projects should be distributed along the coast to both understand gradients such as north-south, and to include a variety of habitat types. Understanding connectivity and differences among places was also a recurring comment.

Workshop participants were not directed to develop critical information needs directly from NOAA's Strategic Plan for Deep-Sea Coral and Sponge Ecosystems (although it was provided as a guiding document), the "Top 10" list of critical information needs developed was very consistent with the Plan's Exploration and Research Objectives. Each critical information need correlated directly to at least one of the objectives of the Plan.

The information provided by the participants at the workshop is an initial step that will help to inform future budget allocations for the U.S. West Coast; ensure that research activities address management needs; maximize opportunities to utilize regional expertise; leverage and complement existing regional efforts; and share information on these habitats. The goal for future research activities will be to provide a better understanding on the location, distribution, ecosystem role, and status of deep-sea coral and sponge habitats.

Appendix A: Workshop Agenda

NOAA West Coast Deep-Sea Corals
Exploration and Research Priorities Workshop
January 20-21, 2010
Portland, Oregon
Agenda

GOAL:

- To develop a three year exploration and research priorities plan for deep-sea corals and sponges off the U.S. West Coast that addresses resource management needs.

OBJECTIVES:

- Review and understand existing exploration and research objectives for deep-sea coral and sponge ecosystems.
- Identify critical exploration and research information needs.
- Develop a concise description of priority activities that will address those needs.

DAY 1 – Activities and Objectives

8:00	Registration
8:30	Welcome, Meeting Logistics, and Review of Agenda (Elizabeth Clarke and Katie Watson)
9:00	Presentation on NOAA's Deep-Sea Coral Plan (Kacky Andrews)
9:30	Introduction on Existing Relevant West Coast Plans (Dani Lipski)
9:40	NOAA Strategic Plan for Deep-Sea Coral and Sponge Ecosystems (Robert Brock)
10:00	Review of West Coast Science Priority Plans (Elizabeth Clarke, Dani Lipski and Mary Yoklavich)
10:50	Break
11:00	Overview of NOAA 2010 West Coast Deep-Sea Coral and Sponge Research Activities (John Tomczuk)
11:30	Lunch

1:00	Presentation on Bamboo Corals and Paleoclimate Research (Howie Spero)
1:30	Discussion of Criteria for Identifying Critical Information Needs and Activities (Plenary)
2:00	Development of List of Critical Information Needs (Breakout Groups)
3:20	Break
3:30	Breakout Groups Present Critical Information Needs (Plenary)
4:10	Discussion of Prioritization of Information Needs (Plenary)
4:50	Review of Day 1 Accomplishments and Next steps (Plenary)
5:00	End of Day 1

DAY 2 – Activities and Objectives	
8:30	Summarize Day 1 and Review Day 2 Agenda (John Tomczuk)
9:00	Development of Exploration and Research List of Activities (Breakout Groups)
10:45	Break
11:00	Presentation of List of Exploration and Research Activities (Breakout Groups)
12:00	Lunch
1:30	Continued Presentation of List of Exploration and Research Activities (Breakout Groups)
2:30	Refinement of List of Activities (Plenary)
3:15	Break
3:30	Discussion of Refined Activities, Wrap Up and Next Steps (Plenary)
4:30	End of Workshop

Appendix B: Breakout Group Participation List

Group A	
NAME	AFFLIATION
Sandra Brooke	Marine Conservation Biology Institute
Rob Jones	Northwest Indian Fisheries Commission
Jennifer Kunzelman	NOAA Marine Fisheries Service
*Stacey Miller	NOAA Marine Fisheries Service
Jan Roletto	National Ocean Service
Howie Spiro	University of California, Davis
Mary Yoklavich	NOAA Marine Fisheries Service

Group B	
NAME	AFFLIATION
Erica Burton	NOAA Ocean Service
Jena Carter	The Nature Conservancy
Kerry Griffin	Pacific Fisheries Management Council
Lara Henry	University of South Florida
Brad Pettinger	Oregon Trawl Commission
Sean Rooney	Washington State University Vancouver
Joe Schumaker	Quinault Department of Fisheries
*Curt Whitmire	NOAA Marine Fisheries Service

Group C	
NAME	AFFLIATION
Ewann Bernston	NOAA Marine Fisheries Service
Ed Bowlby	NOAA Ocean Service
Robert Brock	NOAA Marine Fisheries Service
Peter Etnoyer	NOAA Ocean Service
Steve Joner	Makah Tribe
Brendan Roark	Texas A&M University
Steve Ross	University of North Carolina Wilmington
*Fan Tsao	NOAA Marine Fisheries Service

Group D	
NAME	AFFLIATION
Michele Culver	Washington Department of Fish and Wildlife
Lisa Etherington	NOAA Ocean Service
Chris Goldfinger	Oregon State University
Jennifer Hagen	Quileute Nation
Brian Tissot	Washington State University Vancouver
Jonathan Warrenchuk	Oceana
Gary Williams	California Academy of Sciences
*Timi Vann	NOAA Marine Fisheries Service

*Group Leaders

Appendix C: Participants List

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Agenda Item E.2.a
Attachment 2
(On CD and Website Only)
November 2010

Implementation of the Deep Sea Coral Research and Technology Program

2008 – 2009

NOAA

Report to Congress
February 2010

National Oceanic and Atmospheric Administration
U.S. Department of Commerce

This document was produced by the National Oceanic and Atmospheric Administration (NOAA), U.S. Department of Commerce, in consultation with Regional Fishery Management Councils, to fulfill requirements of the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006 (P.L. 109-479).

February 2010

NOAA CORAL REEF CONSERVATION PROGRAM

For more information about this report or to request a copy, please contact: NOAA's Coral Reef Conservation Program, National Marine Fisheries Service, Office of Habitat Conservation. 1315 East-West Highway, Silver Spring, Maryland 20910. Tel: 301-713-4300.

Or visit:

http://www.nmfs.noaa.gov/habitat/2010_deepcoralreport.pdf

Cover photo: A blackbelly rosefish and squat lobster associate with a deep-sea Lophelia *coral reef off the Southeast U.S.*
Photo Credit: S. Ross et al., NOAA/USGS DISCOVRE Cruise

Table of Contents

LIST OF MAPS

This report includes a series of maps showing known locations of structure-forming deep-sea corals in selected U.S. regions. These maps represent an initial data product of the Deep Sea Coral Research and Technology Program. These initial maps are presented in the report for illustrative purposes, and are not meant to be used for management purposes. Due to the resolution of these maps, a single point may include more than one record. The Program expects to begin analysis of the underlying data in 2010.

The data do not represent density of coral cover but rather known locations of coral that have been compiled by the Program to date and reported by different coral Orders. Compilation of existing data has just begun, so information on many orders is incomplete. Reported coral locations are limited to where fishing or research has occurred. Thus, areas where no corals are shown on a map may reflect either an absence of corals or an absence of sampling. The origin of data varies, including NMFS bottom trawl survey and fisheries observer program databases, fishery management council databases, research cruise results, museum collections and literature citations. A listing of the data sources for the regional maps is found at the end of this report.

The boundaries for the U.S. Exclusive Economic Zone shown on the maps are for illustrative purposes only and are not intended to reflect areas claimed by the U.S.

ABOUT THIS REPORT

In January 2007, the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006 (P.L. 109-479) was enacted, reauthorizing the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1801 et seq.) (MSA), and including a requirement to establish the "Deep Sea Coral Research and Technology Program." Section 408 (b) of the reauthorized Act tasked NOAA with submitting, in consultation with the Regional Fishery Management Councils, "biennial reports to Congress and the public on steps taken by the Secretary of Commerce to identify, monitor, and protect deep-sea coral areas, including summaries of the results of mapping, research and data collection performed under the program." The first Report to Congress (NOAA 2008) was submitted in 2008 (http://www.nmfs.noaa.gov/habitat/rtc.pdf). This is the second biennial report in fulfillment of that requirement.

In Fiscal Year (FY) 2009, NOAA's National Marine Fisheries Service (NMFS) received $1.5 million to begin implementation of the Deep Sea Coral Research and Technology Program. The Deep Sea Coral Research and Technology Program is being developed and implemented under the auspices of NOAA's Coral Reef Conservation Program and in collaboration with NOAA's NMFS; National Ocean Service (NOS); Office of Oceanic and Atmospheric Research (OAR); and National Environmental Satellite, Data, and Information Service (NESDIS); in consultation with the eight Regional Fishery Management Councils; and in coordination with other Federal agencies and educational institutions. This report summarizes activities initiated by NOAA with FY 2009 Deep Sea Coral Research and Technology Program funding.

In addition to the Deep Sea Coral Research and Technology Program, multiple NOAA programs, such as National Marine Sanctuaries, Ocean Exploration and Research, Fisheries Science Centers, Fishery Management Program, and the National Centers for Coastal Ocean Science, support exploration, research and managment activities critical to understanding and managing trust resources, including but not limited to deep-sea corals. Annual budget support for these complementary deep-sea coral activities varies based on programmatic priorities. This report provides a brief summary by region of the important research, conservation, and managment actions that have taken place since the first Report to Congress in 2008.

EXECUTIVE SUMMARY

This is the second biennial Report to Congress and the public on Implementation of the Deep Sea Coral Research and Technology Program, established under the authority of Section 408 of the Magnuson-Stevens Fishery Conservation and Management Act (MSA). The report, prepared by the National Oceanic and Atmospheric Administration (NOAA) in consultation with the Regional Fishery Management Councils, summarizes activities initiated with fiscal year (FY) 2009 Deep Sea Coral Research and Technology Program funding. It also briefly summarizes critical, complementary activities by other NOAA programs to support exploration, research and management of deep-sea coral ecosystems that have taken place since the first Report to Congress was submitted in 2008.

NOAA's Strategic Approach to Deep-Sea Coral and Sponge Ecosystems

In 2009, NOAA developed a *Strategic Plan for Deep-Sea Coral and Sponge Ecosystems: Research, Management, and International Cooperation* (NOAA, in review). The Strategic Plan addresses the requirements of the Deep Sea Coral Research and Technology Program, but is broader and covers all of NOAA's relevant mandates, programs and activities related to these ecosystems for FY 2010–2019. The primary goal of the Strategic Plan is to improve the understanding, conservation, and management of deep-sea coral and sponge ecosystems.

The Deep Sea Coral Research and Technology Program

In FY 2009, NOAA received $1.5 million to begin implementation of the Deep Sea Coral Research and Technology Program. The first year saw an integrated set of activities designed to inform the management of deep-sea coral ecosystems:

- The Program began a 3-year mapping and research effort in the Southeast United States, developed in consultation with the South Atlantic Fishery Management Council. New deep-sea coral areas were discovered during the first year's field season, providing new information relevant to the Council's proposed deepwater Coral Habitat Areas of Particular Concern (C-HAPCs).
- The Program began development of a national capability to manage data and information on deep-sea coral and sponge ecosystems.
- The Program supported smaller projects in most U.S. regions to analyze existing information that can inform management of U.S. deep-sea coral ecosystems, to analyze and map the distribution and intensity of fishing activities using gears that may damage deep-sea corals in Federal waters, and to develop methods to improve identification of coral and sponge bycatch in fisheries.

Complementary Activities to Identify, Monitor, and Protect Deep-Sea Coral Areas

The Congressional mandate for a Deep Sea Coral Research and Technology Program signaled recognition of the considerable work that multiple NOAA programs (e.g., National Marine Sanctuaries, Ocean Exploration and Research, Fisheries Science Centers, Fishery Management Program, and National Centers for Coastal Ocean Science) have conducted for years on these critical ecosystems. The Deep Sea Coral Research and Technology Program continues to leverage past and ongoing activities conducted by its NOAA partners. NOAA continues to work with the Regional Fishery Management Councils and numerous other partners to explore, study, and manage deep-sea coral ecosystems. These activities are implemented by other NOAA programs that build upon longstanding partnerships. Major actions that have taken place in 2008 and 2009 include the following:

- In September 2009, the South Atlantic Fishery Management Council recommended protection of five deepwater C-HAPCs. If approved by the Secretary of Commerce, this action will protect 24,215 square miles of habitat (twice the size of Maryland) containing the most extensive deep-sea stony coral reefs known in the northwest Atlantic.

- In the U.S. Pacific, three new Marine National Monuments were designated in 2009. Although largely unexplored, important deep-sea coral communities are expected to occur in these regions.

- In September 2008, NOAA Office of Ocean Exploration and Research, Minerals Management Service, and U.S. Geological Survey embarked on a 4-year effort to explore deep-sea coral sites in the deep Gulf of Mexico and characterize their biology, ecology, and genetic connectivity. In both 2008 and 2009, major expeditions involving scientists from various agencies and universities were conducted from NOAA ships.

- Habitat conservation efforts with the potential to provide significant protection to deep-sea coral communities are currently under development by the New England Fishery Management Council.

- NOAA is expanding national and international partnerships, including work with the Department of State, to implement a 2006 United Nations resolution to protect vulnerable marine ecosystems on the high seas from destructive fishing practices.

Next Steps

FY 2010 Activities: In FY 2010 Congress appropriated an additional $1 million, for a total of $2.5 million, for the Deep Sea Coral Research and Technology Program. The Program will continue the second year of field science activities in the Southeast United States, and initiate a new 3-year field science effort off the U.S. West Coast. Smaller-scale investments will be implemented in other U.S. regions, designed to address other requirements of the Program, including identifying the locations of deep-sea corals, monitoring activities at these locations, and performing associated data management.

Outreach to Councils: NOAA will also continue to extend its outreach efforts to engage with the Regional Fishery Management Councils. In particular, NOAA will further encourage the Councils to evaluate areas known to contain deep-sea corals for protection as allowed under discretionary provisions of the MSA.

Links to Ocean Policy: The Deep Sea Coral Research and Technology Program supports the implementation strategy outlined in the Interim Report of the Interagency Ocean Policy Task Force, particularly its emphasis on ecosystem-based management, comprehensive marine spatial planning, and regional ecosystem protection.

CHAPTER 1: INTRODUCTION

The first *Report to Congress on the Implementation of the Deep Sea Coral Research and Technology Program* (NOAA 2008) outlined the nature and importance of deep-sea coral communities and the threats they face. The Report also identified NOAA's authorities to study and manage these ecosystems and proposed an approach to implement the Deep Sea Coral Research and Technology Program (the Program) called for in Section 408 of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (see Appendix 1).

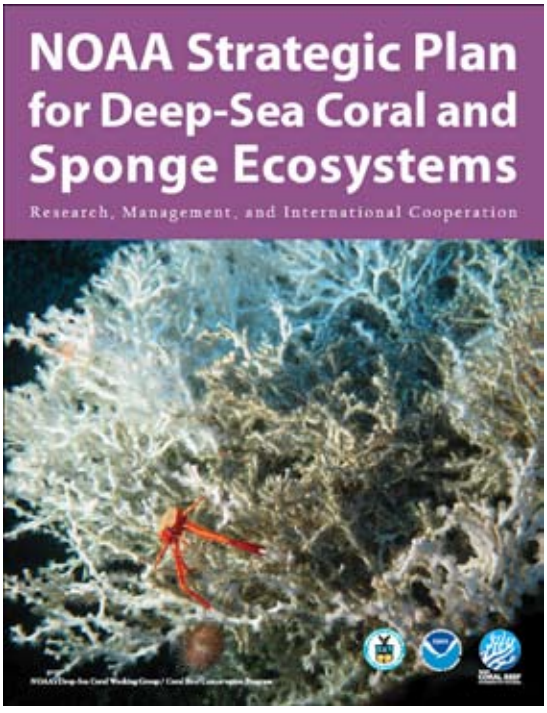
Building on the first report, this 2010 report identifies NOAA's strategic approach toward deep-sea coral and sponge ecosystems, and describes the first year of implementation of the Deep Sea Coral Research and Technology Program. The Report also briefly summarizes critical complementary activities funded by other NOAA programs and partners to support science and management of deep-sea coral ecosystems in 2008 and 2009 in each U.S. region. Lastly, the Report provides a brief update on important international conservation efforts in which NOAA has been a partner. NOAA's approach recognizes existing and emerging threats to these ecosystems (see Box 1) and builds partnerships to address them.

The major structure-forming coral taxa addressed in this report are outlined in Appendix 2. Further background on deep-sea coral ecosystems can be found in Roberts et al. (2009) and in the *State of Deep Coral Ecosystems of the United States* (Lumsden et al. 2007).

NOAA's Strategic Plan for Deep-Sea Coral and Sponge Ecosystems: Research, Management, and International Cooperation

In 2009, NOAA developed a *Strategic Plan for Deep-Sea Coral and Sponge Ecosystems: Research, Management, and International Cooperation* (NOAA, in review). The Strategic Plan identifies goals, objectives, and approaches to guide NOAA's research, management, and international cooperation activities on deep-sea coral and sponge ecosystems for FY 2010 – 2019. This plan integrates research and conservation needs and is intended 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.

The Strategic Plan addresses the requirements of the Deep Sea Coral Research and Technology Program, but is broader in scope and addresses all of NOAA's relevant mandates and programs. As such, this plan has the potential to influence a much larger realm of NOAA activities beyond the Program.



NOAA developed a strategic plan for deep-sea coral and sponge ecosystems in 2009.
Photo credit: S.W. Ross et al.

Box 1. Threats to Deep-Sea Corals

The *State of Deep Coral Ecosystems of the United States* (Lumsden et al. 2007) and the first Report to Congress (NOAA 2008) summarized knowledge on the major threats to deep-sea coral ecosystems in general, and to these ecosystems in each U.S. region in particular. These reports concluded that damage from bottom trawling was the greatest threat to deep-sea coral ecosystems in areas where trawling is allowed and overlaps deep-sea coral habitats. Fishing with other gear that contacts the bottom (e.g., traps and pots, bottom-set longlines, and bottom-set gill nets) was generally the next most serious threat.

Damage to deep-sea coral habitats by fishing gear continues to be a major concern. Such threats are manageable with appropriate gear restrictions in areas where corals are likely to occur. For example, the potential expansion of such fishing into deep-sea coral areas in the South Atlantic Fishery Management Council's jurisdiction would be significantly curtailed if the proposed Deepwater Coral Habitat Areas of Particular Concern (C-HAPCs) are implemented (see section 3.1).

Deep-sea coral ecosystems also may face adverse impacts from energy exploration and development, deployment of cables and pipelines, and other human activities that disturb the seafloor. Potential new activities or emerging threats with potential consequences for deep-sea corals include the following:

- Geographic expansion of the Outer Continental Shelf Oil and Gas Leasing Program, which could include new areas with significant deep-sea coral habitats.
- Deep-sea mining of cobalt-rich crusts on seamounts at depths where deep-sea corals occur.
- Ocean acidification due to increased atmospheric CO_2, which lowers the saturation states of the calcium carbonate minerals used to form supporting skeletal structures in many major groups of marine organisms, including corals. This change in ocean chemistry will reduce the ability of corals to produce calcium carbonate skeletons (calcification) and build reefs.

Red tree corals (Primnoa *sp.*) *are periodically caught in bottom trawl gear in Alaskan waters. This specimen was caught during the NOAA Fisheries groundfish stock assessment survey in Dixon Entrance, Gulf of Alaska.*
Photo Credit: R. Lauth, Alaska Fisheries Science Center

Table 1. Summary of Objectives from NOAA's Draft Strategic Plan for Deep-Sea Coral and Sponge Ecosystems: Research, Management, and International Cooperation

GOAL	OBJECTIVES
Exploration and Research	**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.
Conservation and Management	**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.
International Cooperation	**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.

The objectives under each of the three goals laid out in the Strategic Plan are shown in Table 1. The Exploration and Research goal identifies the role of research in management. NOAA's exploration and research on deep-sea coral and sponge ecosystems are designed to provide decision-makers with sound scientific information that will enable effective ecosystem-based management decisions. The Conservation and Management goal 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, National Marine Sanctuaries, 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 MSA and the National Marine Sanctuaries Act. Because NOAA, in partnership with the Regional Fishery Management Councils, is the Federal agency responsible for managing fisheries in the exclusive economic zone (EEZ), managing fishing threats to these ecosystems is one of the primary focuses of the Strategic Plan. The International goal describes NOAA's participation in international activities to study and conserve vulnerable marine species and ecosystems in the deep sea , including deep-sea coral and sponge ecosystems.

CHAPTER 2: DEEP SEA CORAL RESEARCH AND TECHNOLOGY PROGRAM – FISCAL YEAR 2009 ACTIVITIES

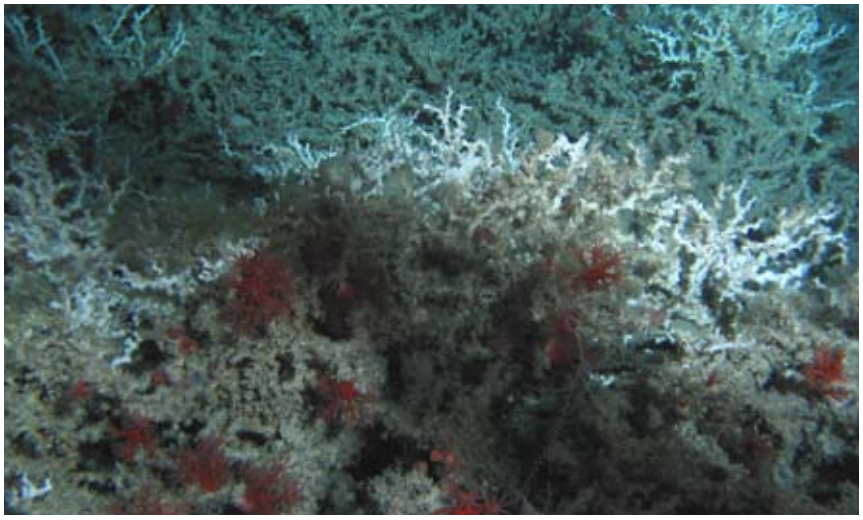
2.1 OVERVIEW

The Deep Sea Coral Research and Technology Program (the Program) is being implemented by NMFS, NOS, OAR, and NESDIS under the auspices of the NOAA Coral Reef Conservation Program. The Program is an integrated effort that consists of analysis and management of existing data and information as well as new field research and mapping initiatives.

Funding Provided to Implement the Deep Sea Coral Research and Technology Program in 2009

Funding to implement the inaugural year of the Deep Sea Coral Research and Technology Program totaled $1,500,000 in FY 2009. This funding came from a NOAA budget line item entitled Sustainable Habitat Management.

Table 2 lists the activities the Program initiated in 2009, along with the specific MSA provisions addressed. Individual activities are summarized in the following sections. Most Program activities have just begun implementation, so the summaries represent interim reports of results. Many of these projects leveraged significant outside funding and involved partners from other Federal agencies, nongovernmental organizations, and universities.



A Lophelia *reef explored in 2009 in the southeast U.S. Photo credit: S. Ross et al., NOAA/USGS DISCOVRE Cruise*

Table 2. Projects and activities funded to implement the Deep Sea Coral Research and Technology Program in FY 2009		
Project Title	**MSA Sec. 408 Provision**	**Funding Provided**
Field Research and Mapping of Deep-Sea Coral Ecosystems		
Southeast U.S. Deep-Sea Coral Research and Mapping	(a) 2, 4	$1,013,500
Southeast U.S. Deep-Sea Coral Research Priorities Workshop	(a) 1, 2, 4	$20,000
West Coast Research Coordination Workshop	(a) 1,2,4	$15,000
Database Development and GIS Analysis		
U.S. National Deep-Sea Coral Data and GIS Management	(a)1,2,3,4	$150,000
Enhancing the West Coast Regional Deep-Sea Coral Database	(a)1,2,3,4	$12,000
Projects to Inform Conservation through the Analysis of Existing Data and Information		
Deriving Deep-sea Coral and Sponge Distribution Data from Archived Video Records	(a) 1,2	$15,000
Analysis of AUV Sonar Data from Deepwater Coral Habitats off Eastern Florida	(a) 1,2	$15,000
Analysis and Distribution of Deepwater Commercial Fisheries Species (Golden Crab, Tilefish, Royal Red Shrimp) in Deepwater Coral Habitats off Eastern Florida	(a) 1	$10,000
Integrating Mapping and Fisheries Data for Deep-Sea Coral Habitats off South Carolina and Georgia	(a) 1,2	$15,000
Flower Garden Banks National Marine Sanctuary Deep Coral Investigations	(a) 1	$15,000
Deep-Sea Coral Community Research off California	(a) 1,2	$15,000
Using Cordell Bank as a Model to Conduct Fine-Scale Deep-sea Coral Predictive Habitat Modeling	(a) 1,5	$15,000
Analysis of Fishing Intensity and Deep-Sea Coral Bycatch		
Mapping the Intensity of Fishing in the Northeast Using Gears That May Damage Deep-Sea Corals	(a) 1,3	$30,000
Analysis of Fishing Intensity and Potential Deep-Sea Coral Impacts in the US South Atlantic and Gulf of Mexico Regions	(a) 1,3	$36,000
Mapping the Distribution and Intensity of Bottom Trawling Effort Along the California Coast from 1997 to 2008, with Impacts on Deep-Sea Corals	(a) 1,3	$32,637
Taxonomic and Genetic Identification of Fisheries Bycatch of Deep-Sea Corals during the 2009 West Coast Groundfish Bottom Trawl Survey	(a) 1,3,4	$40,243
A Field Guide to the Deepwater Sponges of the Aleutian Islands Archipelago	(a) 1,3	$20,750
Program Coordination	(a) & (b)	$28,370
Hollings Fellowship		$1,500
TOTAL		**$1,500,000**

2.2 FIELD MAPPING AND RESEARCH

Background

In FY 2009, NOAA began a 3-year mapping and research effort focused on the deep-sea coral ecosystems of the Southeast U.S. Activities completed during the first year addressed MSA requirements to locate and map locations of deep-sea corals (Sec. 408(a)(2)) and conduct research on deep-sea corals and related species (Sec. 408(a)(4)) – providing key information needed to protect deep-sea coral habitats in this region. A key component of the process was coordination with the South Atlantic Fishery Management Council (SAFMC) to determine specific areas to target and issues to address.

The Southeast U.S. (outer continental shelf and slope off the Carolinas to Florida: the SAFMC Region) was selected as the initial area for field operations under this national program based on the importance of its deep-sea coral habitats and the ability of the research to inform conservation efforts. The region contains the most extensive and well developed deep-sea stony coral reefs in U.S. waters, as well as an abundance of other coral habitats (e.g., gorgonians, black and gold corals).

Lophelia *reef surveyed on the 2009 submersible cruise.*
Photo Credit: S. Ross et al., NOAA/USGS DISCOVRE Cruise

The Johnson Sea Link submersible emerges with the microlander on the front.
Photo Credit: L. Baird, NOAA/USGS DISCOVRE Cruise

Box 2: How NOAA plans for field activities to study deep-sea corals under the Deep Sea Coral Research and Technology Program

Research on, and conservation of, deep-sea coral ecosystems has lagged behind similar efforts on shallower systems. There are a variety reasons for this, including that the extent of these ecosystems was generally unknown until the last 15 years. Also, these ecosystems are relatively inaccessible; research requires expensive, specialized equipment and presents logistical constraints not encountered in near-shore shallow zones.

In order to be effective with limited resources and to help ensure the Program has a significant conservation impact in a particular region, major investments (i.e., more than $750,000) in new deep-sea coral field research and mapping will be targeted to a single geographic area over at least a 3-year period. The rationale for this approach reflects the high cost of deep-sea field operations. The Program will expand into a new region after three years, or as additional funding becomes available. As noted above, smaller-scale investments will continue to support projects across the nation.

For FY 2009, the Southeast U.S. (South Atlantic Fishery Management Council Region) was chosen as the first focal area. In FY 2010, the Program expects to receive an additional $1,000,000, which will allow new field work initiatives to expand to a second region, notably the U.S. West Coast (Pacific Fishery Management Council Region).

The SAFMC has been proactive in working to conserve these areas by establishing deepwater Coral Habitat Areas of Particular Concern (C-HAPCs) where the use of all bottom-damaging fishing gear would be prohibited. The proposed areas encompass more than 24,000 square miles (> 60,000 km^2, about twice the size of Maryland) containing deep-sea coral ecosystems. Much of the fundamental science underpinning the proposed C-HAPCs was funded by NOAA programs over the past ten years. In addition, the SAFMC is also proposing designation of "allowable fishing areas" for the golden crab (*Chaceon fenneri*) and deepwater shrimp fisheries which occur within and in the vicinity of the C-HAPCs, respectively. However, accurate maps of the majority of these areas, including the locations of deep-sea coral habitats, do not currently exist and the SAFMC is particularly concerned with direct and indirect impacts from fishing activities on deep-sea coral ecosystems in the region.

Deep-Sea Coral Exploration and Research Priorities Workshop

In July 2009, NOAA convened a Deep-Sea Coral Exploration and Research Priorities Workshop for the Southeast U.S., in Wilmington, North Carolina, where scientists and resource managers identified and prioritized critical information needs to improve our understanding of deep-sea coral and sponge ecosystems to help inform management. The workshop helped NOAA ensure that the research activities address management needs, maximize opportunities to utilize regional expertise, and leverage and complement existing regional efforts. Workshop participants represented a broad range of stakeholders, including the Federal government, SAFMC, academia, private industry and nongovernmental organizations (NGO). The principal outcome of this workshop was a list of research priorities.

The three highest priorities identified by the participants were to:

- Map and characterize deep-sea coral habitats in the proposed deepwater C-HAPCs.
- Understand species and coral habitat relationships and the factors that control or influence them.
- Identify and assess areas impacted by fishing and non-fishing activities.

The Southeast workshop report will be available at: http://coralreef.noaa.gov. A Research Priorities Workshop for the U.S. West Coast was held in January 2010.

FY 2009 Field Science Activities

An integrated research and mapping program was developed with four field research missions funded in FY 2009:

- Submersible Cruise: A cruise aboard the Harbor Branch Oceanographic Institute (HBOI) *R/V Seward Johnson*, utilizing the *Johnson Sea Link* (JSL) submersible.
- Mapping Cruise 1: A multibeam mapping survey cruise with the NOAA Ship *Nancy Foster*.
- Benthic Lander Cruise: A cruise to deploy an underwater observatory (benthic lander) with University of North Carolina at Wilmington (UNCW); and
- Mapping Cruise 2: A multibeam mapping survey with University of South Florida (USF).

The near-term goal was to collect information for the SAFMC to use in refining the border of the C-HAPC. The mapping cruises were designed to identify potential deep-sea coral habitats in the C-HAPC and guide the Program's research efforts in FY 2010 and FY 2011.

Submersible Cruise

In August 2009, the Program's initial cruise off Cape Canaveral, Florida was completed aboard the *R/V Seward Johnson*. The primary operations included 22 dives in the JSL manned submersible on known or suspected deep-sea coral sites along the margin between the Stetson-Miami Terrace C-HAPC and the allowable fishing areas (Map 7). Data were collected at 108 stations and supplemented with ship-based oceanographic sampling and biological collections. Additional information on methods and results is available in the cruise report (Ross 2009).

The primary research goals of the cruise were to (1) identify and characterize deep-sea coral habitats, and (2) to collect samples and observations necessary to better understand the ecology of the structure-forming corals and the relationship of associated species to these habitats.

The preliminary conclusions from this cruise indicate the three inshore sites (400 – 540 m depths) and southern most deep sites (680 – 750 m depths) had the most structurally complex coral habitats. The shallower inshore sites were some of the most biologically interesting and diverse ones. These sites were characterized by large colonies of living *Lophelia*

Box 3: NOAA's collaborative partnerships in deep-sea coral field research

In the FY 2009 Deep Sea Coral Research and Technology Program field activities in the Southeast U.S., NOAA collaborated with numerous partners and will continue to do so in the future. These collaborations allowed the Program to utilize methodologies comparable to those used in research conducted by partners in the Gulf of Mexico and across the Atlantic, adding international value to the research conducted. Many of these collaborations provided significant leverage against NOAA expenditures and afforded cost savings for all parties involved. At the Federal level, four NOAA line offices were involved along with the U. S. Geological Survey (USGS) and the Minerals Management Service (MMS). Academic partners included UNCW, USF, College of Charleston, Florida Atlantic University, Temple University, and the Oregon Institute of Marine Biology. NGOs and international partners included Marine Conservation Biology Institute, HBOI, the Scottish Association for Marine Science, and the Royal Netherlands Institute for Sea Research. Research operations were coordinated through NOAA's new Cooperative Institute for Ocean Exploration, Research, and Technology.

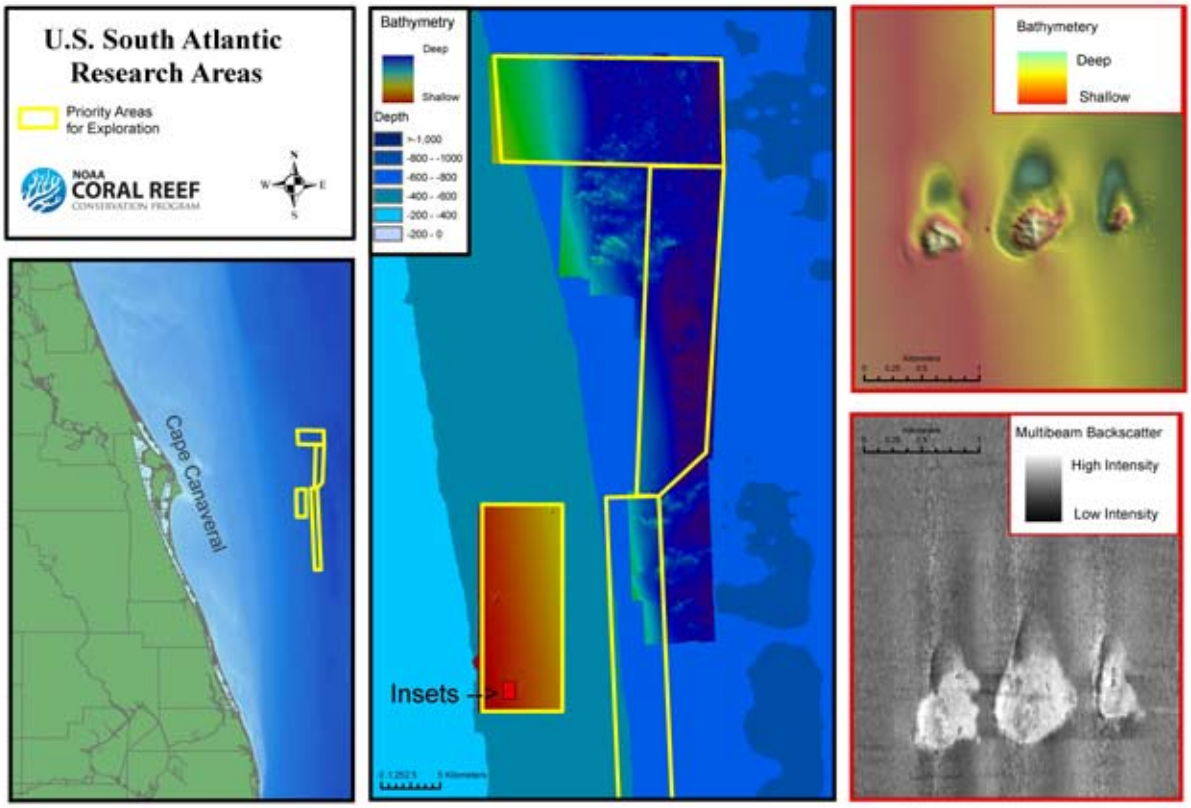
pertusa and *Madrepora oculata* as well as an abundant and diverse assemblage of fishes and large invertebrates. Golden crab, an important fisheries species managed under the SAFMC Golden Crab Fishery Management Plan (FMP), were common on these inshore sites and often observed in close association with the corals. These inshore sites are within the depth range of the golden crab allowable fishing zones as designated in the Council's proposed Comprehensive Ecosystem-Based Amendment 1. The southern most deep sites were also characterized by extremely high invertebrate biodiversity.

The least well developed coral habitats occur in the deep northern most and central stations (700 – 760 m depths), and appear to support fewer invertebrates. Coral mound formations on these sites were almost completely covered with mostly dead *L. pertusa* coral. Most sites exhibited a well developed sponge community composed of many species. Black corals and bamboo corals appeared to be rare in all of the areas surveyed.

Benthic animals associated with the corals were frequently observed feeding upon various midwater animals (e.g., crabs eating midwater fishes). As in past observations, several fish species appeared to be exclusively associated with coral habitat. Although identifications of all species collected are yet to be completed, it appears likely that several undescribed species of invertebrates were collected.

In addition to meeting the primary goals of the cruise, the interdisciplinary scientific team conducted a number of associated studies and collections that will provide a fuller understanding of these ecosystems:

- Corals were collected to measure coral growth



Map 1: Multibeam imagery of priority deep-sea coral sites off Cape Canaveral, FL, collected by the NOAA Ship Nancy Foster in September 2009. Large map shows multibeam bathymetry of areas surveyed. Inset shows a close up of multibeam bathymetry and backscatter for three shallower coral pinnacles. Lighter color on the backscatter imagery indicates hard substrata. Submersible dives on these pinnacles showed extensive deep-sea coral cover.

Box 4: Benthic landers are long-term observatories on the seafloor

While submersibles and remotely operated vehicles (ROVs) provide information about a habitat at a specific moment in time, monitoring long-term variations in oceanographic parameters is necessary to place this snapshot information into an ecological context. The benthic lander provides this type of long-term data.

In December 2009, landers were placed in a well-studied deep-sea coral ecosystem in the northern Cape Lookout C-HAPC, and will be recovered after six months. The landers, equipped with cameras, will continuously measure near-bottom temperature, salinity, the amount of particles in the water column, current speeds, and current directions.

The 2009 field season also tested the Sùil na Mara (Scots Gaelic for 'Eye of the Sea') microlander, a small aluminum platform designed to be deployed from submersibles or large ROVs in areas of rough substrata and the high current velocities associated with deep-sea coral habitats.

A microlander was deployed during the August 2009 submersible cruise off the Southeast U.S.
Photo Credit: S. Ross et al., NOAA/USGS DISCOVRE Cruise

and determine their reproductive biology. Colonies of the three dominant reef-building coral species (*Lophelia pertusa, Madrepora oculata*, and *Enallopsammia profunda*) were retained alive from several JSL dives.

- Tissue samples were collected from 70 taxa for stable isotope analyses. Results from these analyses will help elucidate food webs and energy flow through deep-sea coral ecosystems.

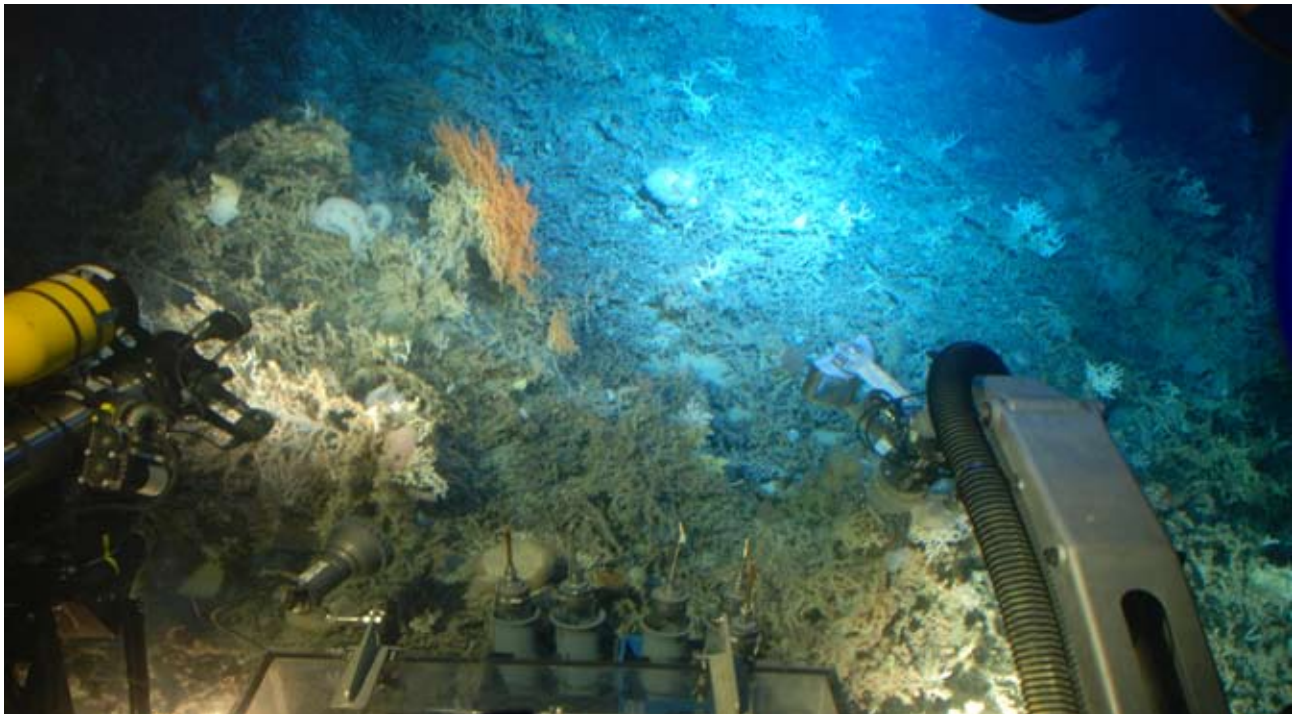
- Tissue samples from 33 taxa were collected for genetic studies to understand connectivity and population dynamics among deep reef ecosystems. This region off the east coast of central Florida was poorly sampled in previous cruises and represented a critical area between previously studied areas in the Northeastern Atlantic and Gulf of Mexico.

- At least 28 taxa were sampled for microbiology and/or biomedical screening – studies that may discover new biomedical compounds.

- The cruise tested a new, small lander (Box 4). The "Microlander" Sùil na Mara was deployed for 30 hour sessions on two different deep-sea coral habitats. Preliminary data revealed highly variable bottom currents with regular tidal signals in bottom currents and temperature.

Mapping Cruise 1

Scientists from NOAA and UNCW used multibeam sonar to map a total area of 225 square miles (580 km^2) along the western edge of the C-HAPC off central Florida from the NOAA Ship *Nancy Foster* in September 2009 (Map 1). Numerous limestone pinnacles and ridges were located in the area roughly 47 miles (75 km) offshore between Cape Canaveral and Ft. Pierce, FL. The resulting maps



The submersible extends a manipulator arm to collect samples.
Photo Credit: S. Ross et al., NOAA/USGS DISCOVRE Cruise

from this survey will inform selection of dive sites for future manned and unmanned observations, as well as contribute new information to the SAFMC for potential adjustment of C-HAPC boundaries.

Benthic Lander Cruise

In early December, the *R/V Cape Hatteras* deployed two benthic landers for long-term observations on deep-sea coral banks off North Carolina and conducted a variety of other sampling (Box 4). These landers were recently recovered after monitoring conditions for a year at deep-sea coral sites in the Gulf of Mexico in a separate MMS/USGS/NOAA program. These landers were developed in partnership with the Royal Netherlands Institute for Sea Research, and are an important first step in an effort to standardize sampling techniques throughout the Atlantic basin.

Mapping Cruise 2

A team of USF geologists specialized in seafloor mapping will conduct an additional mapping cruise in the C-HAPC in early 2010. It is anticipated 450 – 600 square miles (1200-1500 km^2) of habitat will be mapped during this cruise. The target area, approximately 47 miles (75 km) off the east coast of central Florida, is adjacent to the area surveyed during the first mapping cruise. Efforts are underway to maximize the cost effectiveness of this operation by matching a compatible survey vessel with multibeam mapping equipment designed for the water depths here.

Outreach Efforts

To enhance public understanding of these spectacular ecosystems and the science conducted to understand them, an outreach team representing NOAA,

SAFMC, HBOI, UNCW and USGS was formed to publicize FY-2009 research efforts. Press releases were generated for the program in general and the cruises specifically. Members of the press and local management agencies were invited aboard the *R/V Seward Johnson* during the JSL submersible cruise, where the scientists could explain their research. This event resulted in an NBC Nightly News feature and articles in newspapers across the nation. Through the partnerships on this program, daily logs from the submersible cruise were made available online through USGS' DISCOVRE website: http://fl.biology.usgs.gov/DISCOVRE/index.html.

Plans for FY-2010 and FY-2011

Planning for FY-2010 and FY-2011 operations in the Southeast U.S. is well underway. Ship time has been secured for three NOAA research cruises in FY 2010. This will allow significant leverage of program funds and an increased operational tempo. The primary mission will be an ROV cruise aboard the NOAA flagship *Ronald H. Brown*. A second research cruise is planned aboard the NOAA Ship *Pisces*. The third cruise will continue the mapping efforts aboard the NOAA Ship *Nancy Foster*. Mapping targets and research goals for all cruises will be selected with input from the SAFMC with particular consideration given to the research priorities identified at the July 2009 workshop. FY-2011 efforts will be guided by results from the FY-2009 and FY-2010 research. Existing collaborations will be strengthened and new collaborations begun. One exciting direction is a greater linkage with the Trans-Atlantic Coral Ecosystem Study (TRACES). TRACES is an international collaboration of coral scientists and a partnership with this established group will significantly expand NOAA's capabilities (more in Section 3.3).

2.3 ANALYSIS AND MANAGEMENT OF EXISTING DATA AND INFORMATION

The new field science activities supported under the Deep Sea Coral Research and Technology Program provide the opportunity for dedicated, longer term research and mapping of deep-sea coral ecosystems. However, because of the costs and logistic constraints of working in the deep sea, the Program will only be able to conduct field operations in a few high priority areas.

MSA Section 408 (a)(1) directs NOAA "to identify existing research on, and known locations of, deep-sea corals and submit such information to the appropriate Councils." To carry out this mandate, NOAA will analyze data, integrate new findings, and make data available to managers in usable formats.

NOAA has supported deep-sea exploration and research conducted by several NOAA program offices and through collaborations with other Federal agencies, the Regional Fishery Management Councils, and external university partners. Other sources of information, such as museum collections and NMFS research trawl surveys provide additional data on the distribution of deep-sea corals. While much of this work was not specifically directed toward deep-sea coral ecosystems, analysis of previous research can provide valuable information to inform management and to guide future field efforts. Identification of new deep-sea coral areas will continue to depend upon visual ground-truthing. Analyses of existing information, however, complement and add value to this work, and can be conducted at a much lower cost and in more areas than it would be possible to mount new field expeditions.

Managing both existing and new data and information is critical in order to ensure that data are accurate, reliable, secure, understandable, and available in appropriate formats for use by researchers, managers and the public. Thus the development of geographic information system (GIS) databases for use by the research, management, and education communities is essential. NOAA will build on experience from its Coral Reef Information System and on existing database partnerships to 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.

In FY 2009, the Deep Sea Coral Research and Technology Program began to address these requirements through two related efforts:

1. Deep-sea coral database and GIS development
2. Projects that inform conservation through the analysis of existing coral data

The following are summaries of individual activities. In most cases, these projects have just begun and only preliminary results are available.

Analysis and Management of Existing Data and Information – Deep-Sea Coral Database and GIS Development

National Deep-Sea Coral Data and GIS Management **$150,000**

Project Goal Ensure that data and information acquired by the Deep Sea Coral Research and Technology Program are accurate, reliable, secure, and understandable; and that they are made available to managers, Regional Fishery Management Councils, researchers, and the public in a useful manner.

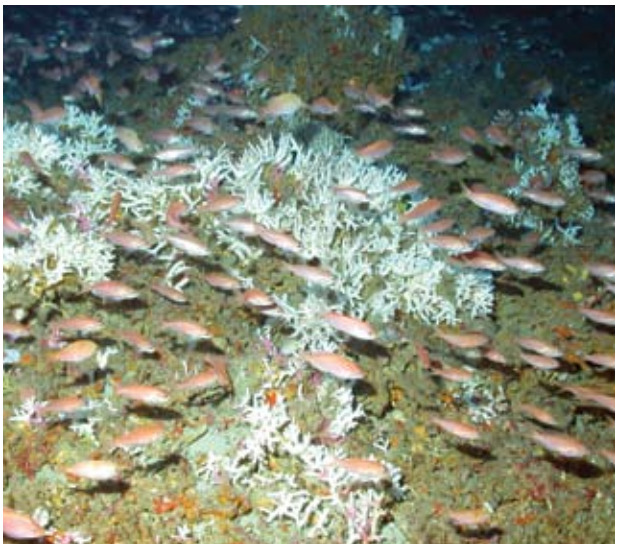
Management Application Making accurate information and value-added products available to managers is critical to ensuring the Program has the greatest conservation impact.

Summary This activity addresses the primary needs for data management and GIS analysis to support the activities of the Deep Sea Coral Research and Technology Program:

1. Collect and integrate available information on the status and distribution of deep-sea coral and sponge ecosystems.
2. Develop approaches and tools to analyze and display information on the activities that may impact deep-sea coral ecosystems. Primary focus will be on interactions with commercial fisheries.
3. Lead the development of a NOAA Deep Sea Coral Research and Technology Program data management plan to be integrated and implemented within the Coral Reef Conservation Program Data Management Plan.
4. Produce maps and conduct spatial analysis and predictive modeling to support deep-sea coral conservation.
5. Maintain coordination and consistency for GIS and data management matters associated with field activities off the U.S. Southeast and West coasts.

The maps of deep-sea coral locations included in this Report represent a first product from these efforts. This is a significant enhancement over the capabilities and products available when the first Report to Congress was prepared in 2007.

Rockfish take refuge among the branches of a deep-sea gorgonian coral in the Olympic Coast National Marine Sanctuary.
Photo Credit: OCNMS



Fish associate with the Oculina *coral habitat off Florida.*
Photo Credit: L. Horn, NOAA Undersea Research Center at UNCW

Enhancing the West Coast Regional Deep-Sea Coral Database **$12,000**

Project Goal Enhance the usefulness and accessibility of deep-sea coral data collected by NMFS and its partners

Management Application This project will provide data on the location and bycatch of corals and sponges to inform Pacific Fishery Management Council and NOAA management efforts.

Summary This project enhances the existing Northwest Fisheries Science Center regional database on coral and sponge observations off the West Coast. Much of the framework for such a database already exists; however, several enhancements are required to meet the needs of future analysis, reporting, and data requests. These enhancements include references to the Integrated Taxonomic Information System serial numbers to ensure proper taxonomic associations, improved tracking of samples sent for genetic analysis or taxonomic identification, and common query structures to facilitate faster responses to data requests. In addition, results of common queries will be served on a regional data portal, the Pacific Coast Ocean Observing System (PaCOOS) West Coast Habitat Server (http://pacoos.coas.oregonstate.edu/). To date, the project team has created many query structures and made NMFS survey data available through the PaCOOS server. More data, specifically from surveys conducted in the five west coast sanctuaries, will be added as appropriate. The team is also developing a new specimen tracking system. Initial outputs from these efforts are included in Maps 3 and 10.

Baskets stars (Gorgonocephalus *sp.*) *attached to bubble gum coral* (Paragorgia arborea) *on the Davidson Seamount at 1497 meters.*
Photo Credit: NOAA/MBARI 2006

Projects to Inform Conservation through the Analysis of Existing Data and Information

Deriving Deep-Sea Coral and Sponge Distribution Data from Archived Video Records in Northeast U.S. **$15,000**

Project Goal Develop and test a rapid image "mining" protocol to review archived underwater images and video for locations of deep-sea corals and sponges, and add these to the existing NOAA/USGS east coast deepwater coral database.

Management Application "Mining" data from existing archives has the potential to locate deep-sea corals more quickly and cheaply than would be possible through field research. The New England Fishery Management Council is currently developing management alternatives for protecting deep-sea corals that can benefit from this information.

Summary Decades of submersible and ROV operations in the EEZ off the east coast (over 5,000 dives; see Figure 1) have produced video and still photos that have yet to be fully examined to reveal deep-sea coral and sponge habitats. This project will access the archive collections of imagery at various institutions (e.g., Woods Hole Oceanographic Institute (WHOI), University of Connecticut) to delineate the distribution and abundance of key coral and sponge taxa. The project team is developing a rapid image "mining" protocol, testing the approach using these image archives, and adding to the existing NOAA/USGS east coast deepwater coral database. Work is underway and focused on Gulf of Maine deep basin and Georges Bank submarine canyon environments. To date, still imagery from dives of the *Johnson-Sea-Link* and *Alvin* submersibles in the 1970s and early 1980s have revealed several gorgonian- and sea pen-dominated communities. Review of archived video from 1960s-80s will commence soon.

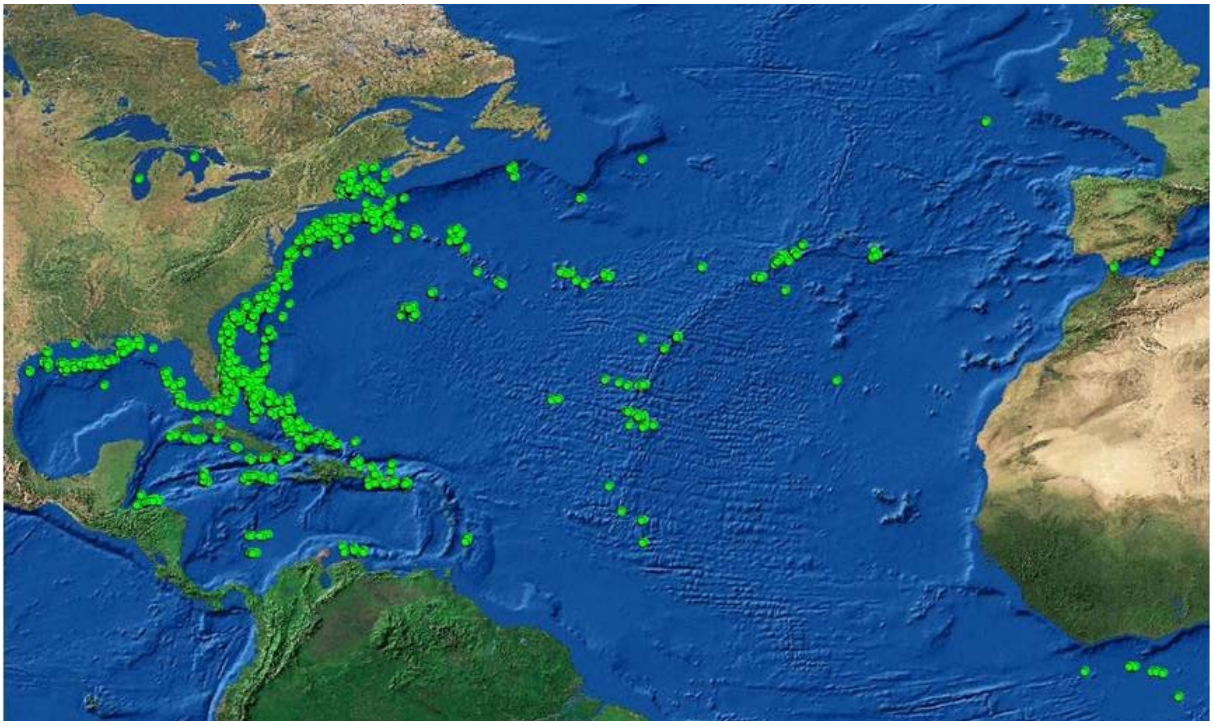


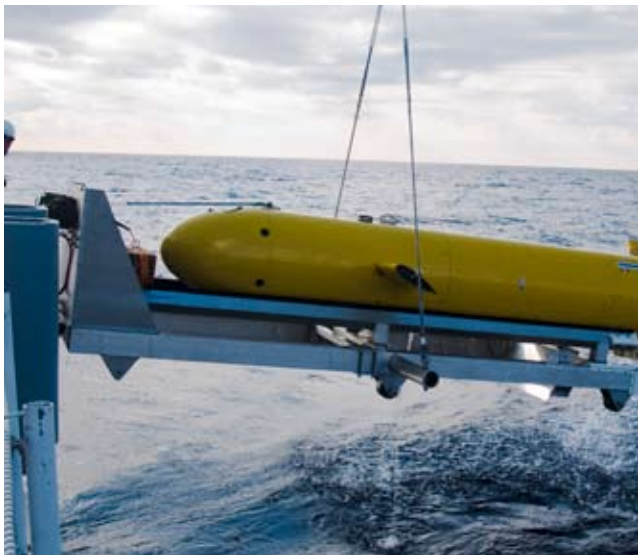
Fig. 1: Submersible and ROV dive sites in the Atlantic with archived video and still imagery data that could reveal additional information on the locations of deep-sea corals.
Source: D. Stevenson, P. Auster

Analysis of Autonomous Underwater Vehicle (AUV) Sonar Data from Deepwater Coral Habitats off Eastern Florida **$15,000**

Project Goal Analyze sonar data (sidescan and multibeam) that was collected with an AUV in 2008 within the Deepwater C-HAPCs and the *Oculina* Habitat Area of Particular Concern (HAPC) in the South Atlantic Fishery Management Council region

Management Application This project will identify potential deep-sea stony coral reef habitat and thus guide future research and inform management of the presence of sensitive habitats.

Summary A number of deep-sea coral sites off eastern Florida were discovered during AUV sidescan and multibeam surveys in 2008. The total area surveyed in 2008 was 60.5 square miles and consisted of 240 miles of AUV track lines. The Deep Sea Coral Research and Technology Program submersible cruise in 2009 found selected sites to contain some of the greatest concentrations of living coral yet observed in the western Atlantic. This project will re-analyze the sonar data to provide higher-resolution maps of these sites that can reveal additional information on potential coral locations. Thus far, a number of the sidescan and multibeam mosaics have been completed. Additional analysis of these and similar AUV data will be processed to characterize the distribution of deepwater habitats. In addition, the integration of centimeter-scale bathymetric and backscatter maps and ground-truthing data (consisting of video transects and bottom samples taken during submersible dives) will allow for habitat mapping of the deepwater reefs with unprecedented resolution.



The Eagle Ray AUV was used to map the Oculina *Bank in 2006. Photo Credit: A. Alexander*

The Eagle Ray AUV was used to map the Oculina *Bank in 2006. Photo Credit: A. Alexander*

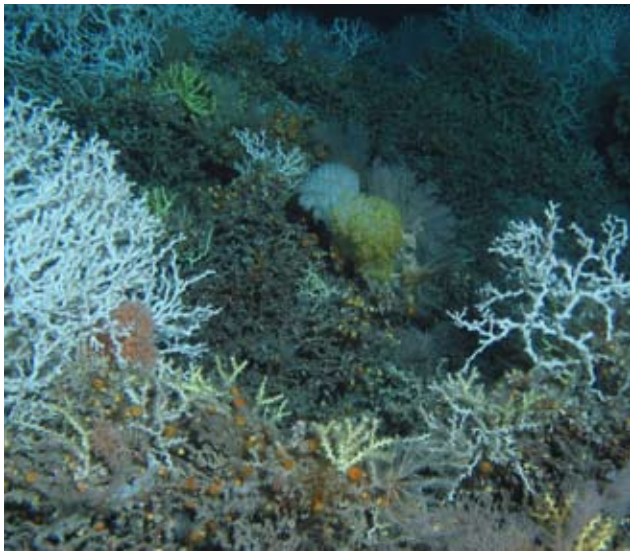
Analysis and Distribution of Deepwater Commercial Fisheries Species (Golden Crab, Tilefish, Royal Red Shrimp) in Deepwater Coral Habitats off Eastern Florida **$10,000**

Project Goal Provide data on the distribution and abundance of the commercially caught golden crab, tilefish, and royal red shrimp in relation to deep-sea coral ecosystems in the Southeast U.S.

Management Application Results of this project will assist EFH description and identification for these commercial species and inform management efforts to reduce fisheries interactions with deep-sea coral habitats.

Summary This project will review video archives collected from over 100 submersible dives between 2005 and 2009 in the South Atlantic Region for the occurrence of the golden crab (*Chaceon fenneri*), tilefish (L*opholatilus chamaeleonticeps* and *Caulolatilus microps*), and royal red shrimp (*Pleoticus robustus*) in deepwater coral ecosystems. A database of submersible and ROV dives has been compiled and entered into GIS to select which dives to analyze for this project. The project will also incorporate observations of these commercial species from the 2009 Deep Sea Coral Research and Technology Program cruise. The SAFMC is also contributing to this project, allowing the analysis of videotapes from additional submersible dives.

A golden crab observed from the submersible during the 2009 cruise. Photo Credit: S. Ross et al., NOAA/USGS DISCOVRE Cruise



Lophelia *coral and associated species observed during the 2009 cruise. Photo Credit: S. Ross et al., NOAA/USGS DISCOVRE Cruise*

Integrating Mapping and Fisheries Data for Deep-Sea Coral Habitats off South Carolina and Georgia
$15,000

Project Goal Process and analyze multibeam sonar and fisheries data to detect deep-sea coral habitats that can be used to delineate Essential Fish Habitat (EFH) off South Carolina and Georgia, and provide methodologies for more rapid assessment of areas during future data gathering expeditions.

Management Application The products generated through this project will support management actions by providing new tools for identifying and mapping potential deep-sea coral habitats. Mapping of coral habitat is essential for meeting the management goals of the SAFMC, so that permitted fishing areas can be designated that minimize impacts on corals.

Summary This project consists of three primary tasks: (1) analyzing available multibeam sonar and backscatter data to construct seafloor and habitat characterization maps (currently underway); (2) identifying areas of existing and potential deep-sea coral habitat; and (3) overlaying and relating existing fisheries data to these newly generated habitat maps. The products will support management actions by providing habitat and fishery managers a stronger mechanism for identifying potential deep-sea coral habitat and supporting future NOAA conservation planning, using sonar-derived datasets and algorithms.

Conger eel and squat lobster are frequently observed in Lophelia *reefs.*
Photo Credit: S. Ross et al.

Flower Garden Banks National Marine Sanctuary Deep-Sea Coral Investigations **$15,000**

Project Goal Analyze imagery obtained by ROV in order to document and understand the biological components of deepwater communities in the northern Gulf of Mexico.

Management Application This project will inform revisions to the proposed boundary expansion of the Flower Garden Banks National Marine Sanctuary. The results will also be valuable in MMS decisions on oil and gas activities.

Summary This project analyzes the imagery captured from the May 2009 ROV cruise at the Flower Garden Banks National Marine Sanctuary. The project team at the sanctuary has developed a photolog of 536 high-resolution digital still images. Each image is inventoried for the biological components. A biological characterization scheme is applied to the images, which will lead to biological zonation maps for locations that currently do not have this level of information. An interactive GIS map is also being developed to show more than 9,000 images at over 200 dive sites. The georeferenced ROV survey tracks, with a selection of images taken along each track are provided online at: http://www.ncddc.noaa.gov/website/google_maps/FGB/mapsFGB.htm.

An example of deep coral habitat at the Flower Garden Banks National Marine Sanctuary, typical of the northwest Gulf of Mexico habitats. Image includes gorgonians, black corals, echinoderms, sponges, and deepwater fishes.
Photo Credit: FGNMS/NURC-UNCW

Deep-Sea Coral Community Research off California **$15,000**

Project Goal Analyze data on the occurrence of deep-sea corals and other biogenic habitats from a NOAA – USGS partnership

Management Application Information from this project will inform NOAA and Pacific Fishery Management Council's review of essential fish habitat (EFH) and help identify vulnerable deep-sea coral areas.

Summary This project examines video footage and still images recorded by a towed camera on surveys from previous years off central and southern California. By reviewing these images, the project team is groundtruthing the habitat maps and verifying the distribution of deep-sea coral communities. The camera surveys were a collaboration between NOAA and USGS to interpret habitat maps generated with high-resolution sonar data as part of the California Seafloor Mapping Program.

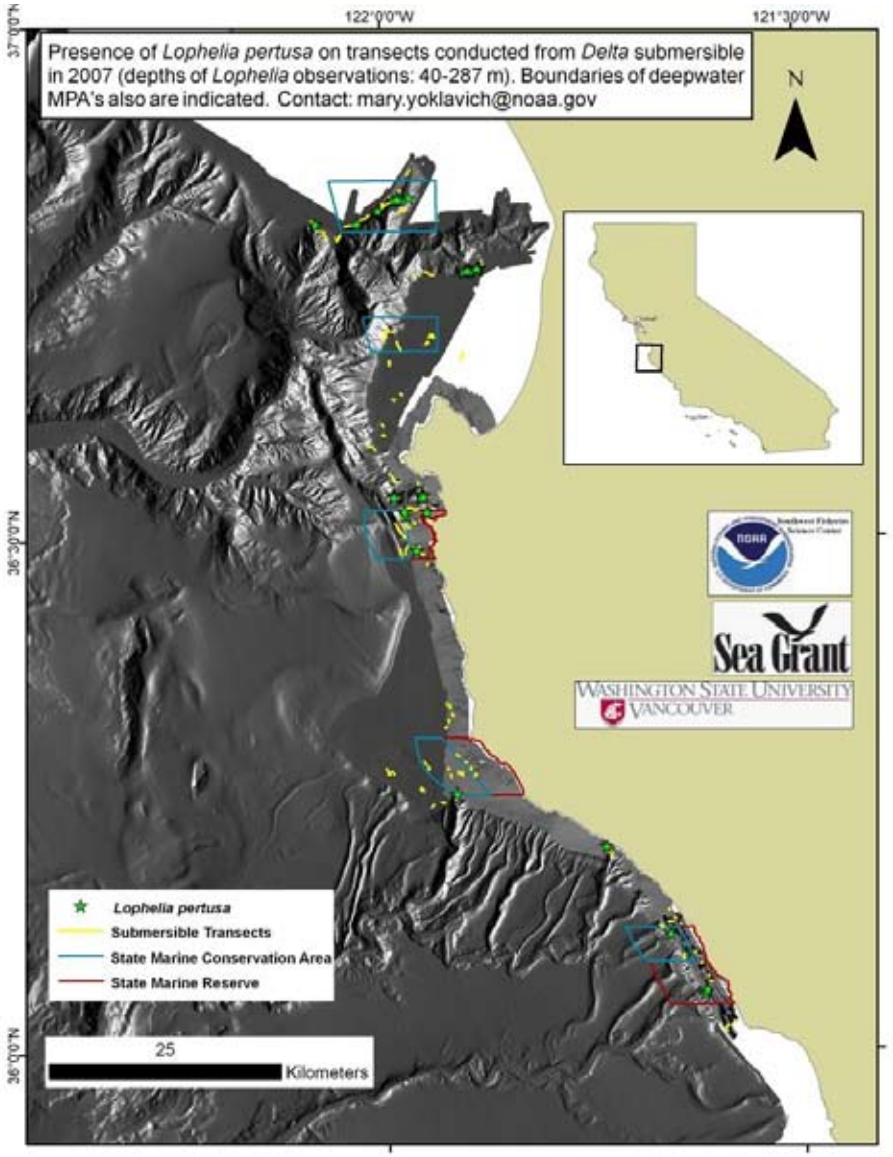


Figure 2: Lophelia pertusa *locations observed from the Delta submersible.*
Source: M. Yoklavich

Using Cordell Bank as a Model to Conduct Fine-Scale Deep-Sea Coral Predictive Habitat Modeling
$15,000

Project Goal Refine and validate models of deep-sea coral distribution and enhance understanding of the geographic distribution of two dominant species of corals

Management Application Using predictive models, this project provides a cost-effective approach to target areas of deep-sea coral habitat for research and for conservation.

Summary This project uses updated geospatial analysis tools to refine GIS models that predict the locations of lace corals and gorgonians at Cordell Bank National Marine Sanctuary. The project team will also evaluate the models' ability to predict the presence of deep corals in other suitable rocky habitats. Additionally, the project team analyzed the range of two lace coral species (*Stylaster californicus* and *S. venustus*) and confirmed their overlap at Cordell Bank.

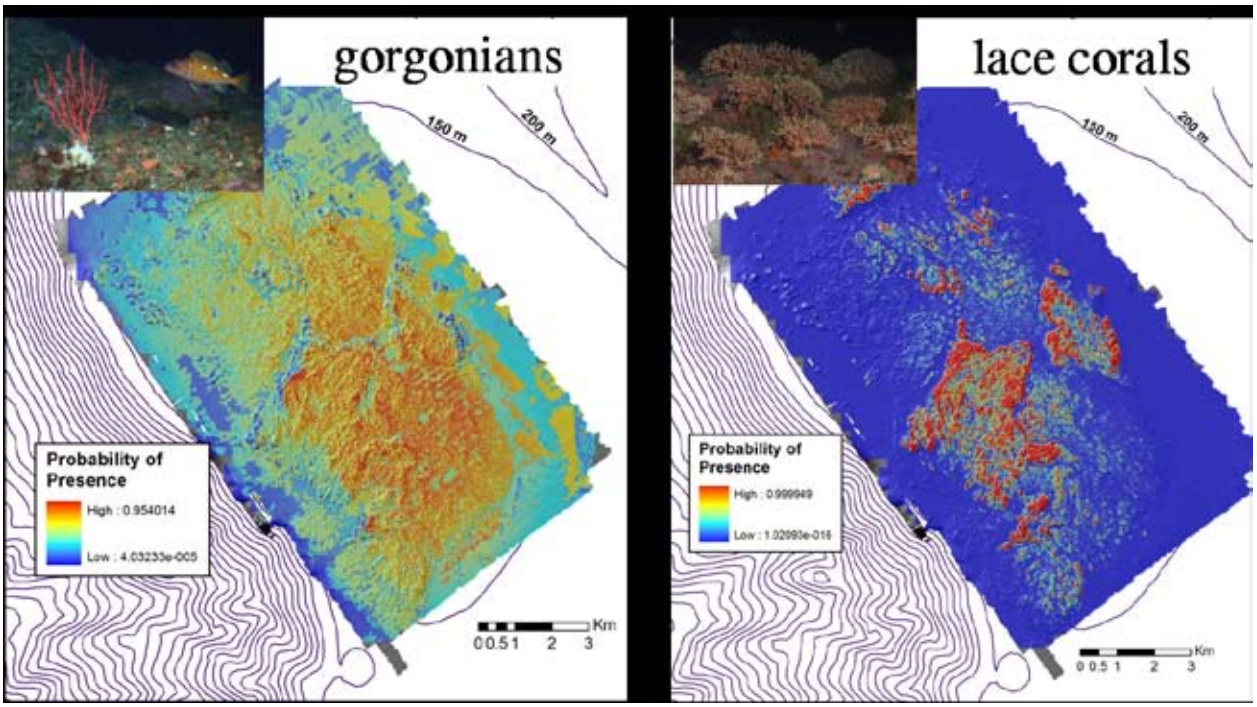


Figure 3: Preliminary model results illustrating the contrasting patterns of predicted habitat use and distribution for gorgonians and lace corals across the rocky feature of Cordell Bank off California. Results indicate that lace corals and gorgonians occupied different niches. Lace corals were restricted to a small proportion of the Bank with distinct habitat features, while gorgonians were more broadly distributed. Source: L. Etherington, CBNMS

2.4 ANALYSIS OF FISHING INTENSITY AND DEEP-SEA CORAL BYCATCH

Understanding the geographic distribution and effects of human activities that may adversely affect deep-sea coral and sponge ecosystems is a key priority for developing and implementing management strategies. The MSA directs NOAA to "monitor activities in locations where deep-sea corals are known or are likely to occur." In many regions, fishing practices that use bottom-tending gear, especially bottom trawling, pose the most widespread threat likely to damage deep-sea coral communities. NOAA, assisted by recommendations from the Regional Fishery Management Councils, has primary responsibility for managing fisheries in the U.S. EEZ. Therefore, monitoring and providing information to manage these activities and their impacts is a top priority for the program.

Investigating the relationship between known locations of deep-sea corals and fishing activities that may damage them requires knowledge of the location of corals and the location and intensity of fishing activities. There are several methods for assigning fishing activities to a specific location. Fishing activity can be directly observed through on-board observers trained by NOAA or through electronic methods. A second approach is through self-reporting of fishing location by fishermen. This information can be collected either through dockside interviews or through logbooks and trip reports submitted by fishermen. Finally, vessel monitoring systems (VMS) locate fishing activity through analysis of position information, vessel velocity, and other variables relayed to satellites.

In FY 2009 the program supported five projects that analyze fisheries activities. The first three projects summarized in this section use existing information to analyze and map the distribution and intensity of fishing activities conducted with bottom-contact fishing gear in Federal waters off the U.S. Northeast, Southeast, Gulf of Mexico, and California. NOAA protects all confidential information (such as the location of fishing activity) received, collected, maintained, or used by the agency as required by law.

The remaining two projects improve NOAA's ability to identify West Coast deep-sea corals and Alaskan sponges that occur as bycatch in Federally-managed fisheries. Measuring bycatch is not a reliable method of sampling deep-sea corals. This is because only a small proportion of the broken corals are likely to be retained in bottom trawls, while other gears (e.g., bottom-set longlines and traps) may damage corals but have minimal bycatch. Nevertheless, bycatch records can provide some indication of where corals occur and are often the only measure of fisheries impact. Improving the recovery of information on deep-sea corals and sponges that is derived from bycatch will help to understand and reduce fisheries impacts to deep-sea corals and associated ecosystems.

Monitoring activities – Analyzing fishing intensity and bycatch

Mapping the Intensity of Fishing in the Northeast Using Gears That May Damage Deep-Sea Corals
$30,000

Project Goal Analyze fishing activity by bottom gears that may damage deep-sea corals and investigate fishery-independent and fishery-dependent data sources for potential georeferenced deep-sea coral bycatch.

Management Application This effort allows NOAA to understand where fishing occurs in relation to deep-sea coral habitat, and to quantify deep-sea coral bycatch in the groundfish and shellfish surveys. These data can inform the development of approaches that reduce deep-sea coral bycatch in specific fisheries.

Summary To map the intensity of bottom fishing, the project team is currently assessing the accuracy of vessel trip reports against other fishery-dependent data sources such as on-board observer databases and data from VMS equipment installed on vessels. The trip reports record the location of fishing activity, and the VMS data can show whether a vessel is fishing or transiting. To date, the project team has analyzed the 2007 vessel trip reports from 157,330 trips by 3,242 vessels. Of these, 282 trips by 175 vessels were also matched to the data in VMS and observer databases. In the next step, the team will investigate the remaining data and determine ways to increase the overlap among the different data sources. The New England Fishery Management Council Habitat Plan Development Team members and staff are partnering in this project.

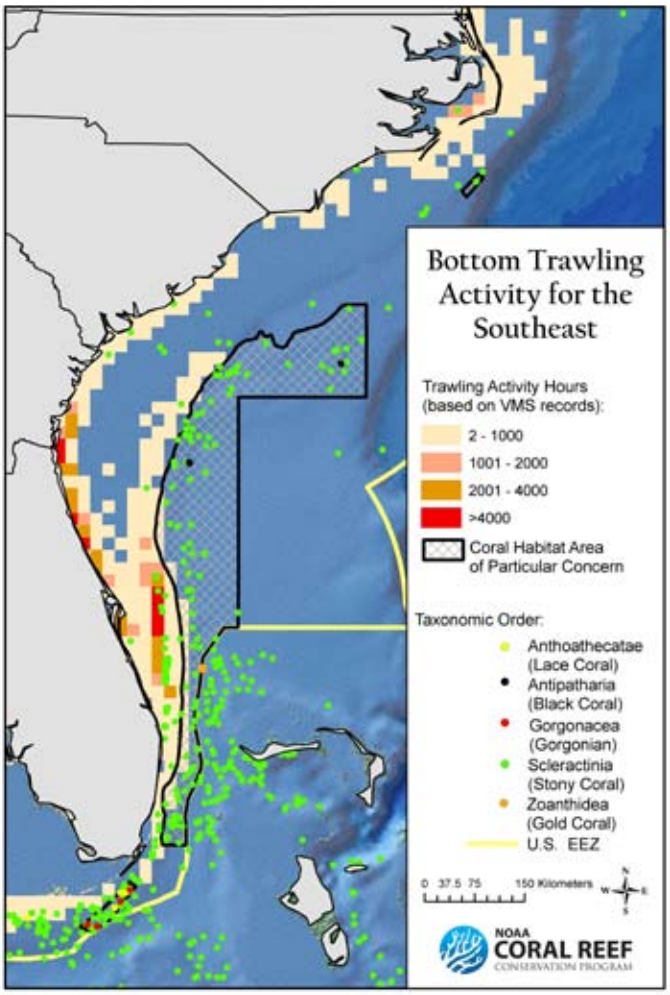
Deep-sea Corallium *and* Trachythela *corals with brittle stars, crinoids, and sponges.*
Photo Credit: Mountains in the Sea Research Team and Institute for Exploration

Analysis of Fishing Intensity and Potential Deep-Sea Coral Impacts in the US South Atlantic and Gulf of Mexico Regions **$36,000**

Project Goal Map deep-sea fishing effort across the U.S. South Atlantic and Gulf of Mexico Fishery Management Council regions using VMS, permit, and catch/effort data.

Management Application This effort will increase NOAA's ability to identify fishing patterns and manage activities that are potentially threatening to deep-sea coral and sponge communities.

Summary This project will develop a database to integrate information from multiple sources to understand and map the location of deep-sea fishing activities. The types of data to be incorporated range from vessel registrations, fishing permits, VMS data, logbooks, to fish landing statistics. The project team has identified the relevant data sources (e.g., NMFS Office of Law Enforcement) and created a model to integrate the various datasets. Eventually, this integrated database will allow NOAA to query data across all systems and receive a comprehensive view of when, where, and what type of fishing occurs within the southeast region in near real-time, while retaining the confidentiality of fishing statistics required by law (Map 2).



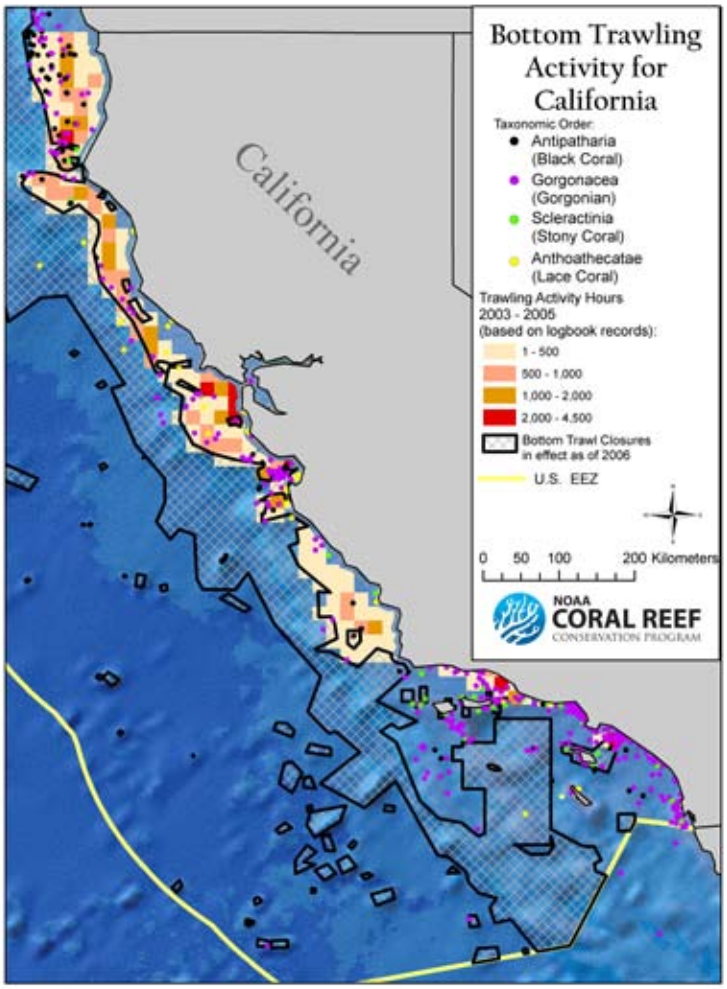
Map 2: Bottom trawling activity and the locations of structure-forming deep-sea corals off the Southeast U.S. This map provides an example of the types of analysis being conducted under this project. Bottom-trawling activity was derived from an analysis of VMS tracks with vessel velocities expected for trawling activities and aggregated by 10' reporting grids. See Map 5 for description of deep-sea coral locations.

Mapping the Distribution and Intensity of Bottom Trawling Effort Along the California Coast from 1997 to 2008, with Impacts on Deep-Sea Corals **$32,637**

Project Goal Create maps of the distribution and intensity of bottom trawling along the California coast

Management Application Finer-resolution information on the location of bottom trawling will inform management measures to benefit both deep-sea coral habitats and the fishing community.

Summary This project will use the start and end locations of trawl tows recorded in California trawl-fishing logbooks to create maps of the distribution and intensity of bottom trawling along the California coast. In 2009, the project team created preliminary maps of trawling through 2005 overlaid with the locations of deep-sea corals observed during groundfish trawl surveys. These maps show some areas of heavy trawl activity and other areas with little or no trawl activity near suspected or known locations of deep-sea corals. The team will next map the changes in trawling activity after the 2004 fleet reduction and 2006 EFH closures as well as coral records from other sources.



Map 3: Bottom trawling activity (2003 to 2005) and the locations of structure-forming deep-sea corals off California. This map shows an initial analysis of commercial bottom trawl activities based on trawl set and recovery points aggregated by 10' reporting grids. Trawl data are from 2003 to 2005. Cross-hatched areas represent trawl closures for bycatch-reduction purposes and the EFH closures that went into effect in June 2006. Subsequent analyses will look at how bottom trawl effort has changed since the 2006 closures. See Map 10 for description of deep-sea coral locations.

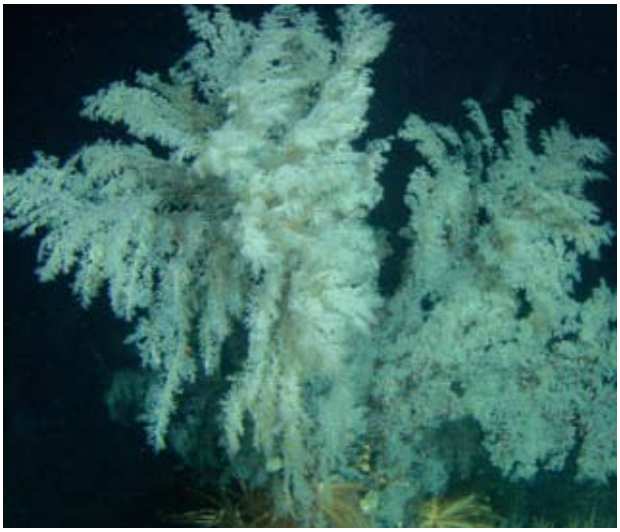
Taxonomic and Genetic Identification of Fisheries Bycatch of Deep-Sea Corals During the 2009 West Coast Groundfish Bottom Trawl Survey **$40,243**

Project Goal Augment the collection of voucher specimens (i.e., species inventory) of deep-sea corals on the West Coast to improve coral identification in bycatch and groundfish surveys.

Management Application Understanding of the impacts of fisheries on deep-sea corals will be enhanced by accurate identification of corals encountered in fishing activities.

Summary The project team collected coral specimens during the 2009 West Coast groundfish survey and conducted DNA sequencing of the specimens from the 2007 and 2008 surveys. In addition, the team began creating scanning electron microscope images of some of the specimens to document their morphology. The project team will use these genetic and morphological techniques to identify the coral specimens to the species level, and incorporate the species designations into a coral identification guidebook.

Close-up of primnoid coral (Calyptrophora *sp.*) *and shrimp on the Davidson Seamount off California at 5150 ft (1570 m) depth.*
Photo Credit: NOAA/MBARI 2002



*A Christmas tree black coral (*Antipathes dendrochristos*) off southern California at 500 ft (150 m) depth.*
Photo Credit: M. Amend, NOAA

A Field Guide to the Deepwater Sponges of the Aleutian Islands Archipelago **$20,750**

Project Goal Provide a field guide to Aleutian Island sponges that can be used by fisheries observers and researchers.

Management Application This guide will help map the distribution of sponges, quantify and reduce the impacts of trawling on particular species, and guide research on these important components of the ecosystem.

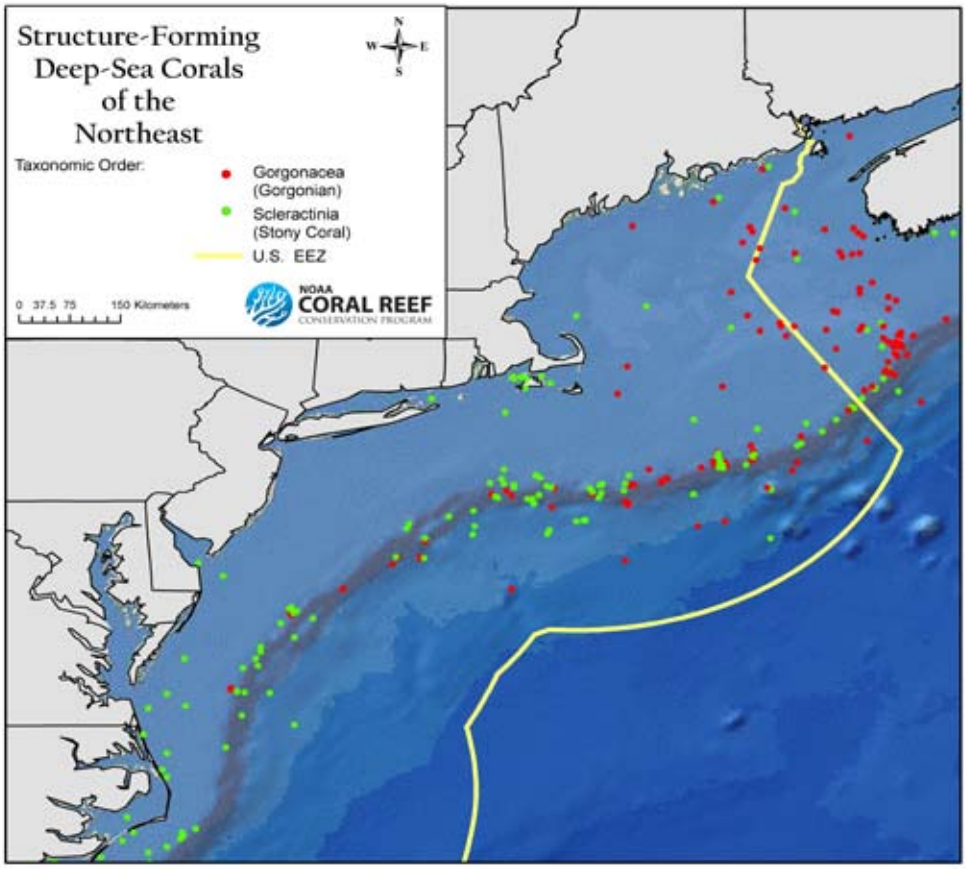
Summary Sponges are common in the bycatch of Alaska bottom trawl fisheries, but the field guides used by fisheries observers to identify bycatch contain inaccurate and incomplete information on sponges. This project will examine hundreds of sponge specimens, including more than 40 species new to science, that NOAA collected between 2003 and 2007 to develop a sponge field guide of the Aleutian Islands. The guide will be available to fishers, fisheries observers and scientists for the 2010 field season, complementing the existing "Field Guide to Alaskan Corals" to record the locations of important benthic invertebrates that provide habitat for other species.

An Alaskan coral garden with several species of gorgonians, lace corals, and sponges.
Photo Credit: A. Lindner

CHAPTER 3: COMPLEMENTARY ACTIVITIES TO IDENTIFY, MONITOR, AND PROTECT DEEP-SEA CORAL AREAS IN 2008 – 2009

NOAA is the principal Federal agency responsible for management of living marine resources within the U.S. EEZ where most U.S. deep-sea coral communities occur. The Congressional mandate for a Deep Sea Coral Research and Technology Program signaled recognition of the considerable work that multiple NOAA programs (e.g. National Marine Sanctuaries, Ocean Exploration and Research, Fisheries Science Centers, Fishery Management Program, and National Centers for Coastal Ocean Science) have conducted for years on these critical ecosystems. The Deep Sea Coral Research and Technology Program continues to leverage the past and ongoing activities conducted by its NOAA partners.

The following summaries—developed by NOAA in conjunction with the Regional Fishery Management Councils—focus on new management activities and selected research conducted by NOAA and its partners since our first Report to Congress in 2008. These activities complement, and in the future will build upon, the activities funded under the Deep Sea Coral Research and Technology Program described in Chapter 2.



Map 4: Known locations of structure-forming deep-sea corals off the Northeast U.S. The data represent known locations of major structure-forming species of gorgonian and colonial stony corals. Data do not represent density of coral cover but rather known locations and may reflect the limited geographic extent of fishing or research effort. *See page 64 for data sources.*

3.1 NOAA AND THE COUNCILS

New England and Mid Atlantic Regions – Maine to Cape Hatteras

The Northeast has numerous deep-sea coral habitats, composed primarily of gorgonians, which appear to be most numerous on rocky areas associated with canyons along the continental shelf and Georges Bank slopes, in rocky habitats in the northern Gulf of Maine, and on the New England Seamount chain (Map 4). The New England Fishery Management Council (NEFMC) has authority over fisheries in Federal waters off Maine, New Hampshire, Massachusetts, Rhode Island, and Connecticut. The Mid-Atlantic Fishery Management Council (MAFMC) covers fisheries off New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, and part of North Carolina. The Councils share management responsibilities for the monkfish and dogfish FMPs.

The NEFMC is currently developing the Omnibus EFH Amendment 2, which will amend existing EFH designations, analyze the impacts of fishing on EFH, and recommend appropriate management measures to minimize the adverse effects of fishing to EFH. The amendment is scheduled for final Council approval and NMFS implementation in 2011. Phase 1 of the amendment included proposed alternatives for designating 15 deep-sea canyons and portions of two seamounts as HAPCs. Several canyons and both seamounts are known to harbor deep-sea coral habitats (Appendix 3). Final action on the HAPC proposals will not be taken until the Omnibus EFH Amendment is implemented. It is likely that some of the proposed canyon and seamount HAPCs will be modified to become coral protection zones.

In this context, two motions have been passed by NEFMC indicating support for deep-sea coral protection:

February 2008: "to direct the Habitat Plan Development Team to evaluate existing information on deep-sea corals and to develop management options to protect deep-sea coral habitat. It is understood that these options would be independent of any EFH and HAPC designations."

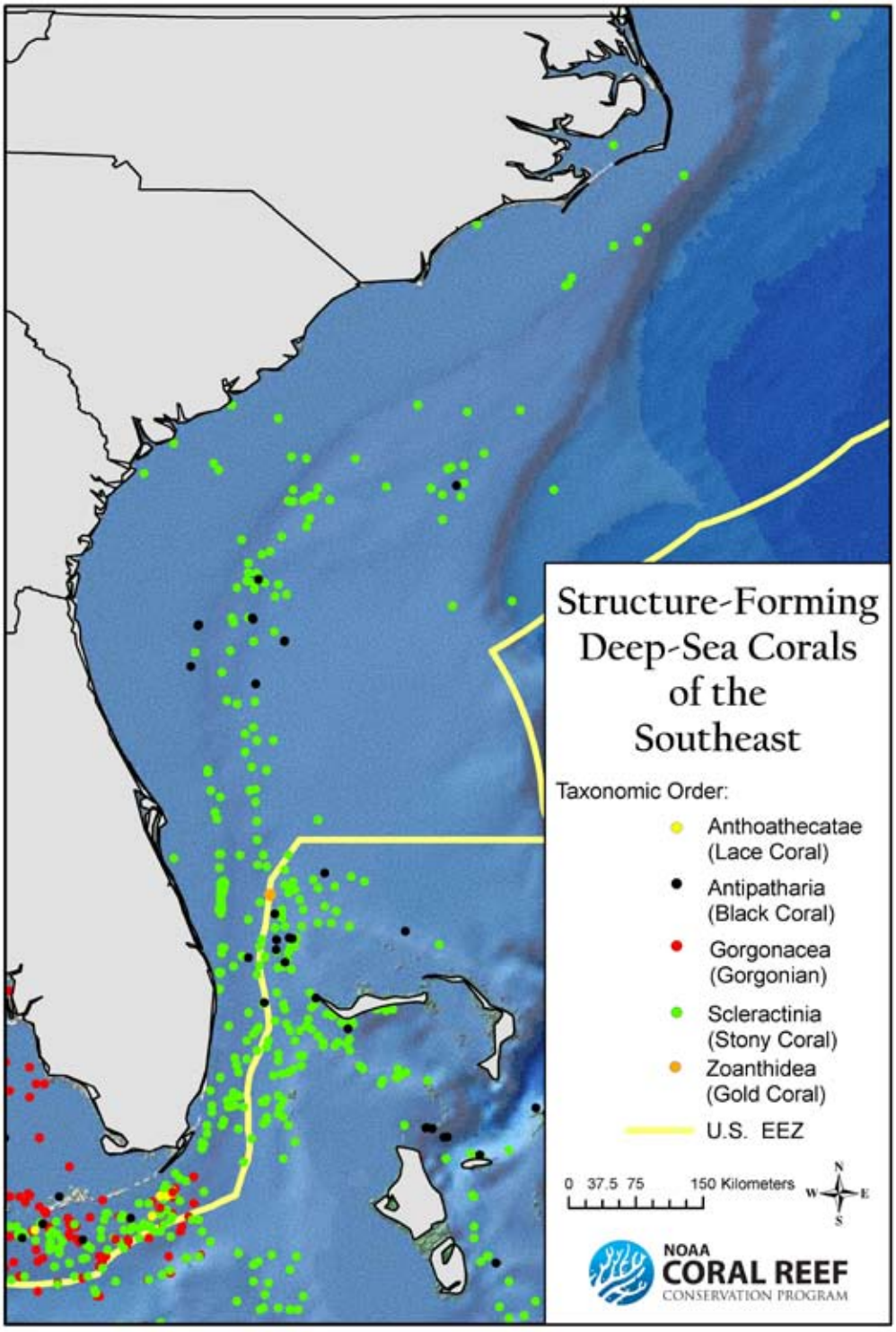
June 2008: "That during phase 2 of the Habitat Omnibus Amendment, the Council will work with the MAFMC to develop protections for deep-sea coral under the authority provided by the reauthorization of the Magnuson-Stevens Reauthorization Act."

In 2008, on the recommendation of MAFMC and with concurrence by the NEFMC, the Secretary of Commerce approved the closure of portions of Lydonia and Oceanographer canyons on the southern flank of Georges Bank to the use of bottom trawls by commercial fishing vessels that are permitted to catch squid, mackerel, and butterfish. The same areas were closed in 2005 to monkfish trawlers. The primary reason for closing these two areas is to protect EFH for Federally-managed demersal fish species that are adversely impacted by bottom trawls. Closures will also have the corollary effect of minimizing fishing impacts on deep-sea corals often found associated with geographic features such as canyons. In November, 2009, portions of these canyons as well as Veatch and Norfolk canyons were closed to all bottom-trawling to protect EFH for tilefish (Appendix 3). The tilefish closures will be more effective than previous measures at protecting deep-sea corals since they will prohibit all bottom trawling activity.

In December 2009, the MAFMC voted to recommend that NMFS nominate Veatch, Norfolk, Lydonia, and Oceanographer Canyons, which are managed under the tilefish FMP, to the National System of Marine Protected Areas.

Box 5: New England Fishery Management Council analyzes fishing impacts on deep-sea corals

The NEFMC's Habitat Plan Development Team is developing a model to evaluate the impacts of fishing on EFH. Three groupings of deep-sea corals (sea pens, stony corals, and soft corals/gorgonians), were identified as structural components of fish habitat in the vulnerability assessment. Their susceptibility to and recovery from impacts from five types of fishing gears were estimated, based on knowledge of coral biology and a comprehensive review of the fishing impacts literature. This information was then incorporated in the model. Results of this analysis were released in late 2009 and will be used to develop and analyze management alternatives intended to protect deep-sea corals.

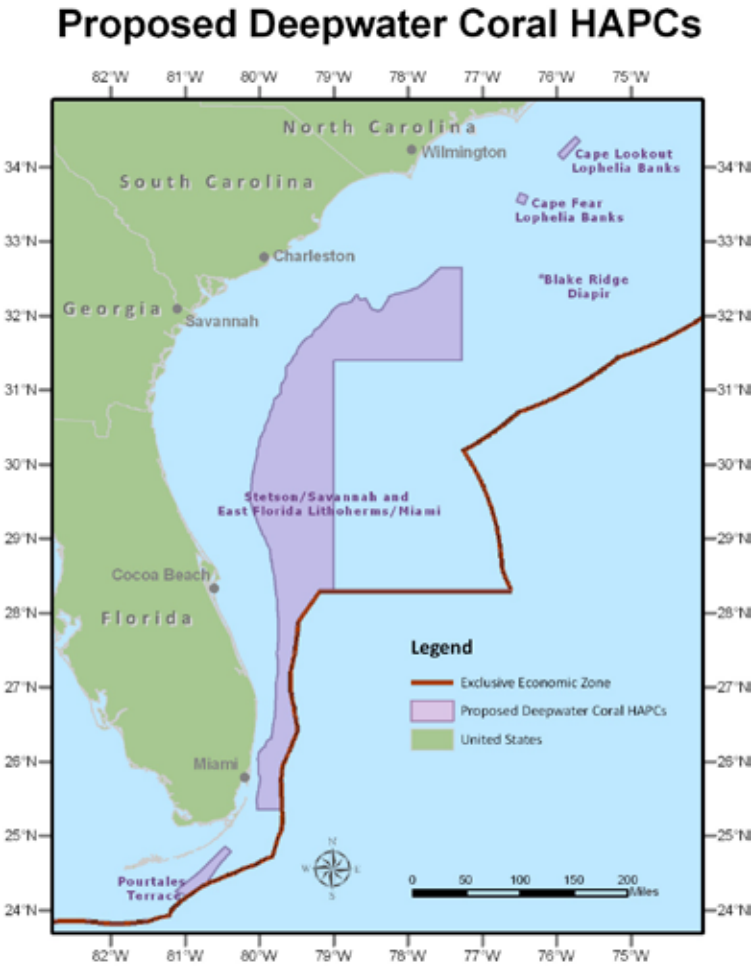


Map 5: Known locations of structure-forming deep-sea corals off the Southeast U.S. The data represent known locations of major structure-forming species of lace corals, black corals, gorgonian corals, colonial stony corals and gold corals. Location data are particularly incomplete for corals other than stony corals. *See page 64 for data sources.*

Southeast – Cape Hatteras to South Florida

As described in Chapter 2, deep-sea stony coral reefs in U.S. waters reach their greatest abundance and development in the Atlantic south of Cape Hatteras (Ross and Nizinski 2007; Map 5). This area was also the first focal region for new field science under the Deep Sea Coral Research and Technology Program. The South Atlantic Fishery Management Council (SAFMC) has authority over fisheries in Federal waters in this region, which includes the waters off North Carolina, South Carolina, Georgia, and the Atlantic coast of Florida, including the Florida Keys.

In September 2009 the SAFMC voted unanimously to approve a Comprehensive Ecosystem-Based Amendment 1 for submission to the Secretary of Commerce. If approved by the Secretary, this landmark amendment will establish five deepwater Coral Habitat Areas of Particular Concern (C-HAPCs)[1] totaling 24,215 square miles (62,717 km^2), protecting complex deepwater coral habitats located off the coasts of the Carolinas, Georgia,

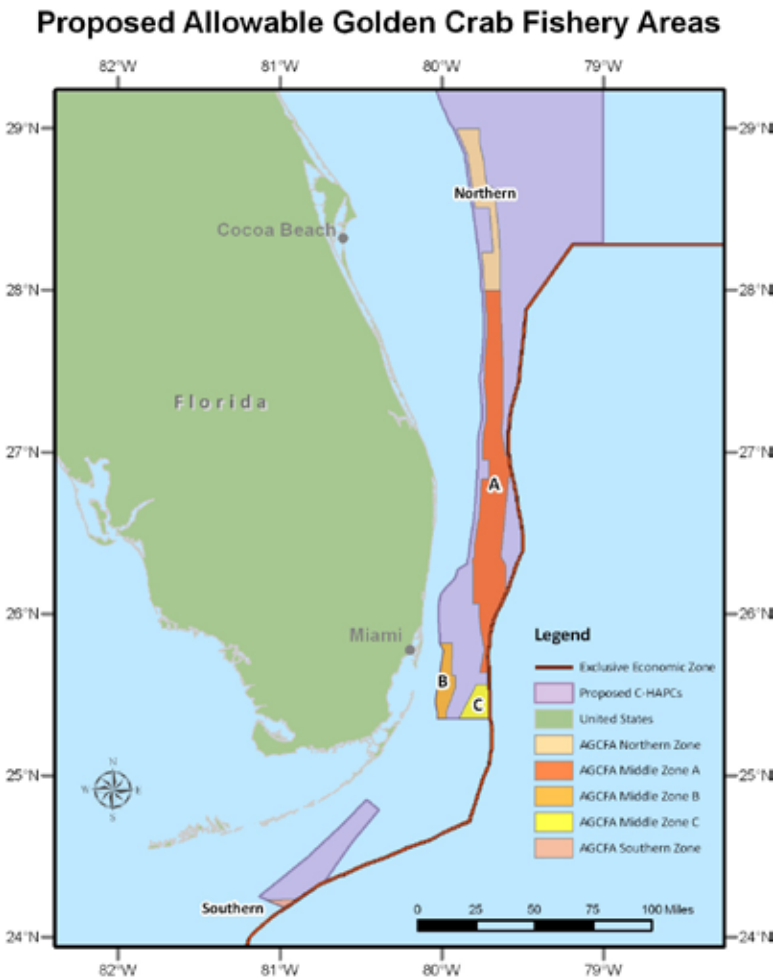


Map 6: South Atlantic Fishery Management Council's proposed Deepwater Coral Habitat Areas of Particular Concern (C-HAPCs). Source: SAFMC

[1] NMFS notes that Coral Habitat Areas of Particular Concern (C-HAPCs) are areas with specific management measures for corals under the South Atlantic Fishery Management Council's Coral, Coral Reef, and Live/Hardbottom Habitat Fishery Management Plan. In contrast, Essential Fish Habitat (EFH), Habitat Areas of Particular Concern (HAPCs) are subsets of EFH for a managed fishery that satisfy the HAPC criteria in the EFH regulatory guidance (50 CFR5600.815 (a)(8)). The Council's C-HAPCs have not been evaluated against the HAPC criteria identified in the EFH regulatory guidance.

and eastern Florida (Map 6). Regulations being proposed for the C-HAPCs mirror those currently in place for the shallower *Oculina* HAPC off central Florida. Within the C-HAPCs possession of coral species and the use of all bottom damaging gear would be prohibited, including bottom longline, trawl (bottom and mid-water), dredge, pot or trap, or the use of an anchor, anchor and chain, or grapple and chain by all fishing vessels. If approved by the Secretary of Commerce, the Stetson Reefs, Savannah and East Florida Lithoherms, and Miami Terrace (Stetson-Miami Terrace) C-HAPC would represent the largest marine protected area on the U.S. East Coast.

The SAFMC also recognized the small traditional fisheries targeting golden crab and royal red shrimp that have set their traps and hauled their nets in areas now known to provide suitable habitat for deep-sea corals. Developed in close consultation with these fisheries, the Council's Comprehensive Ecosystem-Based Amendment proposes "Allowable Golden Crab Fishing Areas" and "Shrimp Fishery Access Areas" within two of the proposed C-HAPCs (Map 7). This action would restrict these fisheries to traditional fishing grounds, providing for the continued existence of these fisheries and the communities they support, while ensuring that they do not expand to areas that have a high potential



Map 7: South Atlantic Fishery Management Council's proposed C-HAPCs and "Allowable Golden Crab Fishing Areas (AGCFAs)." Source: SAFMC

of harboring deep-sea coral ecosystems. The 2009 science cruises of the Deep Sea Coral Research and Technology Program provided information that may help refine these allowable fishing areas in the future.

These historic conservation actions build on many years of efforts by the SAFMC to develop the Comprehensive Ecosystem-Based Amendment and support assembly of information on the region's deep-sea coral ecosystems, both the shallower *Oculina* Banks and the deeper *Lophelia* coral reefs.

Other deep-sea coral activities supported by SAFMC are further described in Box 6.

Box 6: More deep-sea coral activities in the Southeast

• The SAFMC, NOAA, and partners held Deepwater Coral Teacher Workshops in Florida (2008) and North Carolina (2009), which trained educators from kindergarten through college on the deep-sea coral ecosystems in the Southeast region. The SAFMC contributed an article on U.S. deepwater coral ecosystems to a special issue of *Currents: the Journal of Marine Education,* featuring the Regional Fishery Management Councils. The issue will publish in spring 2010.

• The SAFMC's online EcoResearch Database provides a catalogue of relevant ecosystem research in the South Atlantic region. This database helps determine information needs and potential data gaps occurring in SAFMC's jurisdiction. Additional spatial footprints for coral-specific research projects were created in 2008-2009.

• In April 2008, NOAA supported a research cruise to the *Oculina* Bank to revisit deep-sea coral habitat restoration experiments deployed in the past decade. Artificial reef structures were deployed in the Sebastian Pinnacles area of the *Oculina* Bank to stimulate new coral growth and provide structure for reef fish. A dive team, equipped with scooters and digital cameras, documented only limited coral growth on the concrete structures and surrounding habitat. The divers also deployed a bio-observatory designed to stay out for six weeks and capture images and sounds on a living *Oculina* Reef.

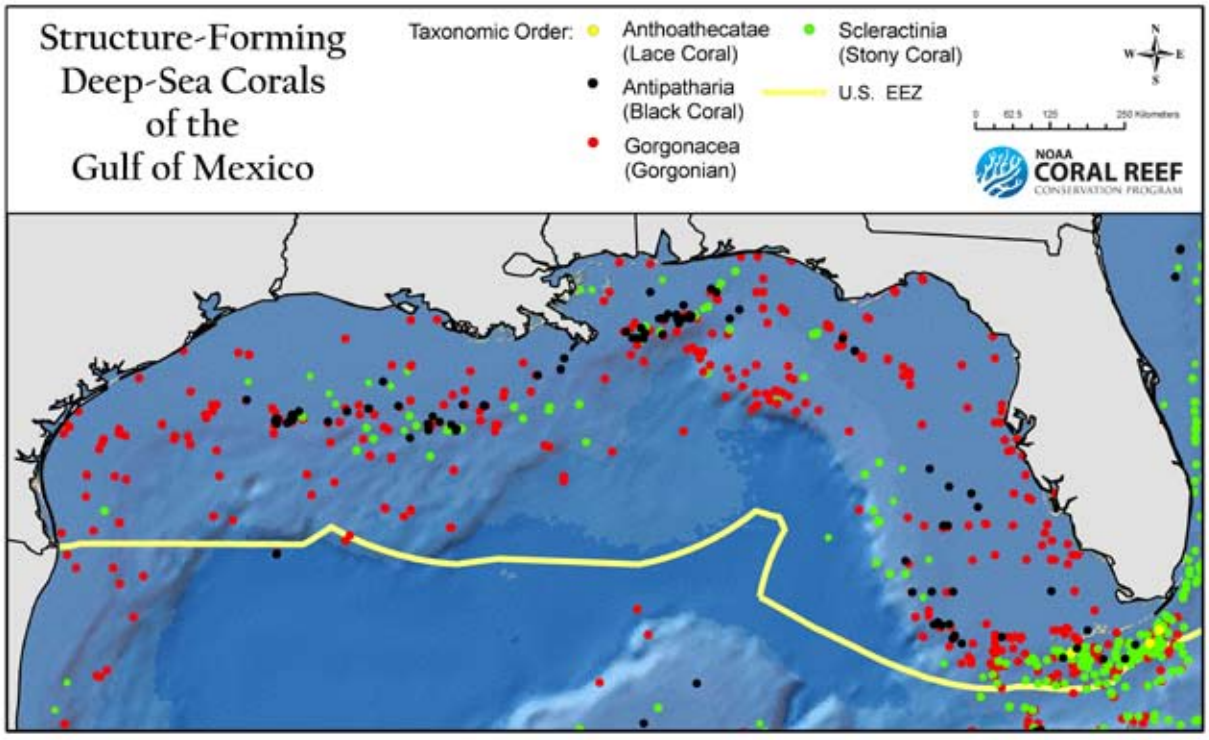
• In October 2009, the Center for Biological Diversity filed a petition seeking to protect 83 coral species, including the deep-sea ivory coral (*Oculina varicosa*) under the Endangered Species Act. Recent research supported by NOAA has revealed that ivory coral from the *Oculina* Banks deep water area was genetically distinct from other *O. varicosa* in nearby shallow waters and other areas of the Atlantic and Gulf of Mexico (Eytan et al. 2009). On February 10, 2010, NMFS announced a 90–day finding on the petition (Federal Register, Vol. 75, pp. 6616-6621) that concluded that the petition presented substantial scientific or commercial information indicating that the petitioned actions may be warranted for 82 species; the petition failed to present substantial scientific or commercial information indicating that the petitioned action may be warranted for *Oculina varicosa*.

Gulf of Mexico – South Florida to Texas

The northern Gulf of Mexico is home to major *Lophelia pertusa* reefs and other deep-sea corals (Brooke and Schroeder 2007; Map 8). Recent compilations of gorgonian records in the Gulf of Mexico (Etnoyer 2009) and new research over the past two years have significantly expanded our knowledge of these resources. The Gulf of Mexico Fishery Management Council (GMFMC) has authority over fisheries in the Federal waters of the Gulf of Mexico off Texas, Louisiana, Mississippi, Alabama, and the west coast of Florida.

Since the first Report to Congress in 2008, the GMFMC has not taken any specific actions to protect deep-sea coral habitats in its region. The Council's five-year review of EFH is due in 2010, including a review of existing and potential HAPCs in each of their FMPs.

The Flower Garden Banks National Marine Sanctuary is located in this region. The sanctuary encompasses three banks in the northwestern Gulf of Mexico and is home to zooxanthellate corals occurring from the crest to at least 170 feet (52 m), as well as deeper communities of gorgonians and black corals. NOAA published the first comprehensive Condition Report for the sanctuary, summarizing the conditions and trends for the sanctuary's habitat and living resources. The sanctuary also conducted research cruises in 2008 and 2009 to characterize the deep water habitat on banks inside and outside the sanctuary. The surveys explored geographic features in areas that may be included in a proposed sanctuary expansion. The habitats encountered were dominated by black corals, gorgonians, sponges, and associated biota. The data



Map 8: Known locations of structure-forming deep-sea corals in the northern Gulf of Mexico. The data represent known locations of major structure-forming species of lace corals, black corals, gorgonian corals and colonial stony corals. Location data are particularly incomplete for corals other than stony and gorgonian corals. *See page 64 for data sources.*

collected are being incorporated into a GIS database, which links the high resolution bathymetry, the georeferenced ROV tracks, still images, and associated inventories of species.

In September 2008, NOAA, MMS, and USGS embarked on a 4-year project to explore new deep-sea coral communities in the deep Gulf of Mexico and to characterize their biology, ecology, and genetic connectivity. In both 2008 and 2009, major expeditions involving scientists from various agencies and universities were conducted from NOAA ships. These expeditions used ROVs to examine ship wrecks and the deep-sea corals colonizing them, as well as to investigate a series of previously unexplored sites along the northern and eastern Gulf of Mexico at depths between 980 and 3,300 feet (300 and 1,000 m). Fish and invertebrate samples were collected on and adjacent to the coral habitat and two benthic landers, designed to collect long-term environmental and biological data, were deployed and retrieved in the vicinity of these deep coral habitats.

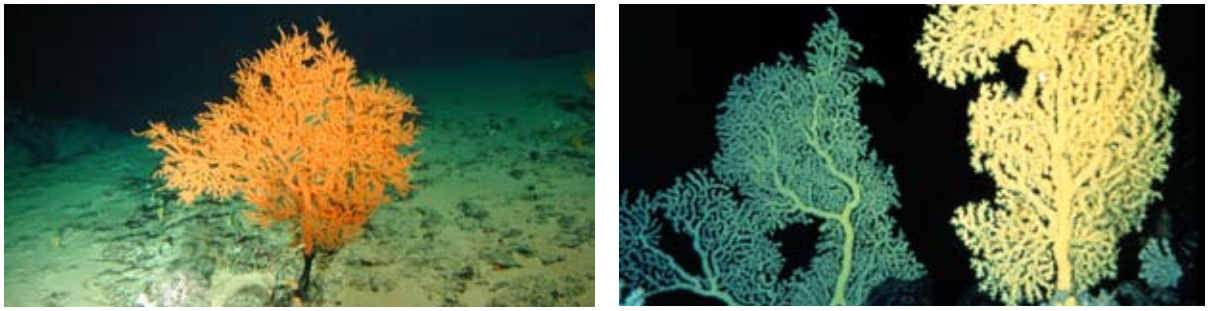
U.S. Caribbean Region – U.S. Virgin Islands, Puerto Rico, and Navassa Island

The U.S. Caribbean includes the waters surrounding Puerto Rico, the U.S. Virgin Islands (USVI), and Navassa Island. Navassa Island is managed as a U.S. Fish and Wildlife Service National Wildlife Refuge. The deeper waters of the region have not been extensively surveyed for deep-sea corals (Lutz and Ginsberg 2007). Deep-sea coral banks have not been reported, but at least 33 species of azooxanthellate deep-sea corals, including the deep water reef builder *Lophelia pertusa*, have been collected from deep reef habitats of the U.S. Caribbean EEZ (García-Sais 2005). The Caribbean Fishery Management Council (CFMC) has authority over fisheries in Federal waters surrounding the Commonwealth of Puerto Rico and the USVI.

The CFMC has not taken new actions to protect deep-sea coral areas since 2007, but continues to be engaged on habitat issues on shallower coral reefs. The original prohibition on the take of corals from the EEZ includes the deeper water species such as the black corals. The CFMC has concentrated efforts on the baseline description and characterization of relatively shallow fish spawning aggregation sites (designated as HAPCs under the EFH Generic Amendment to the FMPs) under management. In the near future, other non-managed areas will be also assessed for the first time, which might include deeper areas (e.g., seamount habitats off the west coast of Puerto Rico, where an important deepwater snapper fishery takes place). The Council's five-year review of EFH will be conducted in 2010. NOAA, in collaboration with the CFMC, the National Park Service, and the USVI and Puerto Rico territorial governments, has continued exploring and characterizing habitats down to 3,300 feet (1,000 m).

Corals may be the oldest living marine animals

Research funded by NOAA has revealed that certain deep-sea coral colonies may live for thousands of years. Radiocarbon dating studies have estimated that colonies of gold coral from Hawaii can live for more than 2700 years, while a Hawaiian deep-sea black coral colony was dated to 4265 years (Roark et al. 2009). This longevity and slow growth suggests that recovery from damage may take millennia.



*Black coral (*Leiopathes *sp., left) and gold coral (*Gerardia *sp., right) in Hawaii*
Photo credit: NOAA Hawaiian Undersea Research Lab (left). J. Moore; OAR/National Undersea Research Program; Hawaii Undersea Research Lab (right).

U.S. Pacific Islands – Hawaii and the United States Pacific Islands

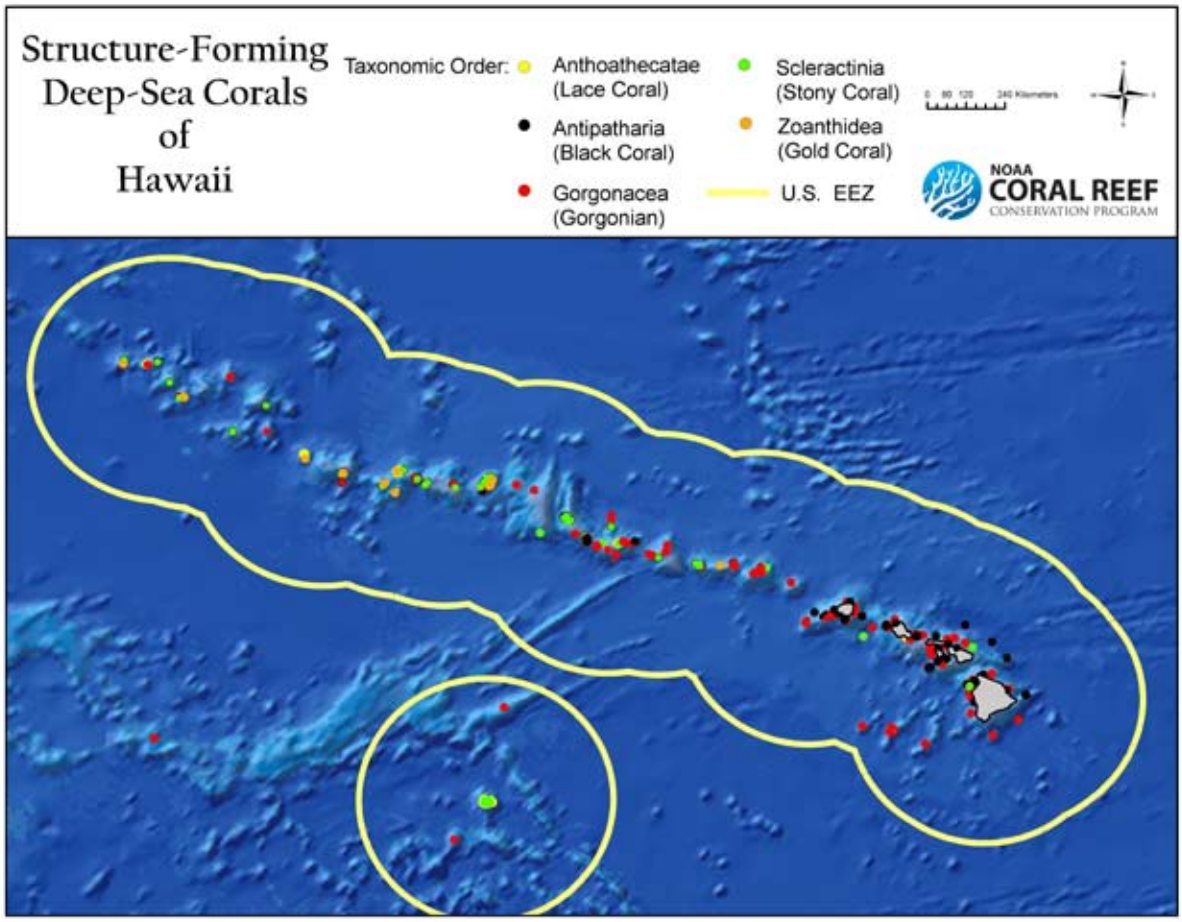
The U.S. EEZ in the Pacific Islands Region covers nearly 2 million square miles of oceans around the State of Hawaii, the Territory of American Samoa, the Territory of Guam, the Commonwealth of the Northern Mariana Islands, and the U.S. Pacific Island possessions, and contains hundreds of seamounts and other deep-sea features. Most studies of deep-sea coral ecosystems here have been limited to the Hawaiian Archipelago (Map 9), and almost nothing is known of the deep-sea coral resources of the other U.S. Pacific Islands. Gorgonians and black corals are the principal structure-forming species on deep Hawaiian slopes and seamounts (Parrish and Baco 2007).

In 2009, three marine national monuments were designated in the central and western Pacific: Marianas Trench, the Pacific Remote Islands, and Rose Atoll, raising their level of environmental recognition and conservation. Destruction or extraction of protected resources within the boundaries of these monuments is now prohibited, as is commercial fishing in the shallower coral reef ecosystem areas of the monuments. Combined, these monuments represent the largest fully protected area in the world, with 195,274 square miles (505,757 km^2) conserved, and are expected to contain important deep-sea coral habitats.

Hawaii has had the only significant U.S. commercial harvests of corals for the jewelry business. Corals collected for jewelry - black, pink, and gold corals - occur throughout the Hawaiian Archipelago. These resources have been managed since 1981 through regulations implementing the Western Pacific Fishery Management Council's Precious Corals FMP and complementary State of Hawaii administrative rules.

In September 2008, NMFS placed a 5-year moratorium on the harvest of gold coral in the Western Pacific region. NMFS also designated the Auau Channel as an Established Bed for black coral under the Precious Corals FMP and set a biennial harvest quota for black coral of 11,000 lbs (5,000 kg). The Council recommended these management measures because of uncertainty in the growth estimates of gold coral and the continued pressure of both fishing and the impact of the invasive soft coral, *Carijoa riisei*, on the black coral stocks in the Auau Channel.

The Council has continued to support assessments of black corals in the Auau Channel. These studies have resulted in the redescription of one species of black coral, and development of a time-series study looking at the effects of the invasive soft coral that has overgrown and killed many commercially valuable black coral colonies. The Council has also supported assessments of black coral reproduction and a black coral mapping project using existing data.



Map 9: Known locations of structure-forming deep-sea corals in waters around the Hawaiian Archipelago. The data represent known locations of major structure-forming species of lace corals, black corals, gorgonian corals, colonial stony corals, and gold corals. *See page 64 for data sources.*

U.S. West Coast Region – Washington, Oregon, and California

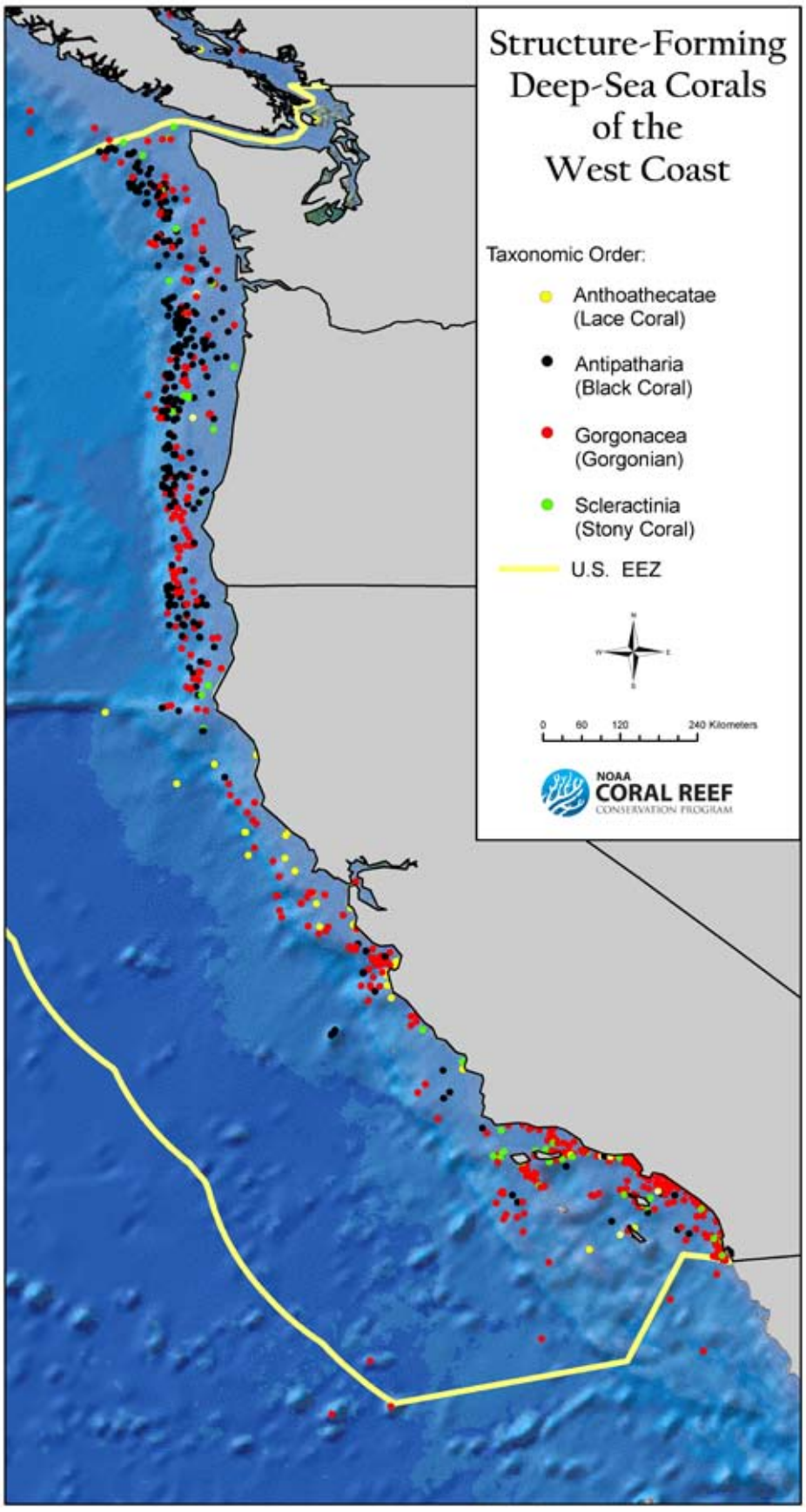
The seafloor off Washington, Oregon, and California contains extensive deep-sea coral communities as documented in NOAA trawl survey catch records and supplemented by museum collection records and underwater vehicle explorations (Whitmire and Clarke 2007). The Pacific Fishery Management Council (PFMC) has authority over fisheries in Federal waters of this region and implemented sweeping measures to protect EFH in areas totaling more than 130,000 square miles (336,700 km^2) in 2006.

PFMC has not taken additional actions to protect deep-sea coral habitats along the West Coast since the first Report to Congress in 2008. The Council has formed an Essential Fish Habitat Review Committee to review and recommend modifications in the designation of groundfish EFH and HAPCs. The committee received a proposal from the NGO Oceana to protect newly discovered deep-sea coral habitats in the Olympic Coast National Marine Sanctuary (NMS) and sponge reefs off the coast of Washington. The Council has tabled the consideration of this proposal until a five-year review of groundfish EFH in 2011.

NOAA manages five National Marine Sanctuaries on the West Coast: the Channel Islands, Monterey Bay, Gulf of the Farallones, Cordell Bank, and Olympic Coast NMS. All contain deep-sea corals. In 2008, NOAA incorporated Davidson Seamount — a volcanic seamount that is home to more than 20 species of deep-sea corals, as well as large sponge fields and deep-sea fishes — into the Monterey Bay NMS, providing additional protection on top of the EFH bottom-gear closure.

To the north, the Olympic Coast National Marine Sanctuary collaborated with Canadian colleagues for a joint ROV survey for deep-sea coral and sponge communities in a July 2008 cruise conducted aboard the Canadian Coast Guard vessel *John P. Tully*. The cruise consisted of two legs, one in Dixon Entrance at the border between Alaska and British Columbia, and the other at the border between Washington and British Columbia, including within the sanctuary. Corals were documented at several new sanctuary sites around the trough of the Juan de Fuca Canyon.

In July 2009, NOAA Office of Ocean Exploration and Research and National Marine Sanctuaries leveraged field trials associated with the NOAA ship *Okeanos Explorer* to complete a backlog of multibeam mapping critical to meeting Sanctuary needs. During the field trials, NOAA personnel mapped a large swath of seafloor off the coast of northern California and Washington, including areas within Cordell Bank, Gulf of the Farallones, and Olympic Coast NMS. Bathymetry and backscatter data were collected mainly in waters deeper than 600 feet (200 m), including continental slope and canyon habitats (e.g., Bodega Canyon). Data are currently being analyzed by NOAA and USGS to create habitat map layers that will allow the agencies to predict the types of seafloor communities in different locations. This new habitat information will help guide NOAA's research and resource protection efforts, including planning for West Coast research activities for FY 2010 under the Deep Sea Coral Research and Technology Program.



Map 10: Known locations of structure-forming deep-sea corals off the U.S. West Coast. The data represent known locations of major structure-forming species of lace corals, black corals, gorgonian corals, and colonial stony corals. *See page 64 for data sources.*

Alaska Region – Gulf of Alaska, Bering Sea, and the Aleutian Islands

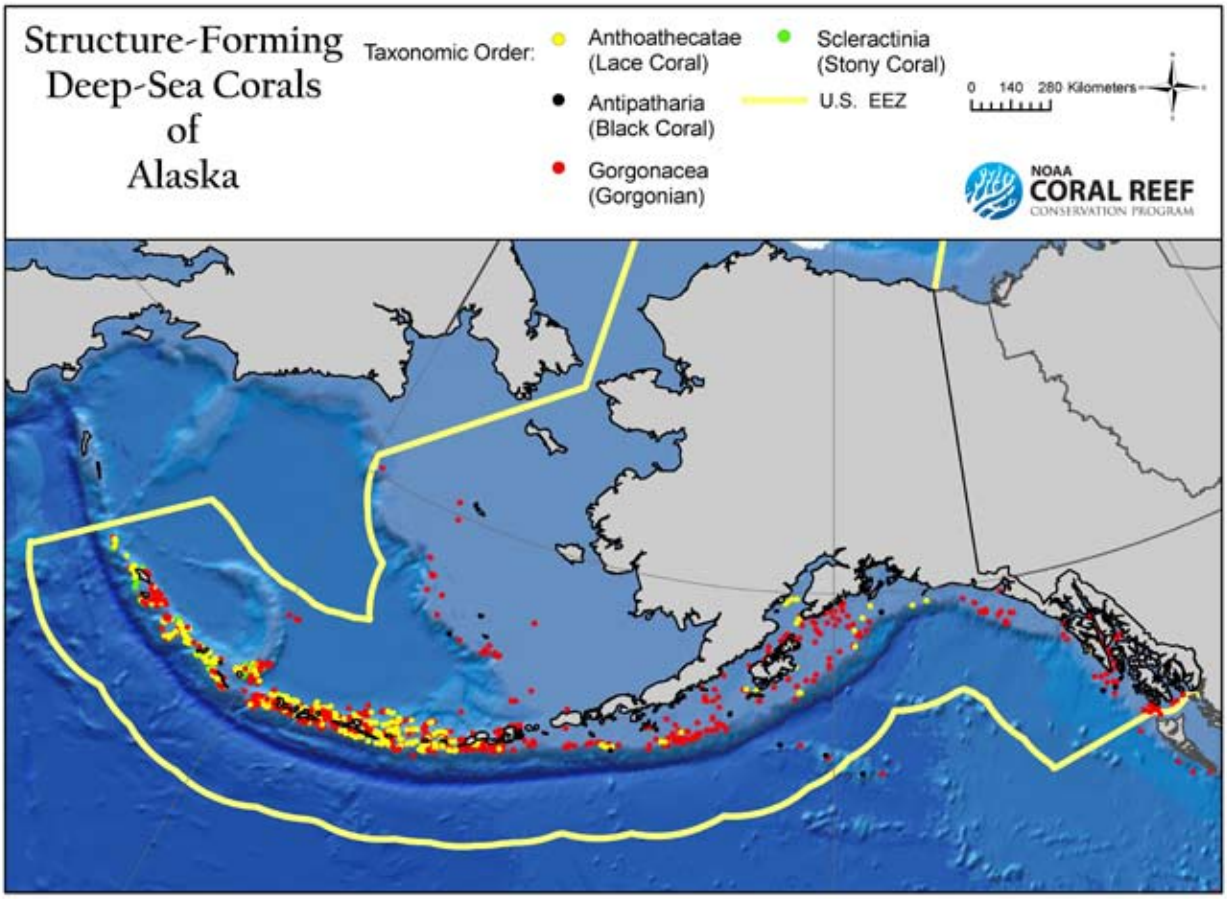
Alaska has some of the richest deep-sea coral habitats in the world, much of which yet to be explored. The North Pacific Fishery Management Council (NPFMC) has authority over fisheries in the 900,000-square-mile (2,330,989 km²) EEZ off Alaska. In 2006, NOAA approved measures recommended by the Council to minimize the adverse effects of fishing on EFH, closing nearly 380,000 square miles (more than 980,000 km²) to bottom trawling in the Aleutian Islands and Gulf of Alaska, including many areas known or suspected to harbor deep-sea corals.

In 2008, additional conservation measures were implemented to protect EFH in the Bering Sea from the potential effects of bottom trawling and to provide the opportunity to further study the effects of such trawling on bottom habitat. These measures also included areas closed to bottom trawling in locations that have not been previously fished with such gear (e.g., Bering Sea Habitat Conservation Area) and in nearshore bottom habitat areas that support subsistence marine resources. True soft corals are the major species occurring in these areas (Stone and Shotwell 2007). Although the closures were not designed specifically to protect deep-sea corals, they represent precautionary measures by the NPFMC to conserve habitats.

In the past two years, the NPFMC has not taken any additional actions specific to deep-sea coral protection. While the Council adopted an Arctic FMP in 2009, which was approved by the Secretary of Commerce and closed the entire Arctic area to commercial fishing, current information, though incomplete, does not indicate the occurrence of significant deep-sea coral resources in the U.S. Arctic.

Large primnoid coral loaded with brittle stars on Dickins Seamount. Photo Credit: Gulf of Alaska cruise, 2004. NOAA Office of Ocean Exploration

Large Paragorgia *coral with galatheid crabs on Pratt Seamount at 800 meters depth.*
Photo Credit: Gulf of Alaska cruise, 2004. NOAA Office of Ocean Exploration



Map 11: Known locations of structure-forming deep-sea corals off Alaska. The data represent known locations of major structure-forming species of lace corals, black corals, gorgonian corals, and colonial stony corals. Location data are particularly incomplete for corals other than stony and gorgonian corals. *See page 64 for data sources.*

3.2 FEDERAL INTERAGENCY COOPERATION

NOAA partners with other Federal agencies to increase understanding of and protection for deep-sea coral ecosystems. Since 2007, coordination on deep-sea coral issues has been facilitated through the Interagency Board on Deep-sea Coral and other Vulnerable Marine Ecosystems established by the National Science and Technology Council's Joint Subcommittee on Ocean Science and Technology. NOAA co-chairs the Board with MMS. The Board has focused on four major areas:

- Coordinating interagency review of major strategic documents.
- Enhancing coordination and planning of major research programs on deep-sea corals, in particular on interagency collaborative research in the northern Gulf of Mexico.
- Coordinating U.S. interagency science advice on international negotiations and processes related to deep-sea ecosystems.
- Providing information exchange and outreach on Federal programs to study and conserve deep-sea ecosystems.

NOAA continues to partner on specific deep-sea coral research and mapping activities with other Federal agencies, particularly USGS and MMS, especially in the Gulf of Mexico as described above. NOAA and USGS have also continued collaboration on a Cold-Water Coral Geographic Database (Scanlon et al. 2009).

Scientists on the August 2009 deep-sea coral cruise in the Southeast U.S. came from NOAA, USGS, and many other organizations. The JSL submersible is in the background.
Photo Credit: NOAA/USGS

3.3 INTERNATIONAL ACTIVITIES

Since the first Report to Congress in 2008, NOAA in coordination with the Department of State and numerous other partners has continued to participate in bilateral and multilateral efforts to understand and protect deep-sea corals and other vulnerable deep-sea ecosystems. For example, NOAA was a cosponsor of the 4th International Symposium on Deep-sea Corals, held in New Zealand in December 2008, and of the International Council on the Exploration of the Seas (ICES) Symposium on Issues Confronting the Deep Oceans, held in the Azores, Portugal, in April 2009. Other NOAA efforts in international fora addressed fishing impacts, coral trade, marine protected areas, seabed mining, and collaborative research as follows.

High-seas fishing impacts

In the late 1990s, the international community began to recognize the need for more measures to protect deep-sea coral ecosystems. Most initial conservation efforts focused on deep-sea coral habitats within the EEZs of individual countries (reviewed by Hourigan 2008). In contrast, action to protect deep-sea coral ecosystems on the high seas was limited and largely uncoordinated until December 2006, when the United Nations General Assembly (UNGA) adopted Sustainable Fisheries Resolution 61/105. This resolution called upon States and Regional Fisheries Management Organizations and Agreements (RFMO/As) to take a series of action to ensure the sustainable management of fish stocks and the protection of vulnerable marine ecosystems (VMEs), including seamounts, hydrothermal vents and cold-water corals, from destructive fishing practices, recognizing the immense importance and value of deep-sea ecosystems and the biodiversity they contain.

Since the 2008 Report to Congress, NOAA has continued to work, in collaboration with the State Department and in consultation with stakeholders, towards the protection of VMEs, in accordance with the 2006 UNGA Resolution 61/105. In 2008, as a result of strong U.S. leadership, the United Nations Food and Agriculture Organization adopted the *International Guidelines for the Management of Deep-Sea Fisheries in the High Seas*. The Guidelines, which are consistent with domestic management approaches, are intended to assist RFMO/As in their adoption

Box 7: More on high seas fishing

Fishing activities that have an adverse impact on deep-sea corals and other VMEs located beyond national jurisdiction, for which there are no applicable conservation or management measures or in areas with no applicable RFMO/As are defined as illegal, unreported, and unregulated fishing under the High Seas Driftnet Fishing Moratorium Protection Act (Moratorium Protection Act), as amended by the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act.

NOAA is currently revising the regulations for the High Seas Fishing Compliance Act, which establishes a system of permitting, reporting, and regulation for U.S. vessels fishing on the high seas. One aspect of the revisions will be to ensure that the U.S. is fully compliant with the relevant bottom fishing sections of UNGA Resolution 61/105. Currently, by policy, all U.S. fishing activities on the high seas must be reviewed for their potential environmental impacts; the revised regulations will codify this requirement. No U.S. vessels were authorized to bottom fish on the high seas in 2009.

and implementation of conservation and management measures pursuant to Resolution 61/105, including criteria for identifying VMEs and assessing the impacts of fishing activities on such ecosystems.

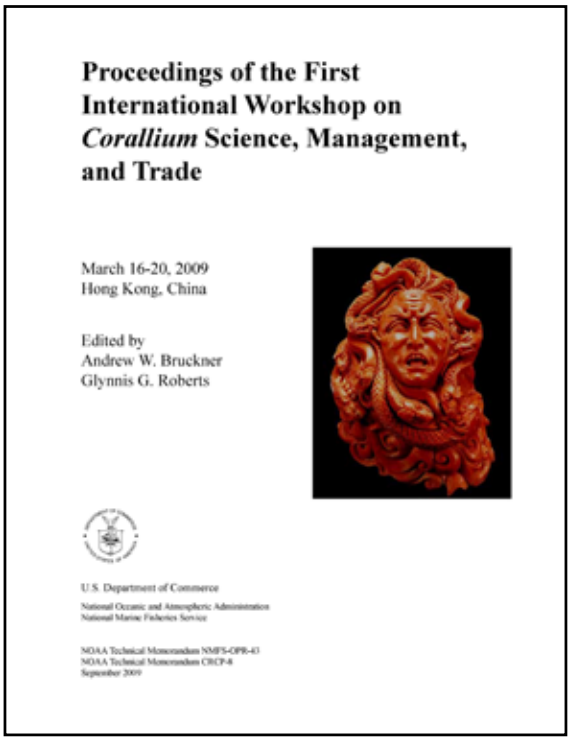
RFMO/As have adopted a number of measures to protect VMEs including deep-sea corals. Measures taken through early 2009 are reviewed in a report by the United Nations Secretary General (UNGA 2009), and additional actions have been taken by several RFMOs in 2009 after the report was released. Furthermore, the U.S. continues to participate in negotiations to develop two new RFMAs to manage bottom fisheries: one in the North Pacific and one in the South Pacific, which have adopted interim measures consistent with UNGA Resolution 61/105. The negotiations for the South Pacific RFMO successfully agreed a Treaty text in November 2009.

In 2009, the UNGA reviewed the implementation of Resolution 61/105 and recognized that, while important progress has been made, further actions are urgently needed to respond fully to the Resolution. Specific calls for action are detailed in Appendix 4.

Deep-sea coral trade

Deep-sea corals in the genus *Corallium*, also known as red and pink precious corals, are harvested around the world for jewelry and curios. In 2007, the U.S. proposed listing these corals on Appendix II under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). CITES Appendix II lists species that are not necessarily threatened with extinction now, but that may become so if trade is not closely controlled. International trade is permitted for species listed in CITES Appendix II if the exporting country makes findings that harvest of the species was legal and that the trade is sustainable. All black, hydrozoan, and stony corals are already included in Appendix II of CITES.

In 2009, NOAA helped organize and fund workshops in Hong Kong and Italy to resolve a number of challenges in implementing and enforcing a potential Appendix II listing for *Corallium* and to determine if adequate biological data were available for *Corallium* populations to demonstrate that the taxa had declined to levels required for listing the species in



NOAA published the proceedings of the First International Workshop on Corallium *Science, Management, and Trade in 2009.*

CITES. International experts from governments, academia, NGOs, and the CITES Secretariat shared information on the coral's biology, fisheries and trade and discussed issues that could improve the effectiveness of a potential CITES Appendix II listing. Proceedings of the Hong Kong workshop (Bruckner and Roberts 2009) have been published. Based on these workshops, the U.S. and the European Union cosponsored a proposal to add precious red and pink corals of the genus *Corallium* to CITES Appendix II. This proposal will be considered at the 2010 CITES Conference of the Parties.

Ecologically or biologically significant deep-sea habitats

In 2008, the Conference of Parties to the Convention on Biological Diversity adopted scientific criteria for identifying ecologically or biologically significant marine areas in need of protection in open-ocean waters and deep-sea habitats, and scientific guidance for designating representative networks of marine protected areas. Although the U.S. is not a party to the convention, NOAA experts, working with the Department of State, provided scientific input into the development of these criteria/guidelines. NOAA has subsequently contributed to the follow-on process to identify ecologically and biologically significant marine areas with particular considerations for deep-sea corals, which States and RFMOs can consider when developing management measures.

Seabed mining

Mining the deep seafloor for metals is not yet a viable commercial enterprise. However, the last two years have seen increased interest and investment in mineral exploitation. Potential targets for seabed mining include cobalt-enriched crusts, which occur as thin layers on the flanks of volcanic islands and seamounts at 3,300 to 8,200 feet (1,000 to 2,500 m) depths, where deep-sea corals also occur. Mineral exploitation outside areas of national jurisdiction would be governed by guidelines set forth by the International Seabed Authority, established under the United Nations Convention on the Law of the Sea. Although not a Party to the Convention, or a member of the Authority, the U.S. has been active in providing scientific expertise to their work. In 2009, the Authority considered a proposal to establish a network of areas in the Central Pacific Ocean where no exploration or mining activity should take place. It also made further progress on the elaboration of draft regulations on prospecting and exploration for cobalt-rich ferromanganese crusts.

International collaborative research

NOAA has actively participated with other U.S., European, and Canadian partners in planning for a Transatlantic Coral Ecosystem Study (TRACES). TRACES is a scientific program being developed to investigate deep-sea corals found along the continental shelf break and slope, and in association with canyons and seamounts, in the North Atlantic Ocean. In 2009, the partners completed a TRACES Science Plan.

NOAA also continues to work with the Census of Marine Life and ICES to enhance understanding and conservation of deep-sea corals and other deep-sea ecosystems. NOAA currently chairs the Northwest Atlantic Fisheries Organization/ICES Working Group on Deepwater Ecology, which is providing advice on management efforts to protect VMEs in the North Atlantic.

CHAPTER 4: CONCLUSIONS AND NEXT STEPS

FY 2009 marked the beginning of funded activities under the MSA-authorized Deep Sea Coral Research and Technology Program (MSA Sec. 408). Appropriations were received in the second quarter, and many activities are just getting underway. The Program has conducted successful deep-sea coral mapping and field research operations in the Southeast U.S. that were developed in consultation with the South Atlantic Fishery Management Council. This research confirmed the presence of important deep-sea coral communities in one area that is part of the Council's proposals to protect more than 24,000 square miles of habitat through the establishment of deepwater Coral Habitat Areas of Particular Concern (C-HAPCs). The Council's Comprehensive Ecosystem-Based Amendment 1 containing these provisions has been submitted to the Department of Commerce for final approval.

NOAA has not yet analyzed new information on deep-sea coral locations, and therefore no new deep-sea coral areas have been identified in this report (Appendix 3). NOAA is developing a coordinated national data management approach that will assist in the identification, analysis and distribution of management-relevant data on deep-sea coral ecosystems.

Fiscal Year 2010 and Beyond: NOAA's *Strategic Plan for Deep-Sea Coral and Sponge Ecosystems: Research, Management, and International Cooperation* (NOAA, in review) provides an overall framework for NOAA's deep-sea coral program activities in the coming years. In FY 2010, the President's budget request and Congress' appropriation for NOAA included an additional $1 million, for a total program of $2.5 million. Planned activities include the following:

- The Program will continue the second year of field science activities in the Southeast U.S., targeting the deepwater *Lophelia* coral reef ecosystems in the South Atlantic Council's recommended C-HAPCs.
- Increased funding will allow NOAA to expand field science activities to deep-sea coral habitats off the U.S. West Coast (Box 8).
- These multi-year field efforts will be complemented by smaller-scale investments in all regions, designed to address other requirements of the Program through analysis and management of existing information, outreach, and other high-value targeted activities. NOAA expects to modestly increase the resources available to these high-value, lower-cost initiatives in 2010 and to begin efforts to model the predicted distributions of deep-sea corals.
- In FY 2010, NOAA will also extend its outreach efforts to engage with the Regional Fishery Management Councils on deep-sea coral issues. In particular, NOAA will further encourage the Councils to evaluate areas for protection known to contain deep-sea corals as allowed under discretionary provisions of the MSA as amended, including the areas included in Appendix 3.

As the Deep Sea Coral Research and Technology Program moves forward, it will continue to emphasizes collaborative approaches and leverage the critical complementary activities funded by other NOAA programs and external partners to support exploration, research and management of deep sea coral ecosystems. This will include enhancing the comparability of methods, sharing of data, and leveraging resources among programs to maximize the conservation impact for deep-sea coral ecosystems.

The Program expects to conduct 3-year field research and mapping activities in the Southeast U.S. (FY 2009-2011) and West Coast (FY 2010 – 2012). Given the high cost of deep-sea field operations, a 3-year effort will allow preliminary research on only the highest priority deep-sea coral areas in a portion of these large geographic regions. The Program plans to shift

Box 8: Field research off the West Coast

In FY 2010, the Program will begin a 3-year field research effort designed to inform management decisions as they relate to deep-sea coral habitats. The West Coast was chosen as the second focal area based primarily on the following criteria:

- PFMC is scheduled to review its EFH designations in 2011, many of which were designed to protect biogenic habitats including deep-sea corals. NOAA and PFMC have been petitioned by Oceana to protect recently discovered deep-sea coral (see Appendix 3) and sponge areas off Washington, but have identified that additional information is needed to understand the extent of such habitats before the existing FMPs are amended.

- The region includes five National Marine Sanctuaries with rich deep-sea coral resources, all of which have identified the need for increased information on these habitats. All five sanctuaries are currently reviewing and updating their management plans, and pending legislation calls for sanctuary expansions at the Cordell Bank and the Gulf of the Farallones sanctuaries. These efforts would be informed by this research. The ability to address management needs of multiple NOAA Line Offices in this region was considered an important plus.

- The region is known to have extensive and important gorgonian and black coral habitats, but much of the current information is limited to observations from NMFS trawl surveys. Targeted ROV and AUV studies have the potential to provide valuable new information on these habitats.

funding to new regions by FY 2012 and 2013. In consultation with the Regional Fishery Management Councils, the Program has developed criteria to identify the future priority geographic regions for new field research. Based on the criteria, the next regions for major new field activities under the Program would be Alaska (North Pacific Fishery Management Council Region) and the Northeast U.S. (New England and Mid-Atlantic Fishery Management Council Regions).

The Program will look for opportunities to enhance international cooperation on deep-sea coral science. One of the greatest challenges in the implementation of measures to protect vulnerable marine ecosystems on the high seas is a lack of information on the distribution of these ecosystems in most regions. NOAA and the Department of State will continue to actively engage in various RFMO/As and through other regional and multilateral organizations to protect these ecosystems. While the Deep Sea Coral Research and Technology Program is a domestic program, it offers an opportunity to leverage U.S. expertise to help meet international conservation goals.

NOAA is a leading participant in the development of the National Ocean Policy called for by President Obama in June 2009. The Deep Sea Coral Research and Technology Program is designed to support the Ocean Policy's implementation strategy, particularly its emphasis on ecosystem-based management, comprehensive marine spatial planning, and regional ecosystem protection.

A NOAA scientist adjusting the ROPOS ROV on a cruise off the West Coast.
Photo Credit: Olympic Coast NMS

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LIST OF ACRONYMS

AUV	Autonomous underwater vehicle
C-HAPC	South Atlantic FMC's deepwater Coral Habitat Area of Particular Concern
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CFMC	Caribbean Fishery Management Council
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
FMC	Fishery Management Council
FMP	Fishery Management Plan
FY	Fiscal Year
GIS	Geographic information system
GMFMC	Gulf of Mexico Fishery Management Council
HAPC	Habitat Area of Particular Concern
HBOI	Harbor Branch Oceanographic Institute
ICES	International Council for the Exploration of the Sea
JSL	*Johnson Sea Link* submersible
MAFMC	Mid-Atlantic Fishery Management Council
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MMS	Minerals Management Service
NEFMC	New England Fishery Management Council
NESDIS	National Environmental Satellite, Data, and Information Service
NGO	Non-governmental organization
NMFS	National Marine Fisheries Service
NMS	National Marine Sanctuary
NOAA	National Oceanic and Atmospheric Administration
NOS	National Ocean Service
NPFMC	North Pacific Fishery Management Council
OAR	Office of Oceanic and Atmospheric Research
PaCOOS	Pacific Coast Ocean Observing System
PFMC	Pacific Fishery Management Council
RFMO/A	Regional Fishery Management Organizations and Agreements
ROV	Remotely operated vehicle
SAFMC	South Atlantic Fishery Management Council
TRACES	Trans-Atlantic Coral Ecosystem Study
UNCW	University of North Carolina at Wilmington
UNGA	United Nations General Assembly
USF	University of South Florida
USGS	U. S. Geological Survey
USVI	United States Virgin Islands
VME	Vulnerable marine ecosystem
VMS	Vessel monitoring system
WHOI	Woods Hole Oceanographic Institute

APPENDICES

Appendix 1. 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.

Appendix 2. Major Deep-Sea Corals

Deep-sea corals, also referred to as cold-water corals, are a taxonomically and morphologically diverse collection of organisms distinguished by their occurrence in deep or cold oceanic waters. The calcified skeletons of certain branching stony coral species, such as *Lophelia pertusa*, can 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. 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. The following table includes the major groups of deep-sea corals referred to in this Report.

MAJOR DEEP-SEA CORAL GROUPS (Phylum Cnidaria) [1]

Class	Subclass	Order	Common Name	Additional Information
Anthozoa—corals, sea anemones, sea pens	Hexacorallia	Scleractinia	Stony corals	A few species form deepwater reef-like structures known as bioherms, coral banks, or lithoherms.
		Zoanthidea	Gold corals	Only zoanthids in the family Gerardiidae form rigid skeletons.
		Antipatharia	Black corals	Many branching forms. Certain species harvested for jewelry in Hawaii.
	Octocorallia	Alcyonacea	True soft corals	Most are not major structure-forming species.
		Gorgonacea	Gorgonians, sea fans, sea whips	Many branching forms. At least 12 families contain major structure-forming species.
		Pennatulacea	Sea pens	Unlike other species, sea pens are found on soft sediments. Contribution as habitat and to biodiversity is not well understood.
Hydrozoa—hydroids and hydromedusae	Hydroidolina	Anthoathecatae (Family Stylasteridae)	Stylasterids or lace corals	Can form branching colonies. May be confused with stony corals but the resemblance is superficial.

1 Source NOAA (2008). More detailed information on the taxonomic classification of deep-sea corals can be found in Hourigan et al. (2007).

Appendix 3. Deep-Sea Coral Areas in the U.S. EEZ with Limited Protection from Interactions with Fishing Gear

Below is the initial list, excerpted from the first Report to Congress (NOAA 2008), of areas known to contain aggregations of deep-sea corals that currently have limited or no protection from interactions with bottom-tending fishing gear. Areas whose status has changed or where significant steps have been taken to increase protection (e.g., Council action) since 2008 are highlighted in blue. The Councils are considering many of these areas for HAPC designations. The areas were identified through NOAA survey and research cruises, research by academic and Federal partners, and information collected by Regional Fishery Management Council and National Marine Sanctuary processes.

The Deep Sea Coral Research and Technology Program has just begun additional analysis of areas, and no new deep-sea coral areas have been identified for this report. This is not a complete list of deep-sea coral areas. Detailed location data for deep-sea coral resources associated with these general areas will be made available to the Councils. NOAA will continue to develop the list as research continues and new information on the location of deep-sea corals is obtained.

Fishery Management Council (FMC) Region	Identified Area with Deep-sea Corals	Current Status of Protection from Bottom-Tending Fishing Gear Impacts	Reference
New England FMC	Bear Seamount	NEFMC Proposed HAPC	Packer et al. 2007; NEFMC 2007.
	Retriever Seamount	NEFMC Proposed HAPC	Packer et al. 2007; NEFMC 2007.
	Heezen Canyon	NEFMC Proposed HAPC	Hecker and Belchschmidt 1980; Watling et al. 2003; Packer et al. 2007; NEFMC 2007
	Lydonia Canyon	• NE & MAFMC monkfish bottom-trawl & gill net closure • MAFMC squid, mackerel, & butterfish bottom-trawl closure • MAFMC closed to bottom-trawling to protect tilefish EFH. • NEFMC Proposed HAPC	Watling et al. 2003; Packer et al. 2007; MAFMC 2008a; MAFMC 2008b (final rule effective 2009); NEFMC 2007.
	Oceanographer Canyon	• NE & MAFMC monkfish bottom-trawl & gill net closure • MAFMC squid, mackerel, & butterfish bottom-trawl closure • MAFMC closed to bottom-trawling to protect tilefish EFH. • NEFMC Proposed HAPC	Watling et al. 2003; Packer et al. 2007; MAFMC 2008a; MAFMC 2008b (final rule effective 2009); NEFMC 2007.

Fishery Management Council (FMC) Region	Identified Area with Deep-sea Corals	Current Status of Protection from Bottom-Tending Fishing Gear Impacts	Reference
New England FMC (cont.)	Veatch Canyon [1]	• MAFMC closed to bottom-trawling to protect tilefish EFH • NEFMC Proposed HAPC	Hecker and Belchschmidt 1980; Hecker et al. 1983; Watling et al. 2003; Packer et al. 2007; MAFMC 2008b (final rule effective 2009); NEFMC 2007
	Slope near Alvin Canyon	• NEFMC Proposed HAPC	Hecker and Belchschmidt 1980; Watling et al. 2003; Packer et al. 2007; NEFMC 2007.
	Western Jordan Basin	• No special protections	Auster 2005 and Watling et al. 2003; Auster (unpublished)
	Mount Dessert Rock Area	• No special protections	Auster 2005 and Watling et al. 2003
	Georges Tower off the Northern Edge of Georges Bank	• No special protections	Watling and Auster 2005
Mid-Atlantic FMC	Toms/Carteret Canyon	• NEFMC Proposed HAPC	Hecker and Belchschmidt 1980 ; Watling et al. 2003 ; Packer et al. 2007 ; NEFMC 2007.
	Hendrickson Canyon	• NEFMC Proposed HAPC	Hecker et al. 1983 ; Watling et al. 2003 ; NEFMC 2007.
	Baltimore Canyon	• NEFMC Proposed HAPC	Watling et al. 2003; Packer et al. 2007 ; NEFMC 2007
	Norfolk Canyon	• MAFMC closed to bottom-trawling to protect tilefish EFH. NEFMC Proposed HAPC	Watling et al. 2003; Packer et al. 2007; MAFMC 2008; NEFMC 2007
South Atlantic FMC	North Carolina *Lophelia* banks	• SAFMC Proposed Cape Lookout and Cape Fear *Lophelia* Banks C-HAPCs	Ross and Nizinski 2007; SAFMC 2009
	Stetson Banks	• SAFMC Proposed Stetson Reef, Savannah and East Florida Lithoherms and Miami Terrace C-HAPC (Stetson-Miami Terrace C-HAPC) . Imagery from the 2009 research cruise off Cape Canaveral for two high-relief sites within the proposed Stetson-Miami Terrace C-HAPC between two of the "Allowable Golden Crab Fishing Areas" revealed very healthy cover of *Lophelia pertusa*. Almost 100% were live colonies. While these sites were already contained within the proposed C-HAPC, no groundtruthing had yet taken place.	Ross and Nizinski 2007; SAFMC 2009
	Savannah Banks		Ross and Nizinski 2007; SAFMC 2009
	Cape Canaveral Banks		Ross and Nizinski 2007; SAFMC 2009
	Miami Terrace		Ross and Nizinski 2007; SAFMC 2009
	Pourtales Terrace (shared with Gulf of Mexico Council)	• SAFMC Proposed Pourtales Terrace C-HAPC	Brooke and Schroeder 2007; SAFMC 2009

[1] *Deep-sea corals were found near the head of this canyon and on nearby slopes, but it is unclear from the literature if deep-sea corals have been found in the canyon proper.*

Fishery Management Council (FMC) Region	Identified Area with Deep-sea Corals	Current Status of Protection from Bottom-Tending Fishing Gear Impacts	Reference
Gulf of Mexico FMC [2]	Pourtales Terrace (shared with South Atlantic Council)	• SAFMC Proposed C-HAPC	Brooke and Schroeder 2007
	Southwest Florida Slope *Lophelia* lithoherms	• No special protections	Brooke and Schroeder 2007
	Mississippi-Alabama Pinnacles	• No special protections	Brooke and Schroeder 2007
	Viosca Knoll	• No special protections	Brooke and Schroeder 2007
	Mississippi Canyon	• No special protections	Brooke and Schroeder 2007
	Green Canyon	• No special protections	Brooke and Schroeder 2007
	Northwest Texas-Louisiana Shelf Banks	• East and West Flower Garden Banks; Stetson Bank and McGrail Bank – Anchoring, bottom trawl gear, bottom longlines, buoy gear, and all traps/pots prohibited to protect coral. East and West Flower Garden Banks and Stetson Bank are part of the Flower Garden Banks National Marine Sanctuary. • Numerous banks in the NW Gulf of Mexico harbor significant populations of deep water corals, are HAPCs, but do not carry any protection measures. These include, but are not limited to: 29 Fathom, Elvers, MacNeil, Rankin, 28 Fathom, Bright, Geyer, Elvers, Sonnier, Bouma, Rezak, Sidner, Parker, Alderdice, and Jakkula Banks.	GMFMC 2005 (final rule effective 2006).
Caribbean FMC	Mona Passage – Puerto Rico	• No special protections	Lutz and Ginsberg 2007
Western Pacific FMC	All areas of the EEZ are protected from bottom-tending gear.	• Areas in the EEZ are protected from bottom-tending gear • Areas within the National Monument are fully protected.	Parrish and Baco 2007

[2] *In addition to the deep-sea coral areas identified here, there are likely also azooxanthellate deep-sea corals associated with the deeper areas of Pulley Ridge and the North and South Tortugas Ecological Reserves. The Tortugas Ecological Reserves and portions of Pulley Ridge have been designated as HAPCs by the GMFMC, and bottom trawl gear, bottom longlines, buoy gear, and all traps and pots are prohibited to protect coral.*

Fishery Management Council (FMC) Region	Identified Area with Deep-sea Corals	Current Status of Protection from Bottom-Tending Fishing Gear Impacts	Reference
North Pacific FMC [3]	Bering Sea Slope	• The shelf break and upper slope, including areas of Pribilof and Zhemchug Canyons, contain areas of deep-sea corals that currently have no special protections. • Deeper areas near the base of the slope are protected from bottom trawling.	Stone and Shotwell 2007; AFSC 2007
	Aleutian Island "coral gardens"	• Six Aleutian Island "coral gardens" documented in 2002 were protected in 2006 from all bottom-contact gear, and additional vast areas of seafloor are protected from bottom trawling. • Since 2005, additional coral areas have been discovered, some of which are in areas not currently protected.	Stone and Shotwell 2007; AFSC 2007
	Gulf of Alaska *Primnoa* coral habitats [4]	• Bottom-contact gear is prohibited from five small areas in the Gulf of Alaska to protect red tree corals (*Primnoa* sp.). Recently surveys in and near the protected areas indicate that other coral resources are present outside the protected areas.	Stone and Shotwell 2007; AFSC 2007
Pacific FMC [5]	Olympic Coast National Marine Sanctuary Octocoral, stylasterid and scleractinian (*Lophelia pertusa*) aggregations	• Portions of the Sanctuary are protected from bottom-trawling conducted under regulations implementing PFMC management plans. • Recent surveys discovered deep-sea corals outside the no-trawl area.	Brancato et al. 2007; Whitmire and Clarke 2007
	Monterey Canyon (gorgonians)	• Certain areas have no special protections	Whitmire and Clarke 2007
	Astoria Canyon (gorgonians and black corals)	• Certain areas have no special protections	Whitmire and Clarke 2007

[3] *NOAA trawl surveys indicate that many deep-sea coral habitats occur in the Gulf of Alaska and the Aleutian Island chain. The identified areas are only a few that have received more directed field study using ROVs or submersibles.*

[4] *Including Fairweather Ground and Shatter Ridge (southwest of Cape Ommaney).*

[5] *NOAA trawl surveys indicate that many deep-sea coral habitats occur along the continental shelf edge and slope along the West Coast. The identified areas are only a few that have received more directed field study using ROVs or submersibles.*

Appendix 4. United Nations General Assembly Sustainable Fisheries Resolution (2009)

The 2009 UNGA Sustainable Fisheries Resolution (64/72) was adopted on December 4, 2009. Among its provisions, the Resolution recognizes the actions taken by States and RFMO/As to give effect to Resolution 61/105, but considers that further actions are needed to strengthen its implementation. In this regard, the Resolution calls upon States and RFMO/As to:

- conduct assessments called for in 61/105, consistent with the Guidelines, and to ensure that vessels do not engage in bottom fishing until such assessments have been carried out
- conduct further marine scientific research and use the best scientific and technical information available to identify where VMEs are known to occur or are likely to occur and adopt conservation and management measures to prevent significant adverse impacts on such ecosystems consistent with the Guidelines, or close such areas to bottom fishing until conservation and management measures have been established
- establish and implement appropriate encounter protocols, including definitions of what constitutes evidence of an encounter with a vulnerable marine ecosystem, in particular threshold levels and indicator species, based on the best available scientific information and consistent with the Guidelines
- enhance efforts to cooperate to collect and exchange scientific and technical data and information related to the implementation of the measures called for in the relevant paragraphs of Resolution 61/105 and the 2009 resolution to manage deep sea fisheries in areas beyond national jurisdiction and to protect VMEs from significant adverse impacts of bottom fishing by, inter alia exchanging best practices and developing, where appropriate, regional standards with a view to examining current scientific and technical protocols and promoting consistent implementation of best practices across fisheries and regions

The Resolution also encourages States and RFMO/As to develop or strengthen data collection standards, procedures and protocols and research programs for identification of vulnerable marine ecosystems, assessment of impacts on such ecosystems, and assessment of fishing activities on target and non-target species.

The UNGA also decided to conduct another review in 2011 of actions taken by States and RFMO/As to protect VMEs and sustainably manage deep-sea fisheries in response to the actions called for in Resolution 61/105 as well as the 2009 Resolution, and will include, as part of that review, a 2-day workshop to allow for broader participation in the review process.

DATA SOURCES FOR THE MAPS

Northeast (Map 4):
Scanlon et al. (in press)
Dave Packer, NOAA Northeast Fisheries Science Center (see also Packer et al. 2007)
Watling et al. (2003)

Southeast (Map 5):
Scanlon et al. (in press)
Andre Freiwald, University of Erlangen (provided by the Marine Conservation Biology Institute – MCBI)
John Reed, Florida Atlantic University/HBOI (provided by MCBI)

Gulf of Mexico (Map 8):
Scanlon et al. (in press)
Peter Etnoyer, NOAA Center for Coastal Environmental Health and Biomolecular Research
Andre Freiwald, University of Erlangen (provided by MCBI)
Deepwater Program: Northern Gulf of Mexico Continental Slope Habitats and Benthic Ecology, Minerals Management Service, TDI Brooks International (provided by MCBI)

West Coast (Map 9):
Curt Whitmire, NOAA Northwest Fisheries Science Center (see also Whitmire and Clarke 2007)
Southern California Coastal Water Research Project (via Curt Whitmire)
NMFS-PaCOOS
Marine Conservation Biology Institute
Etnoyer and Morgan 2003
Stephen Cairns, Smithsonian Institution (provided by MCBI)
California Academy of Sciences (provided by MCBI)
Monterey Bay Aquarium Research Institute (provided by MCBI)
Monterey Bay National Marine Sanctuary (provided by MCBI)

Alaska (Map 10):
Bob Stone, NOAA Alaska Fisheries Science Center - Resource Assessment and Conservation Engineering (RACE) Division
Marine Conservation Biology Institute
Etnoyer and Morgan 2003
Stephen Cairns, Smithsonian Institution (provided by MCBI)

Hawaii (Map 11):
Etnoyer and Morgan 2003
Chris Kelly, Hawaii Undersea Research Laboratory

Southeast Fishing (Map 2):
Carlos Rivero, NOAA Southeast Fisheries Science Center

West Coast Fishing (Map 3):
Janet Mason, NOAA Southwest Fisheries Science Center

http://www.nmfs.noaa.gov/habitat/2010_deepcoralreport.pdf

Biennial Report to Congress on the
Deep Sea Coral Research and Technology Program

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NOAA CORAL REEF CONSERVATION PROGRAM

Agenda Item E.2.a
Attachment 3
(On CD and Website Only)
November 2010

NOAA Strategic Plan for Deep-Sea Coral and Sponge Ecosystems

Research, Management, and International Cooperation

NOAA Technical Memorandum CRCP 11

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

CITATION:

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FOR MORE INFORMATION:

For more information about this report or to request a copy, please contact NOAA's Coral Reef Conservation Program at 301-713-3155 or write to: NOAA Coral Reef Conservation Program; 1305 East West Highway, NOS/OCRM; Silver Spring, MD 20910 or visit www.coralreef.noaa.gov.

DISCLAIMER:

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

United States Department of Commerce

Gary Locke

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[1] Exploration and Research Strategy
[2] Conservation and Management Strategy
[3] International Strategy

IMAGE CREDITS

Cover: K. Sulak, U.S. Geological Survey. Life on the Edge 2004 Expedition, NOAA Office of Ocean Exploration.

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Page 7: (Top left image) Deep Atlantic Stepping Stones Science Party, IFE, URI-IAO, and NOAA. (Bottom left image) K. Sulak, U.S. Geological Survey. Life on the Edge 2004 Expedition, NOAA Office of Ocean Exploration. (Right image) M. Amend, NOAA Fisheries.

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Page 26: The Gulf of Alaska Seamount Expedition and NOAA.

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Page 32: *DSV Alvin,* Medusa Cruise on Manning Seamount, 2003.

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Page 61: AquaPix, I. MacDonald, and Expedition to the Deep Slope.

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

Table of Contents

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

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.

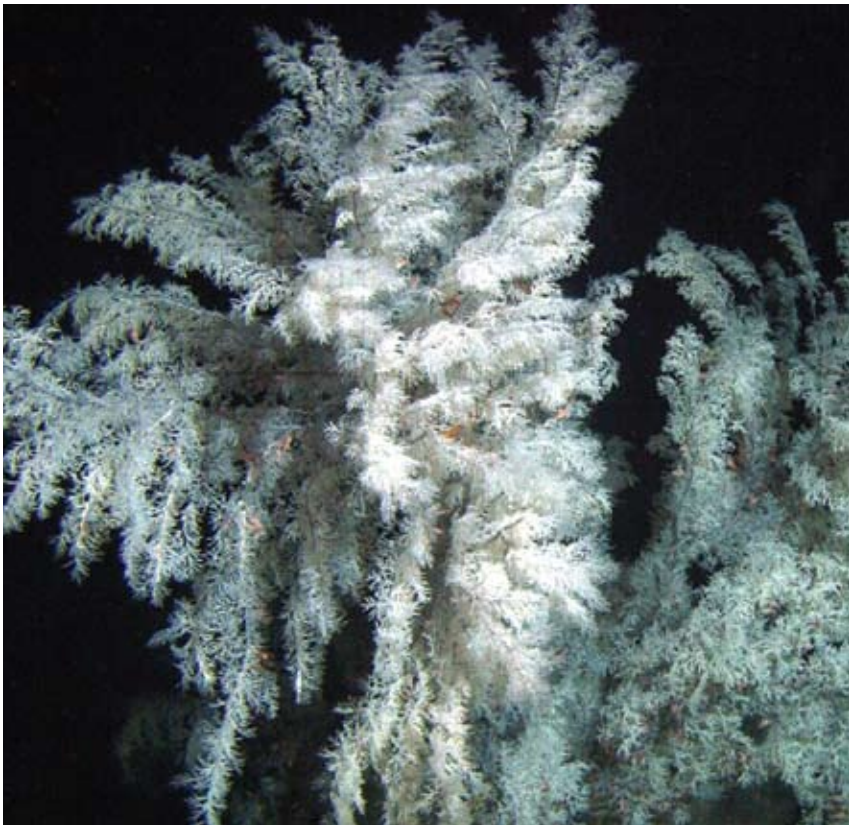
Purpose

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.

Exploration and Research	*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.*
Conservation and Management	*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.*
International Cooperation	*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.*

(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.)**

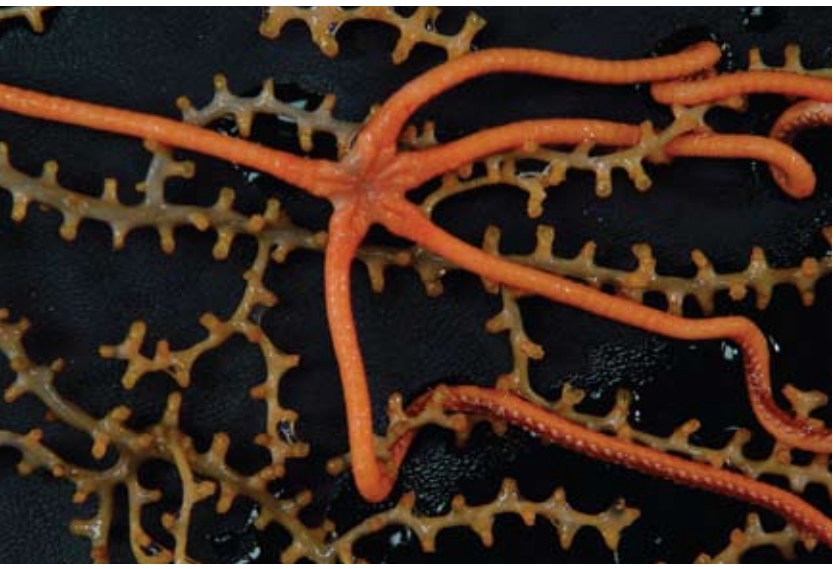
  Authorizes NOAA to identify and protect nationally significant habitats and resources throughout U.S. waters. Deep-sea corals are known to exist within the boundaries of eight National Marine Sanctuaries: Channel Islands, Cordell Bank, Florida Keys, Flower Garden Banks, Gulf of the Farallones, Monterey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

- **Presidential Proclamation 8031: Establishment of the Northwestern Hawaiian Islands Marine National Monument (2006)**

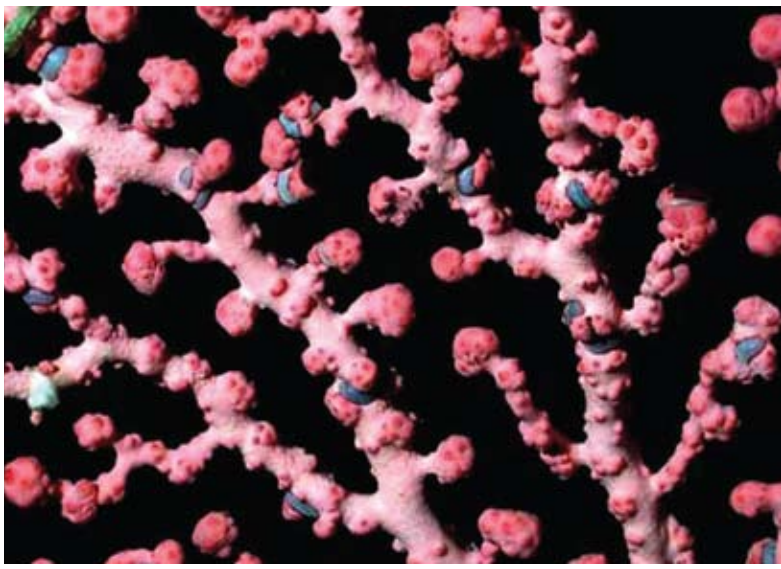
- **Presidential Memorandum on Promoting Sustainable Fishing and Ending Destructive Fishing Practices (2006)**

- **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 parmuricid coral.



Paragoria 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:

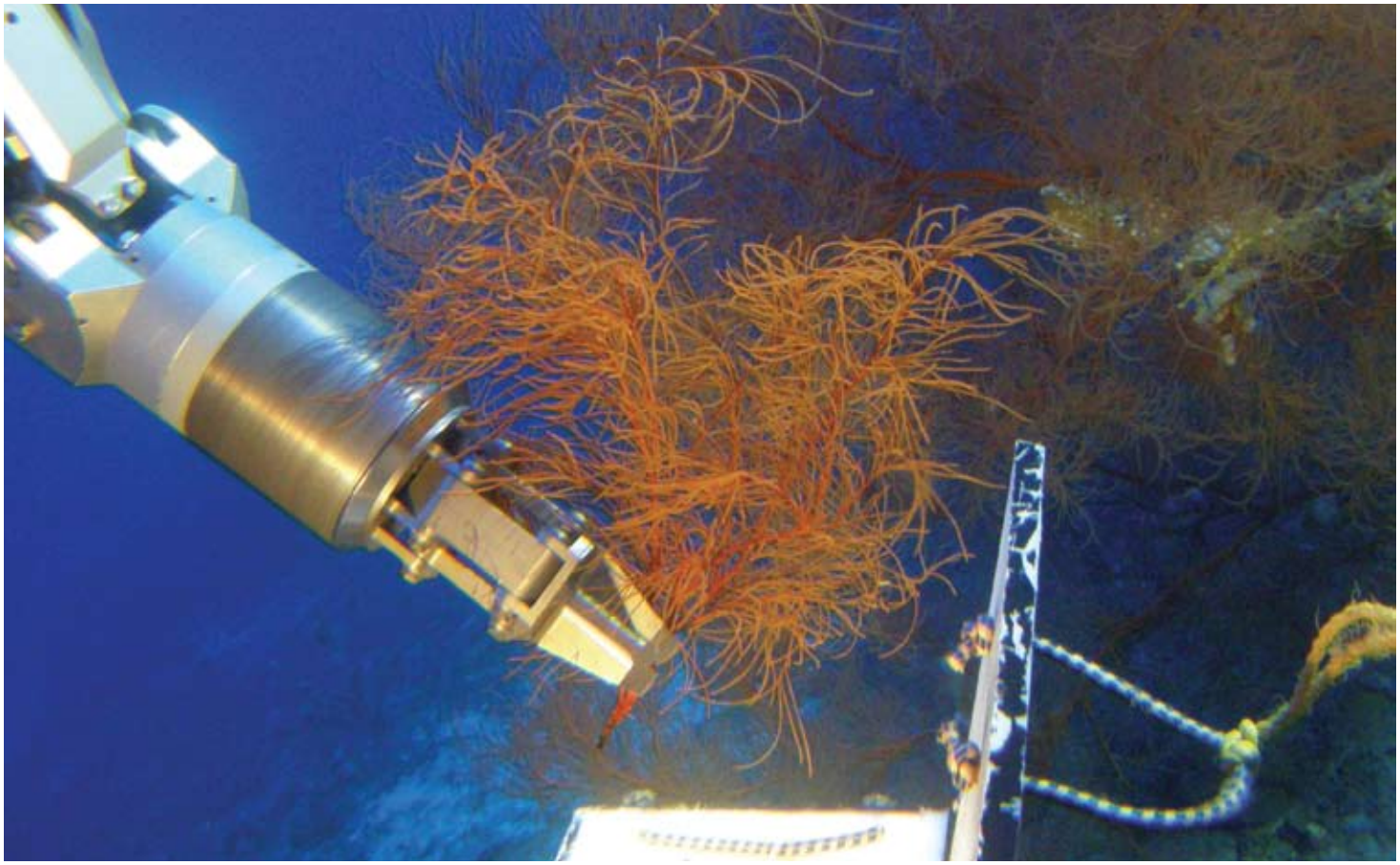
1.1 Locate and characterize priority areas suspected or known to contain deep-sea corals and sponges using appropriate survey technologies, including low-resolution, broad-scale surveys to identify potential targets and high-resolution surveys for creating detailed maps.

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 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.

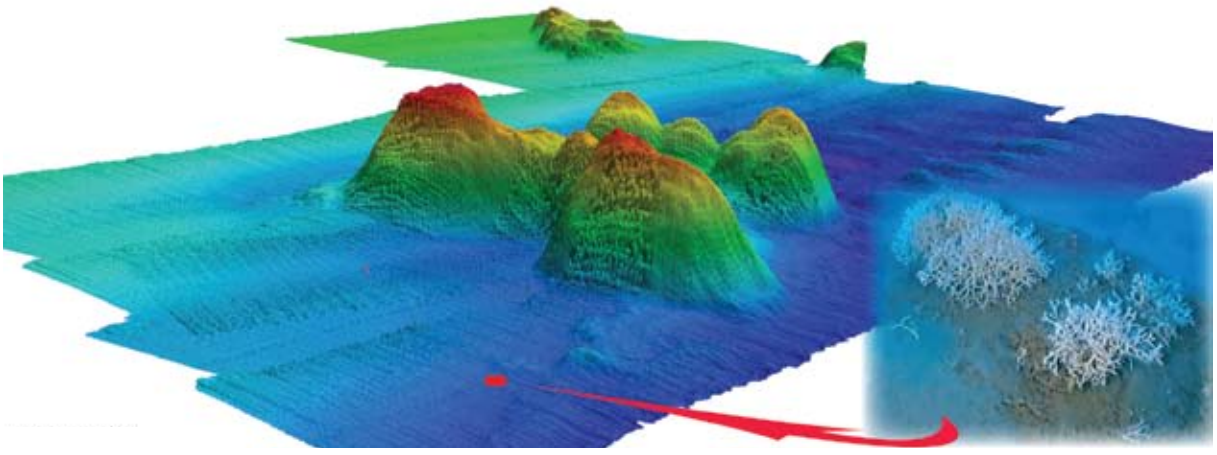
4.6 Document the presence and impacts, if any, of non-native species on deep-sea coral and sponge ecosystems.

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.



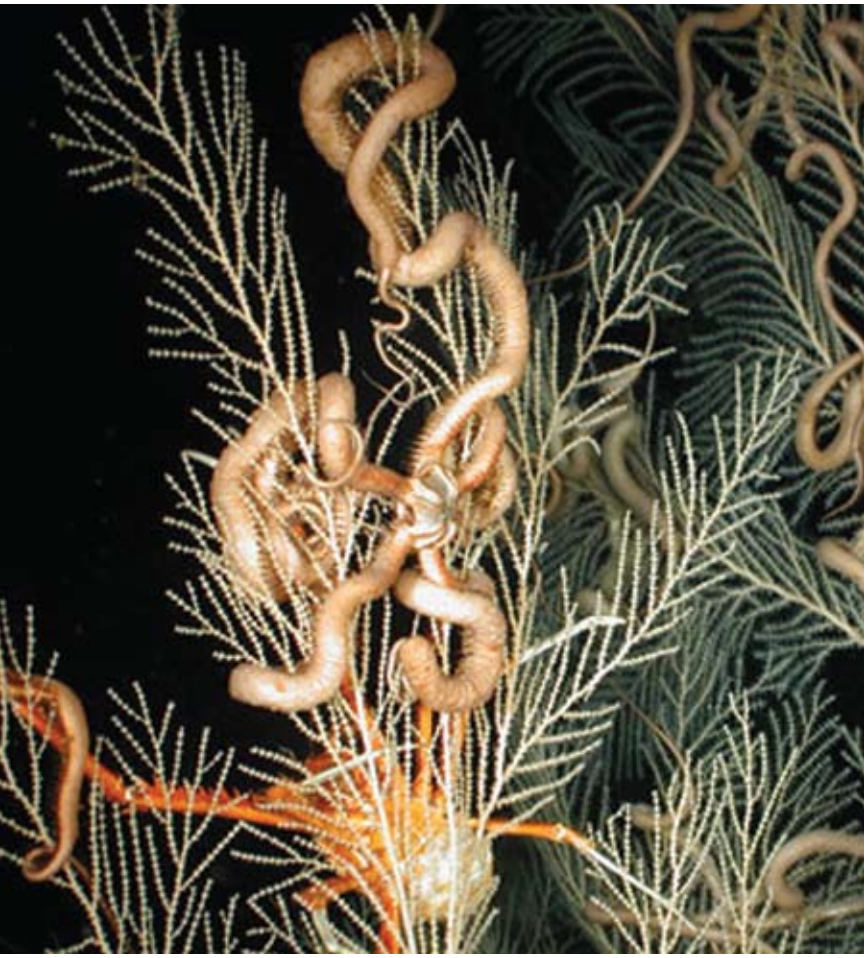
3-D colored bathymetry of Chapman's Reef, from 2005 survey done with multibeam sonar from *R/V Cape Fear* by Seafloor Systems, Inc.

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

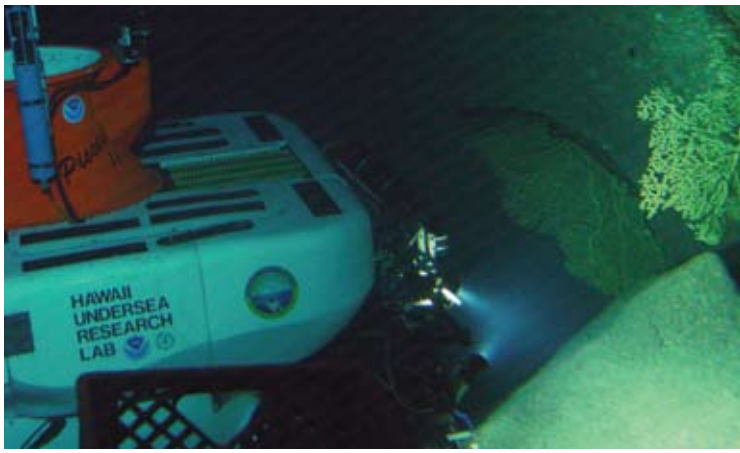
5.UNDERSTAND PAST OCEANIC CONDITIONS AND PREDICT THE IMPACTS OF CLIMATE CHANGE USING DEEP-SEA CORALS

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.



(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.

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.

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.

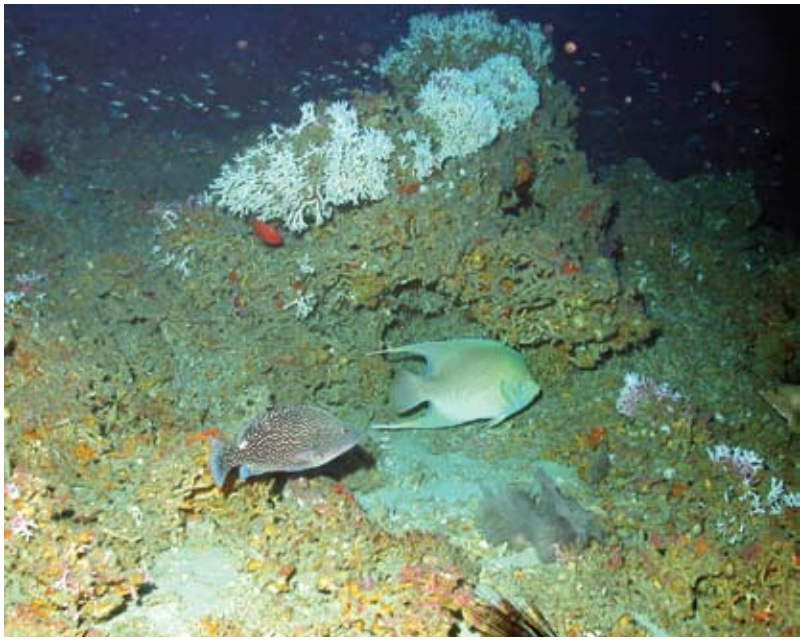
Large primnoid coral with associated brittle stars on Dickinson Seamount, Gulf of Alaska.

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.

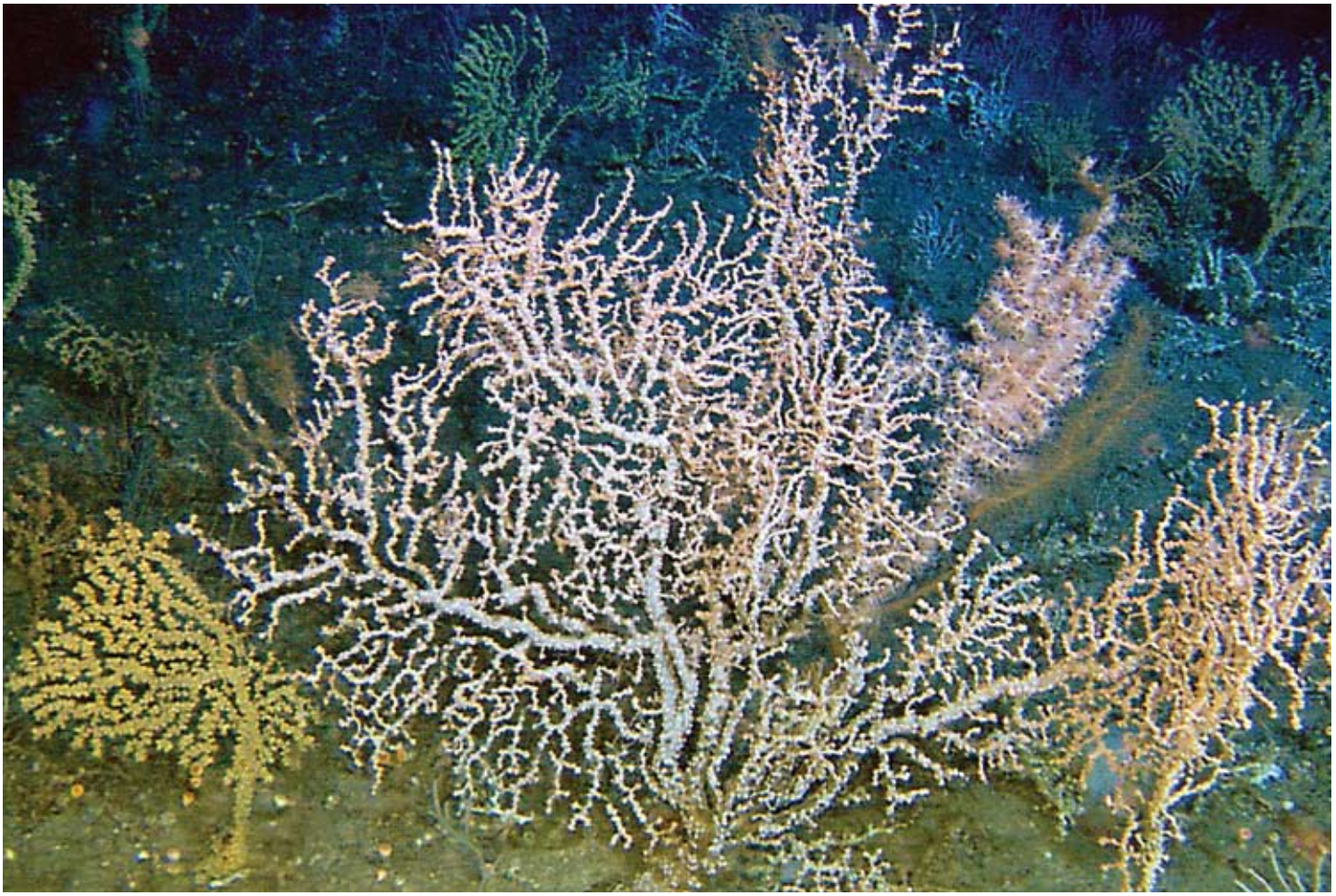
- 303(b)(12) – Include management measures in the plan to conserve target and non-target species and habitats, considering the variety of ecological factors affecting fishery populations.

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.

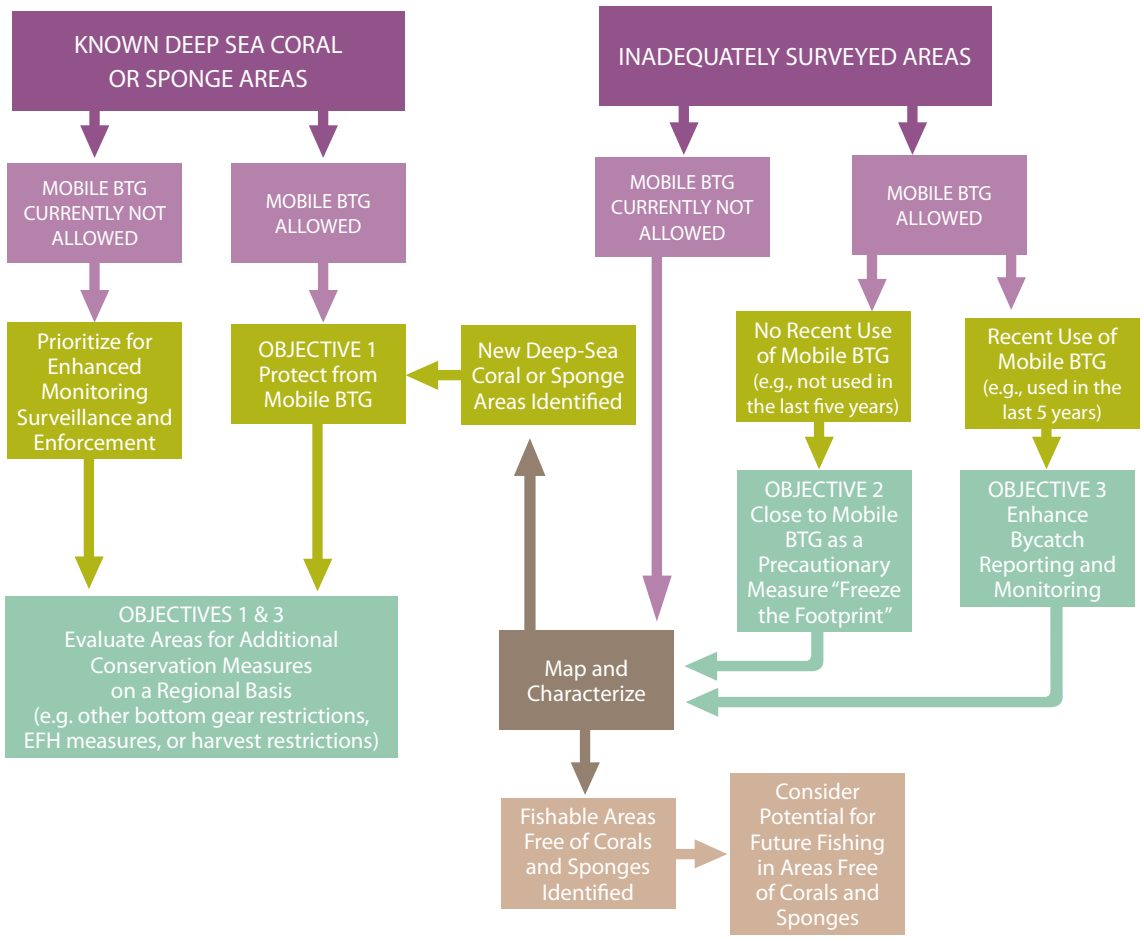
NOAA's precautionary approach to reduce adverse impacts of fishing on deep-sea coral and sponge ecosystems is contained in Objectives 1–3 and depicted in Figure 1. In general, it is expected that the implementation of Objectives 1 and 2 will involve, but not be limited to, area closures to specific bottom-tending 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.

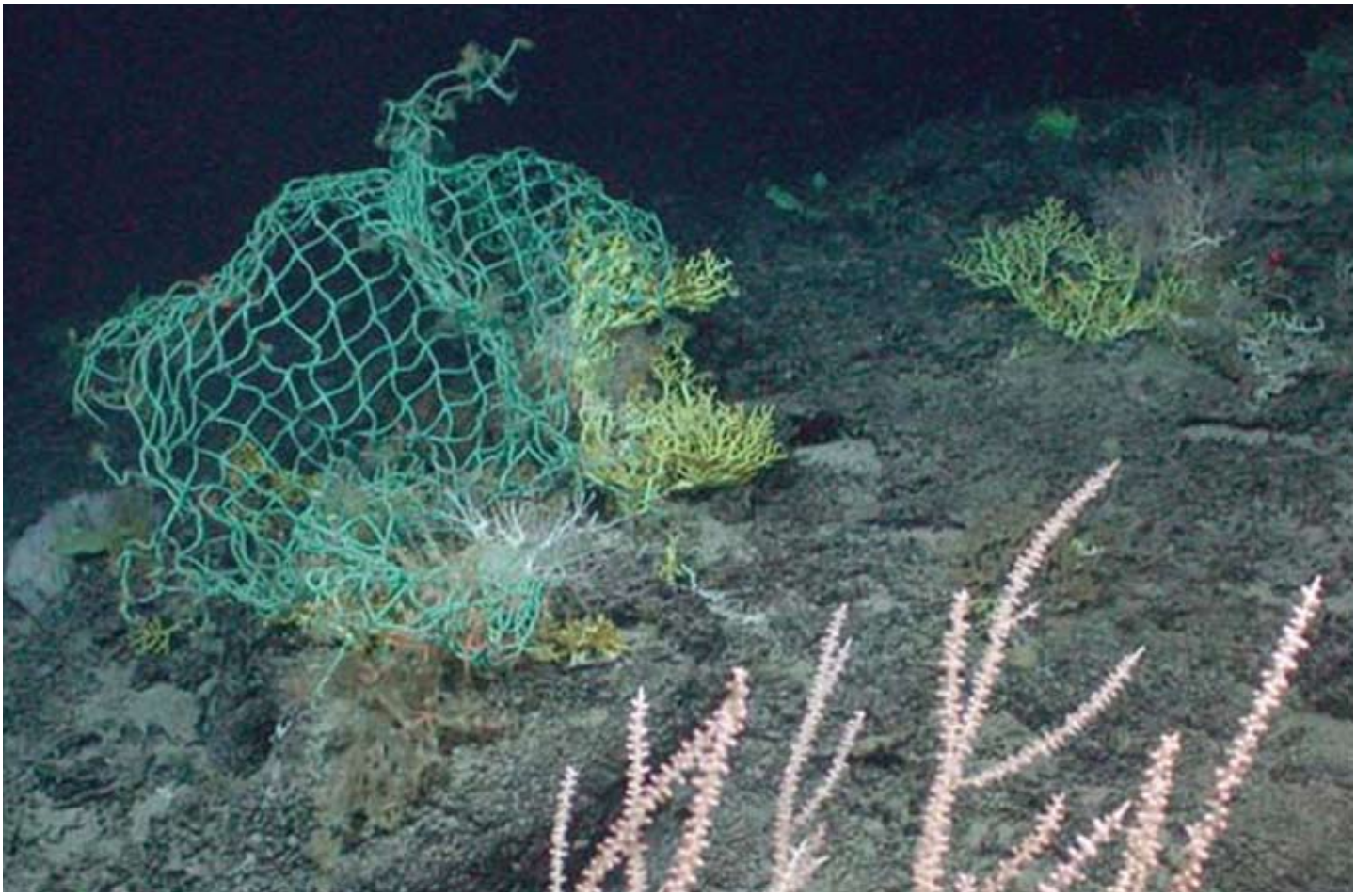
All conservation measures to protect deep-sea coral and sponge ecosystems in the EEZ from the impacts of fishing gear will be evaluated within the context and consistent with the priorities of existing law, and will be implemented through established NOAA and Council processes. Information on NOAA's 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:

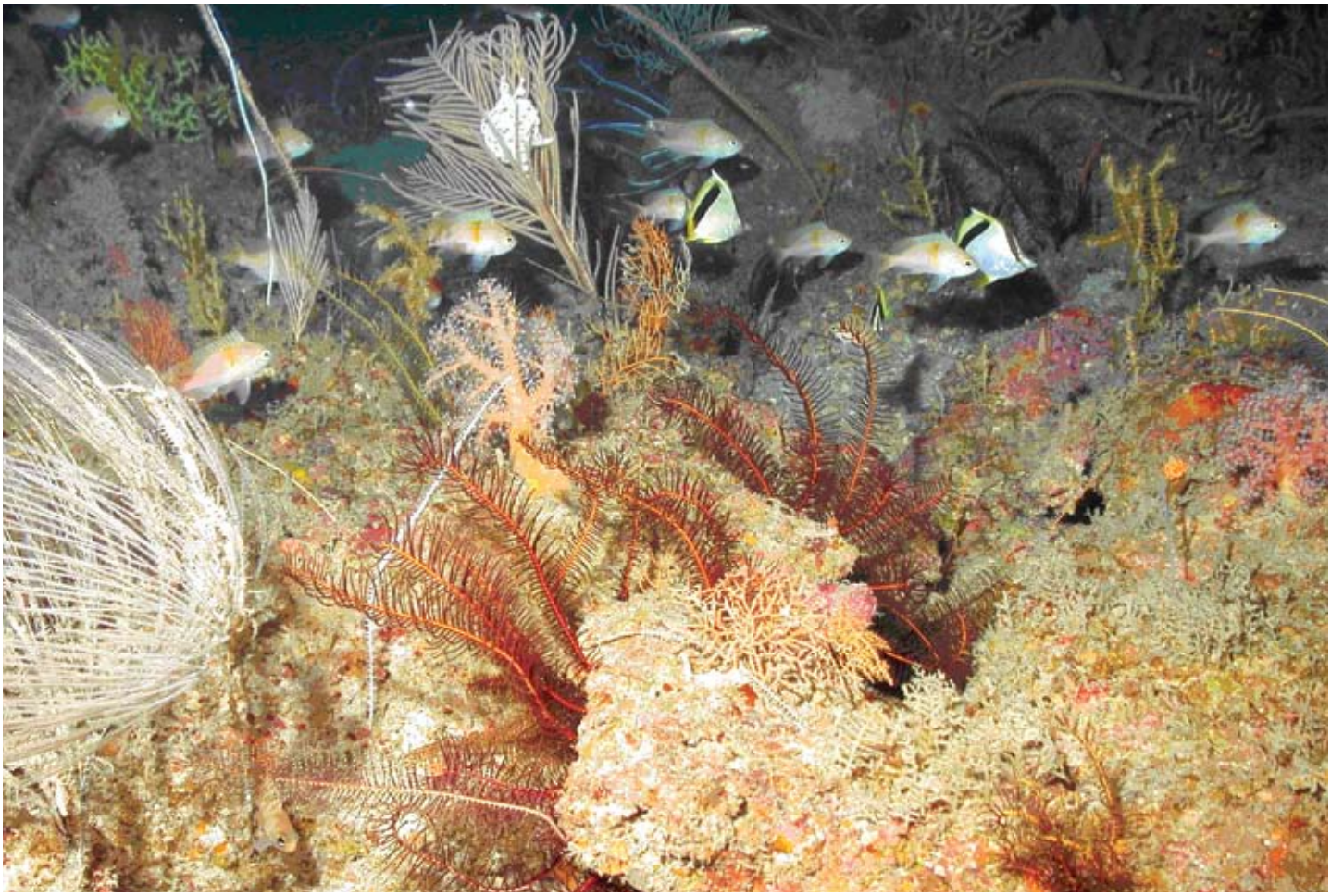
- Criteria, consistent with national guidelines, for identifying "vulnerability" of deep-sea coral and sponge species to adverse impacts from bottom-tending gear.
- Application of those criteria to identify the most vulnerable deep-sea coral and sponge species and ecosystems.
- Identification of serious 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:

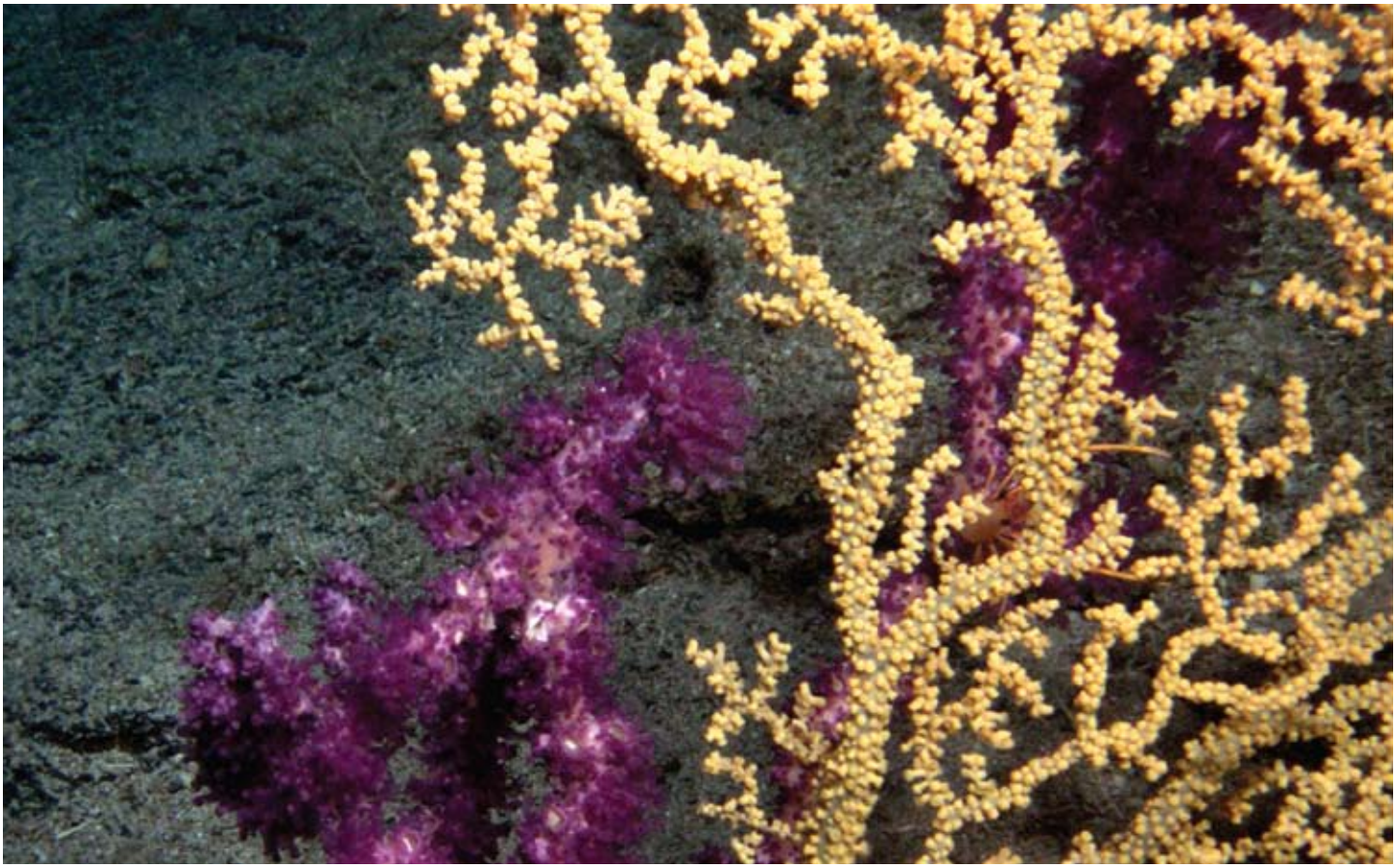
4.1 Evaluate the occurrence of deep-sea coral and sponge ecosystems within National Marine Sanctuary or Marine National Monument boundaries, giving priority to areas where there are likely specific threats to these ecosystems that can be addressed by the Sanctuary or Monument.

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.

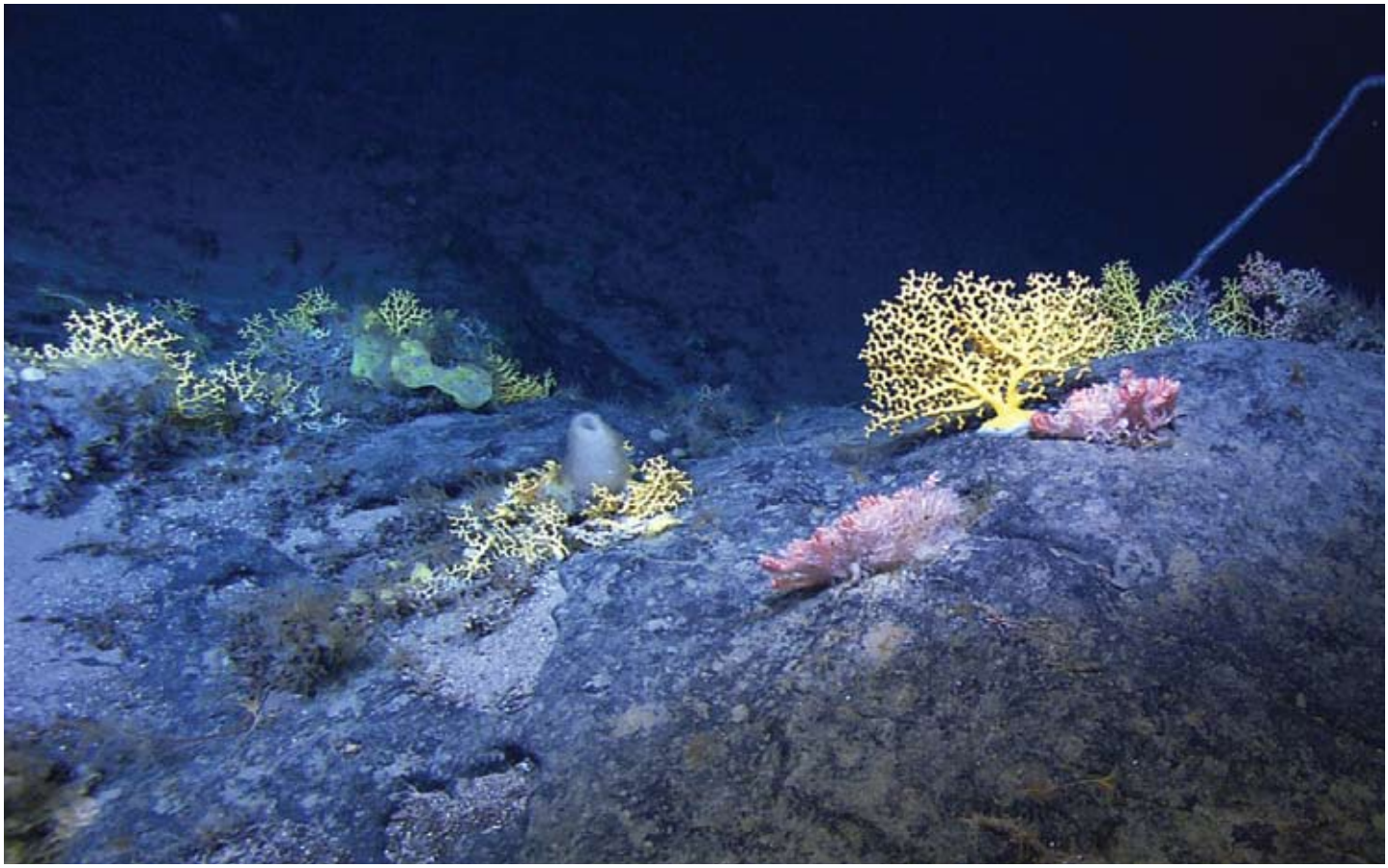
[5]Gray's Reef National Marine Sanctuary is shallower than 25 m; however, several corals and sponges that are common in deeper water are also found within the sanctuary boundaries. The area encompassed by the Hawaiian Islands Humpback Whale National Marine Sanctuary also includes deep-sea coral habitat, 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:

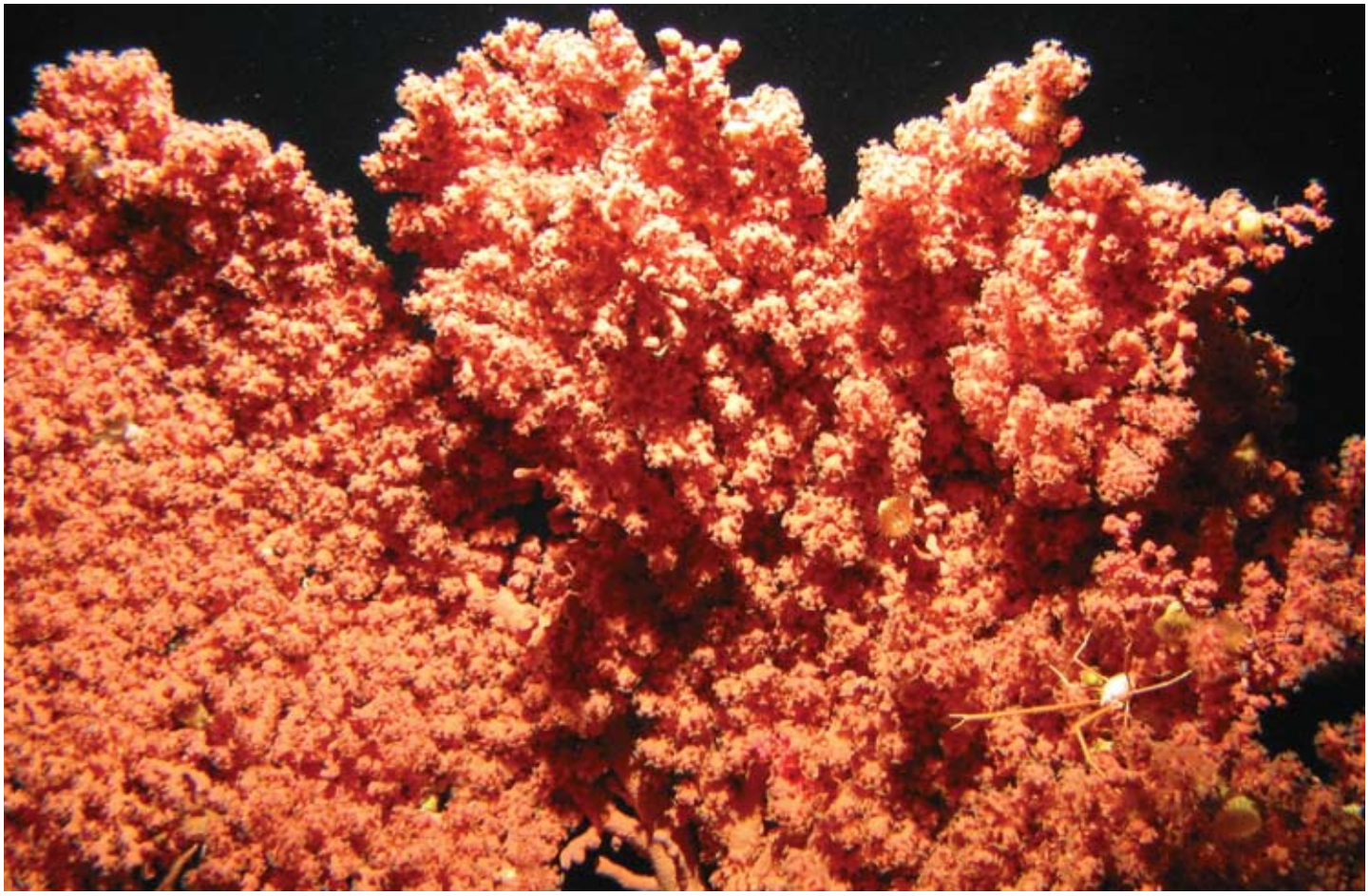
5.1 Provide information on the location of deep-sea coral and sponge ecosystems to other federal agencies, and work with them to identify current and potential impacts or stressors to these ecosystems associated with non-fishing activities.

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.

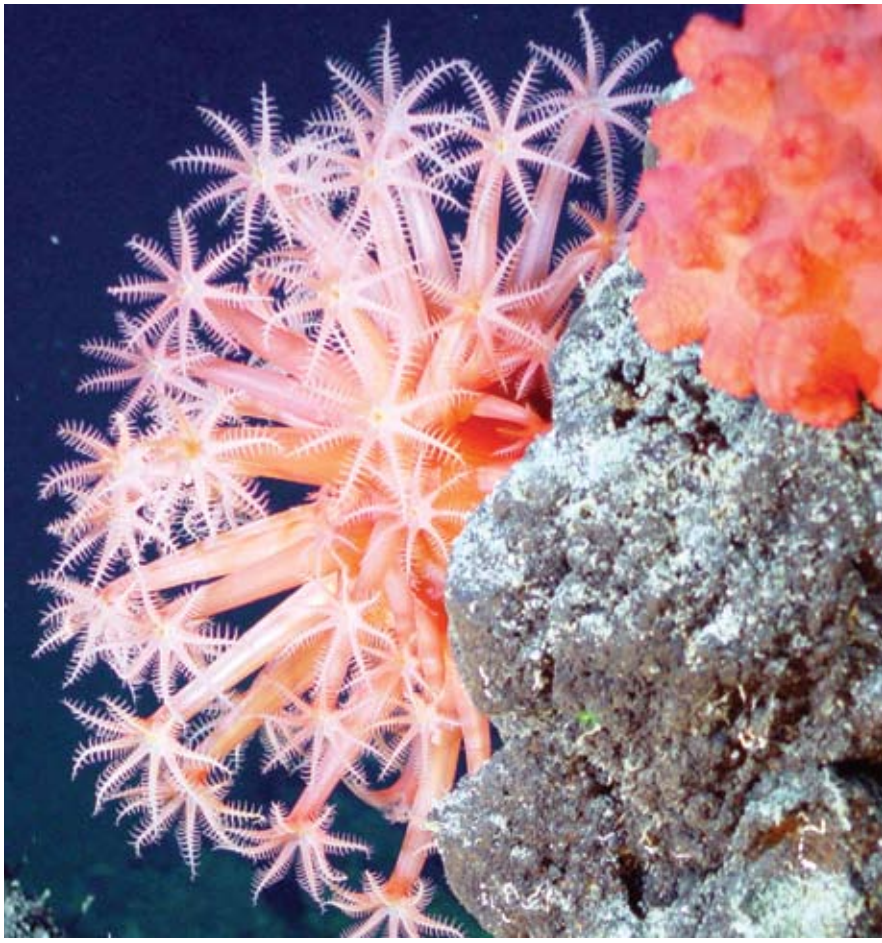
6. PROVIDE OUTREACH AND COORDINATED COMMUNICATIONS TO ENHANCE PUBLIC UNDERSTANDING OF THESE ECOSYSTEMS

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.



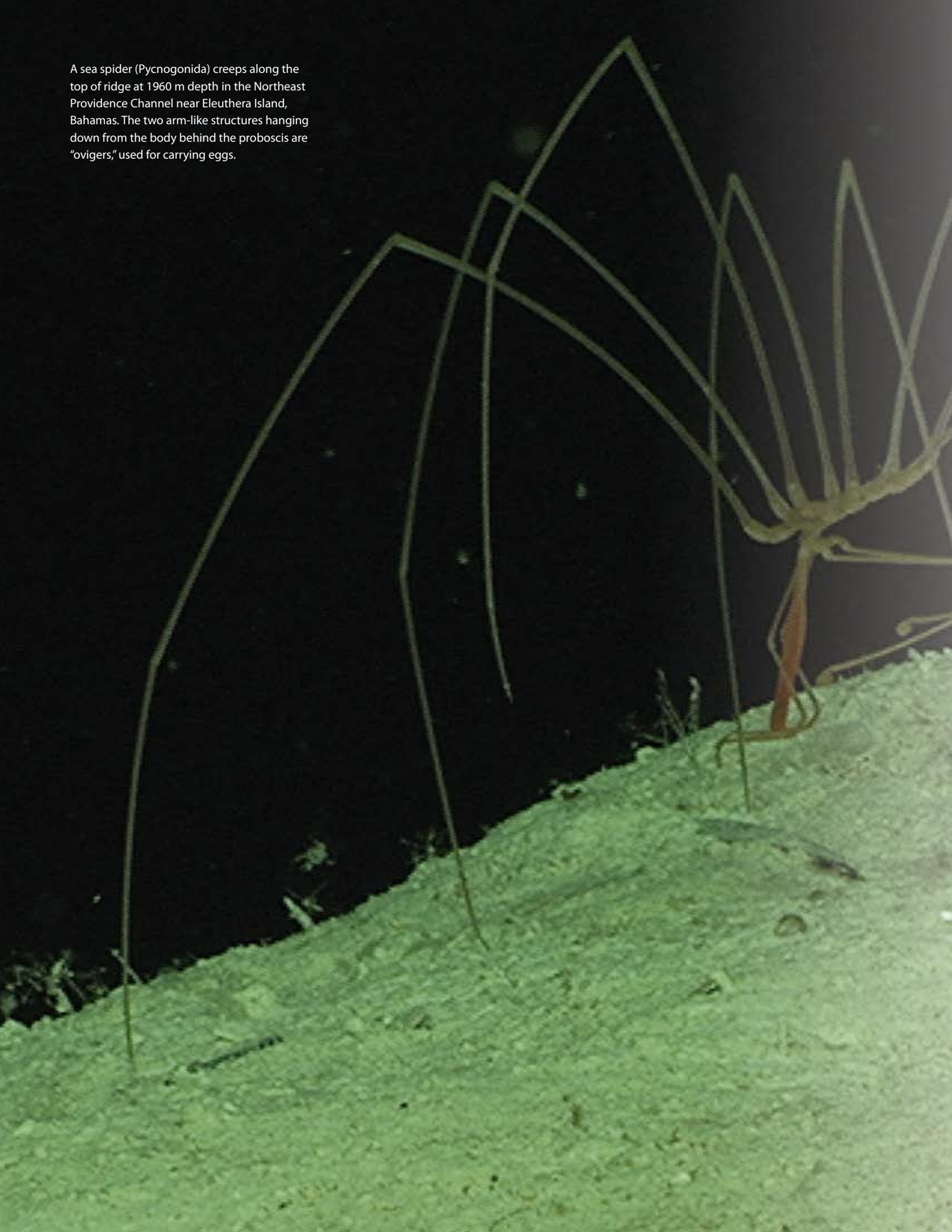
These deep-sea soft corals (Octocorallia: Alcyonacea) sometimes go by the common name "mushroom coral." As with other cnidarians, the mushroom coral has stinging cells or nematocysts within its flashy tentacles that are used to capture minute prey.

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.

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.
- 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.



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.

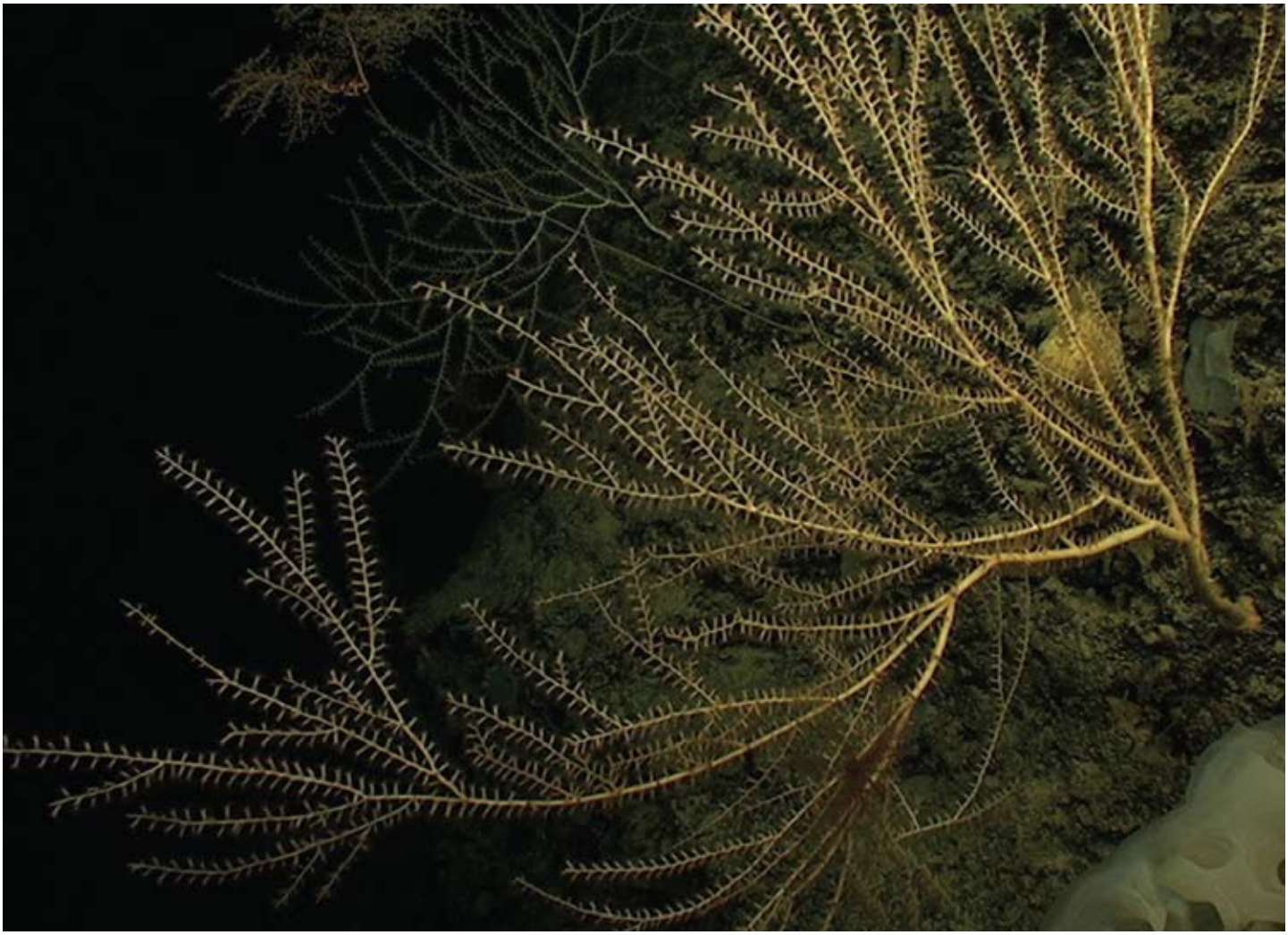
III. International Strategy

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.

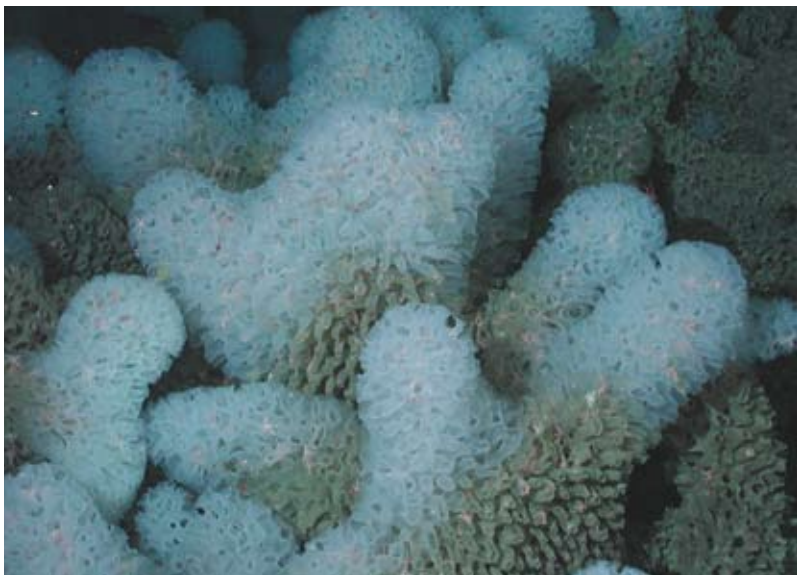
Currently, four RFMO/As have the competency to manage bottom fishing: the Northwest Atlantic Fisheries Organization (NAFO), North East Atlantic Fisheries Commission, South East Atlantic Fisheries Organization, and Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR). Of these,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



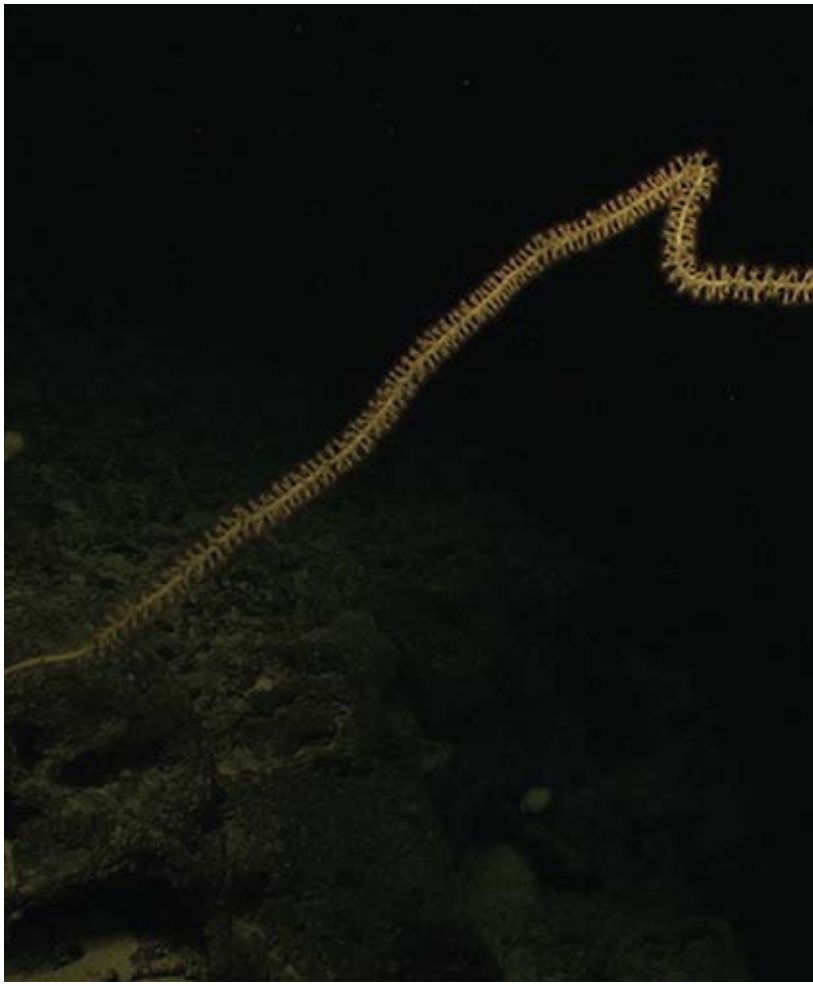
White ruffle sponge, *Ferrea* sp., blankets large areas at or near the crest of Davidson Seamount.

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 zoanthids 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.

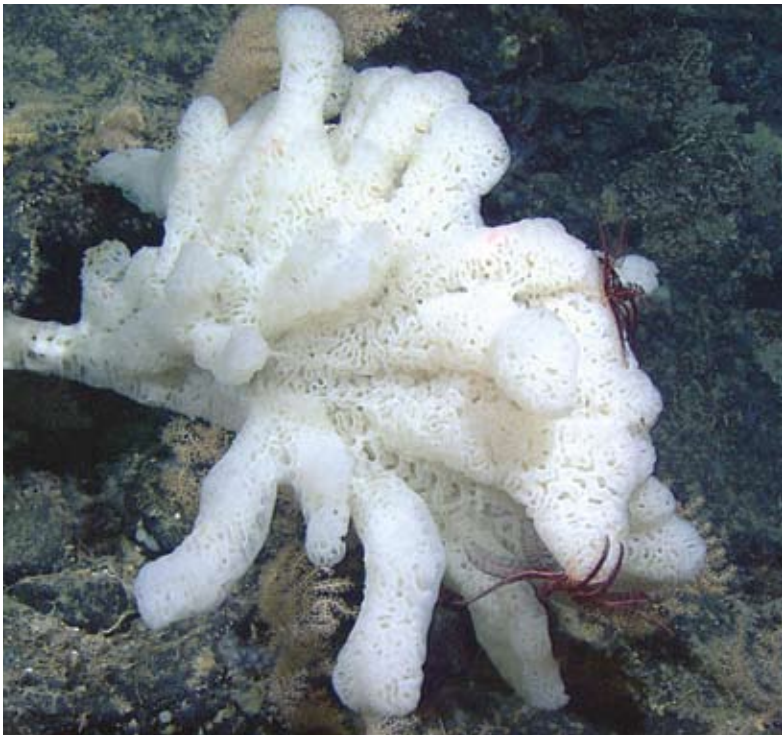
Priority international activities to meet this objective are:

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., *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.

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;

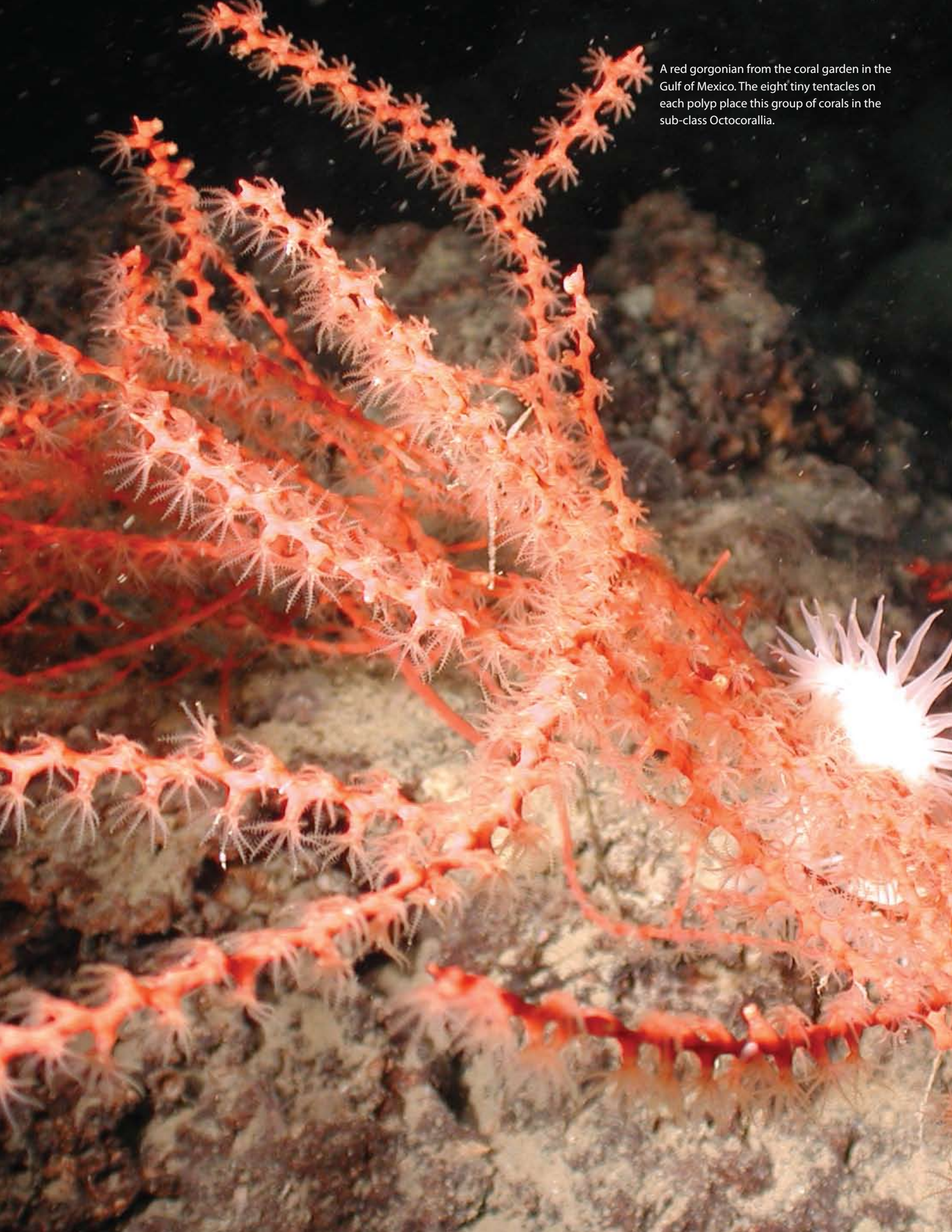
(B) overfishing of fish stocks shared by the United States, for which there are no applicable international conservation or management measures or in areas with no applicable international fishery management organization or agreement, that has adverse impacts on such stocks; and

(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.)

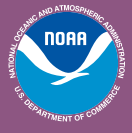
With regard to alternative energy sources from the ocean, the Ocean Thermal Energy Conversion Act (OTEC) established a licensing program for facilities and plantships that would convert thermal gradients in the ocean into electricity. The Act directed the Administrator of NOAA to establish a stable legal 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/


DEPARTMENT OF COMMERCE
UNITED STATES OF AMERICA

NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

NOAA
CORAL REEF
CONSERVATION PROGRAM

NOAA FISHERIES SERVICE

Deep Sea Coral Research and Technology Program

Magnuson-Stevens Fisheries Conservation and Management Act 2006

- **Sec. 408**: Established *Deep Sea Coral Research and Technology Program*
- **Sec. 303(b)(2):** New discretionary authority to protect deep-sea coral areas identified by the Program from damage by fishing gear

Program funded in FY 2009

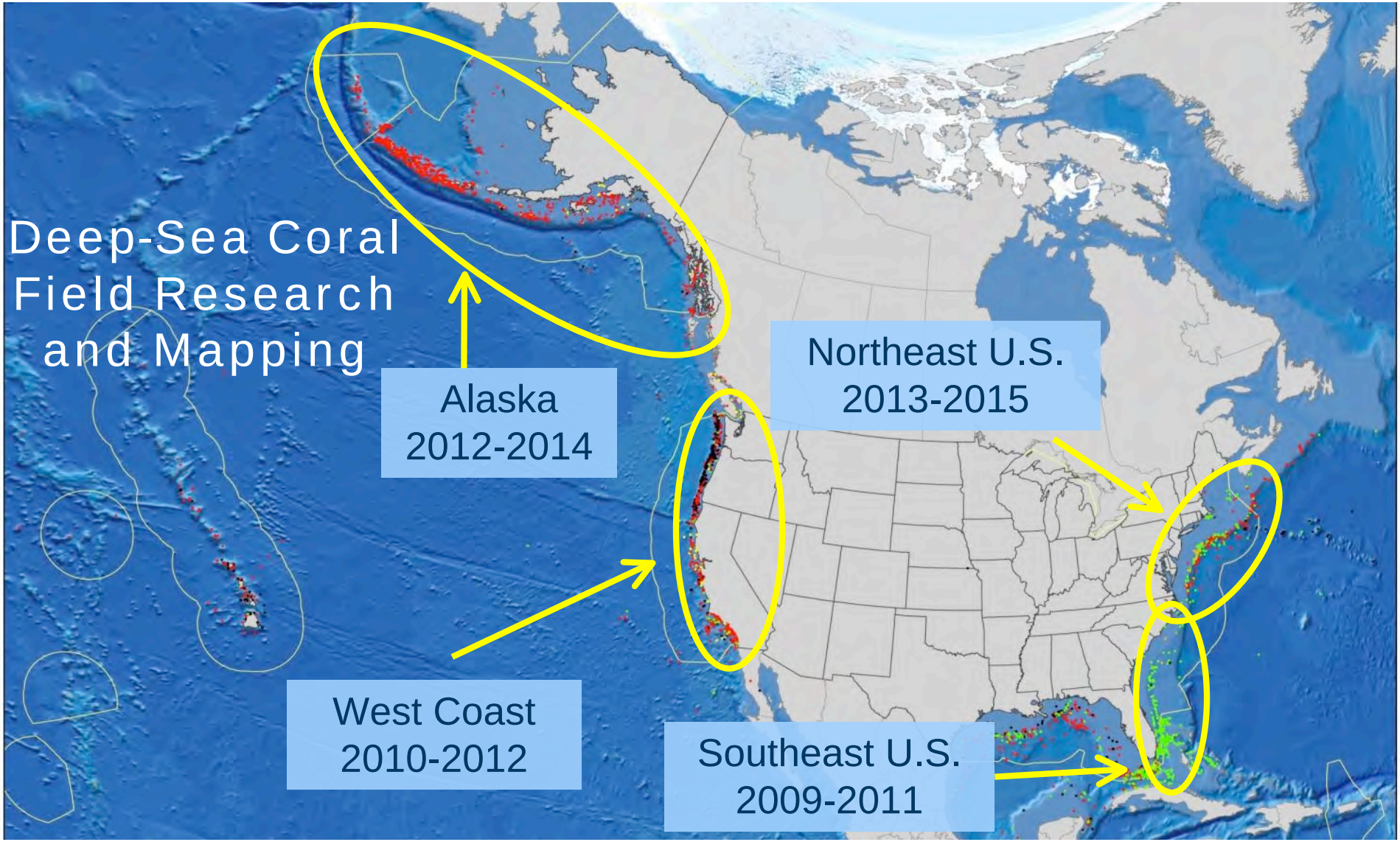
- $1.5 million in FY 2009
- $2.5 million in FY 2010

Implemented as a matrix program – Healthy Oceans in SEE

Based on sound science and targeted to address NOAA's deep-sea coral *management* responsibilities – ***especially fisheries*** and National Marine Sanctuaries

Addresses ***principle threats*** and supports marine spatial planning

Agenda Item E.2.b
NMFS Report
November 2010



Stony Coral Gorgonian Black Coral Gold Coral Lace Coral

Structure-Forming
Deep-Sea Corals
of the U.S.

NOAA CORAL REEF CONSERVATION PROGRAM

NOAA FISHERIES SERVICE

Regional Expert Workshops: Research Priorities

Rank	Southeast U.S. 2009	West Coast 2010	Alaska 2010
1	Complete multi-beam sonar surveys for proposed Deepwater Coral MPAs	Map and characterize deep-sea coral and sponge distributions	Mine existing info on coral & sponge distributions; Conduct new mapping
2	Association of deep-sea corals and sponges with other species	Association of deep-sea corals and sponges with other species	Functions corals & sponges provide for managed species
3	Map and characterize deep-sea coral and sponge distributions	Biology of deep-sea corals (taxonomy, life history, connectivity)	Habitat suitability modeling
4	Anthropogenic impacts	Habitat suitability modeling	Coral and sponge population characteristics
5	Habitat suitability modeling	Anthropogenic impacts	Fishing impacts, bycatch & closed areas

NOAA FISHERIES SERVICE

2010 – 2012 West Coast Field Research

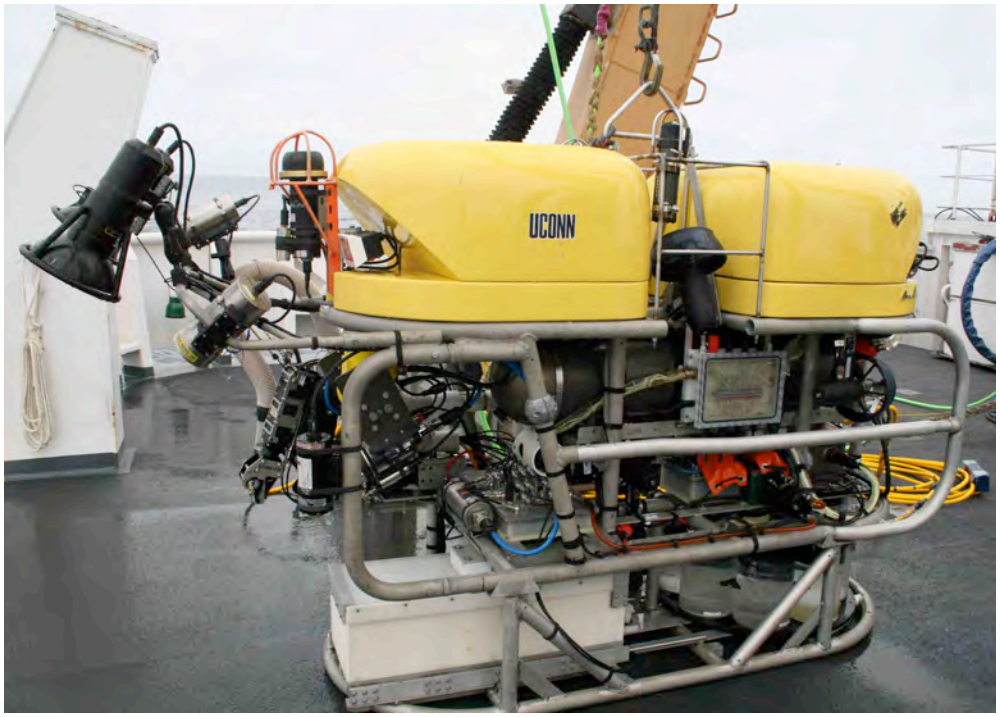
Why the West Coast?

- Inform Council's 5 year EFH Review
- Describe deep-sea coral locations for discretionary deep sea coral zones
- Address petitions for conservation of corals and sponge reefs
- Contribute to Sanctuary planning
- Study systems across large geographic ranges as to ecosystem management plans

NOAA's Deep Sea Coral Program - West Coast

- **Priority EFH sites off WA and CA**
- **Research Objectives**
  - Characterize distribution & abundance of DSC communities
  - Understand factors that influence DSC distribution and condition
  - Evaluate proposed changes to EFH and Sanctuary boundaries
  - Evaluate function of DSC as fish habitat
- **Diverse investigators and participants:**
  - NOAA Fisheries, Sanctuaries, NCCOS
  - Academia & Research Institutes
  - USGS
  - Tribal
- **Multiple underwater tools & support vessels:**
  - U Conn *Kraken 2* ROV, NMFS *Seabed* AUV, multibeam sonar, *Dual Deepworker* manned submersible
  - NOAA *McArthur II*, R/V *Pacific Storm,* F/V *Velero*

***Kraken 2* Remotely Operated Vehicle (ROV)**



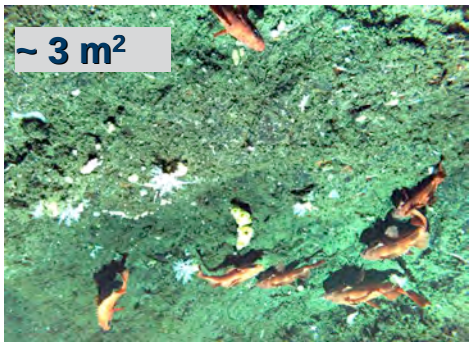
- Owned/operated by University Connecticut
- Real-time imaging of corals, sponges, demersal fishes, and habitats
- Control of sampling and decision-making by science team and pilots
- Collection of HD digital video imagery,digital still photos, CTD data, and samples for species ID and genetics

Nuytco Dual Deepworker Manned Submersible

- Owned/operated by Nuytco Research
- Real-time imaging and observations of corals, sponges, demersal fishes, and habitats
- Collection of HD digital video imagery, digital still photos, CTD data, and samples for species ID and genetics

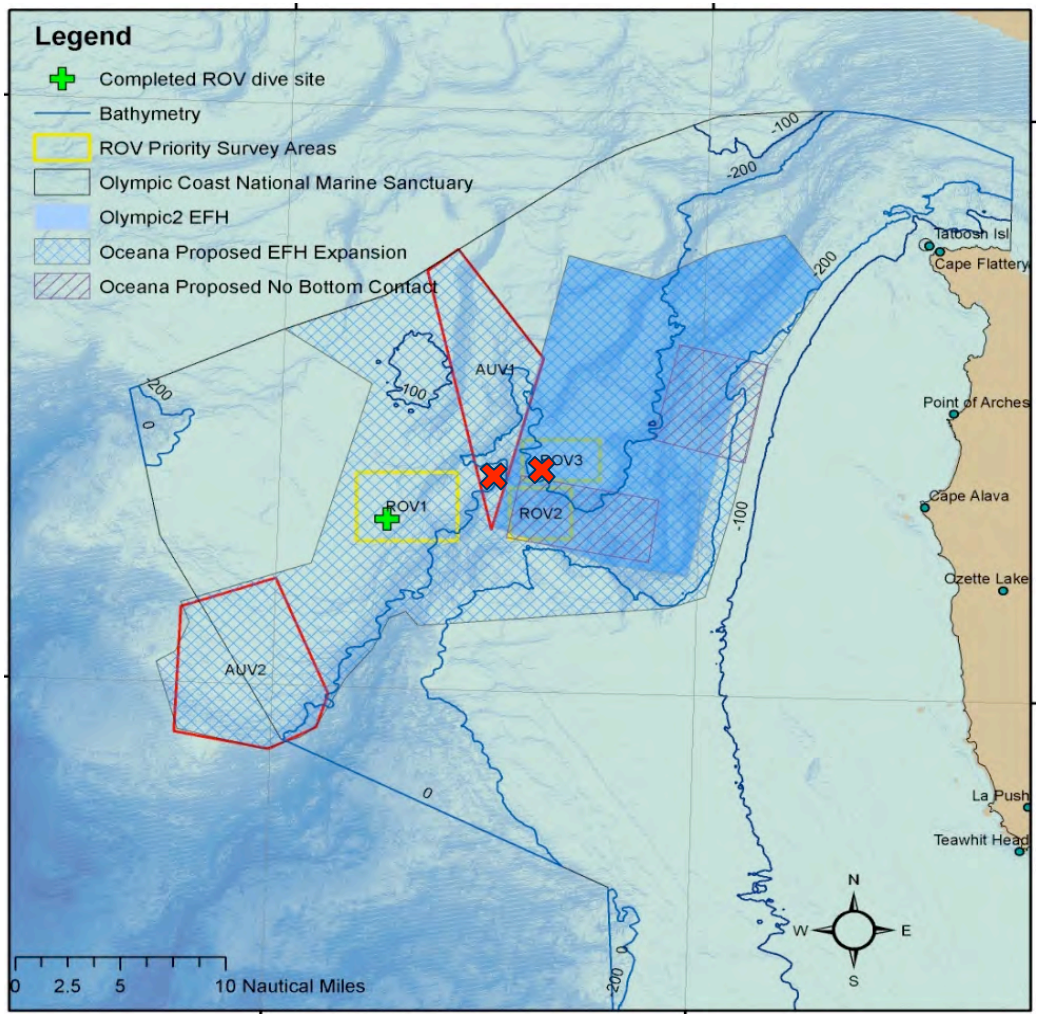
Lucille **Autonomous Underwater Vehicle (AUV)**

- AUV developed and operated jointly by NOAA Fisheries NWFSC & PIFSC (collaboration with WHOI)
- Non-extractive surveys of corals, sponges, demersal fishes, and habitats
- High resolution still cameras (downward and oblique facing), paired lasers, strobe lighting



NOAA's Deep Sea Coral Program - West Coast

***McArthur II* Cruise: Leg 1** June 10 -16



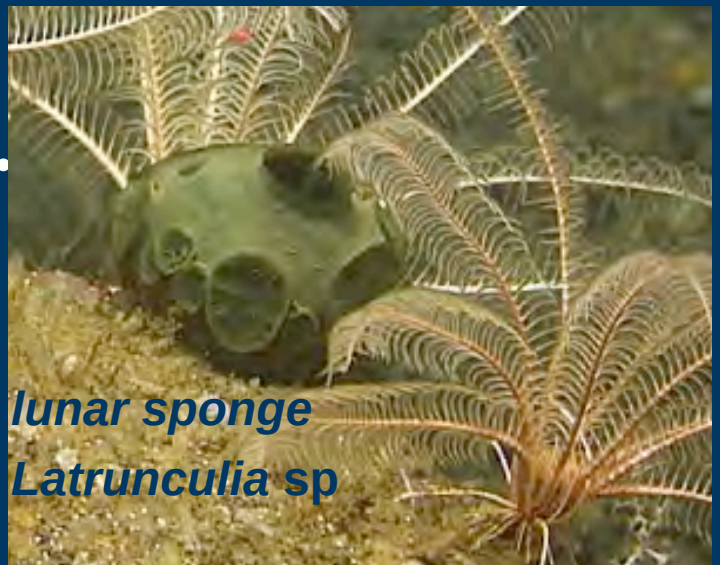
- Focus on obtaining coral and sponge information to inform proposed modifications of Olympic 2 EFH
- 1 ROV test dive (inside Straits)
- 1 ROV daytime survey dive in priority area (9 hrs; 120 m depth)
- 2 AUV night-time survey dives in priority areas
- Number of dives limited by adverse weather

Participants:

- Ed Bowlby, Jennifer Bright, & Janet Lamont (OCNMS)
- Peter Etnoyer (NCCOS)
- Colby Brady (Makah Tribe)
- Sean Rooney (WASU)
- Elizabeth Clarke, Curt Whitmire, Erica Fruh (NWFSC)
- Jeff Anderson & Jeremy Taylor (PIFSC)
- ROV team (University Connecticut)

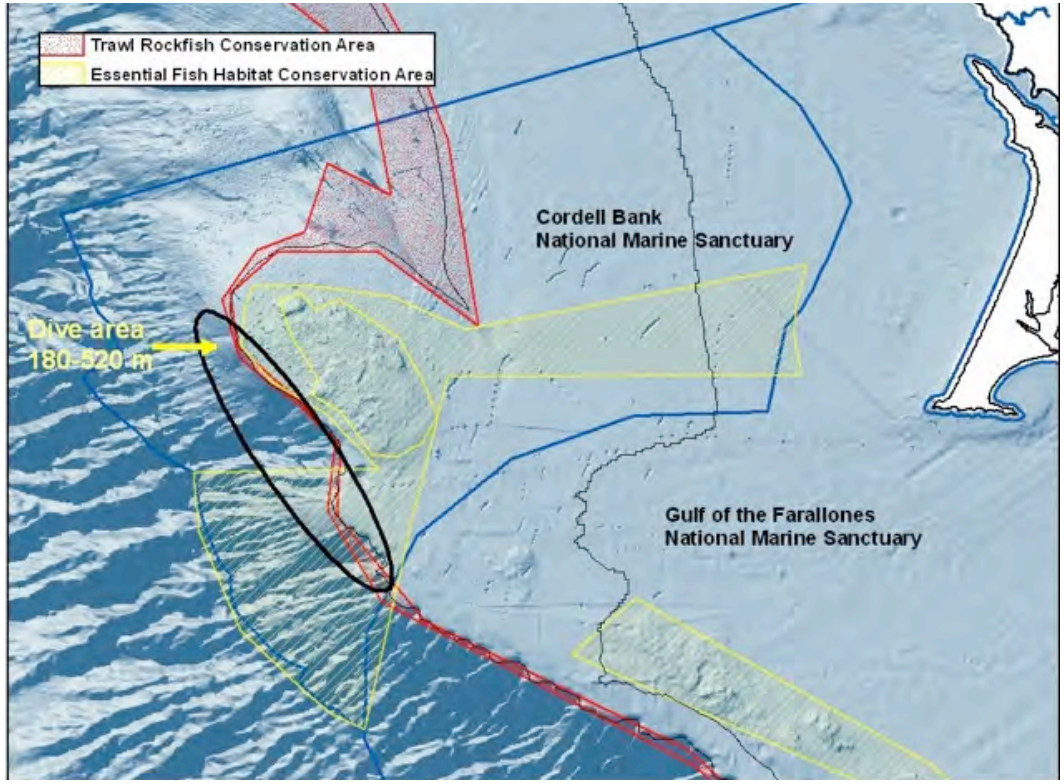
LEG 1

- ROV Habitat: mostly boulder fields with attached crinoids
- Primary coral species: small colonies of *Swiftia beringi*
- Primary sponge: green lunar sponge (*Latrunculia* sp.)
- Primary fish species: yelloweye, yellowtail, and canary rockfish



NOAA's Deep Sea Coral Program - West Coast

McArthur II Cruise: Leg 2 June 19 - 25, 2010



- Focus on assessing coral habitat in area Cordell Bank and Gulf of the Farallones National Marine Sanctuaries
- 1 ROV daytime survey dive in priority area (11 hrs; 180-520 m …*number of dives limited by adverse weather)*
- 3 quantitative transects (300-400 m) for fishes, corals, other inverts
- Water chemistry at night: 5 CTD stations on shelf and slope (100-1000 m); water samples (salinity, nutrients, dissolved inorganic carbon, total alkalinity)

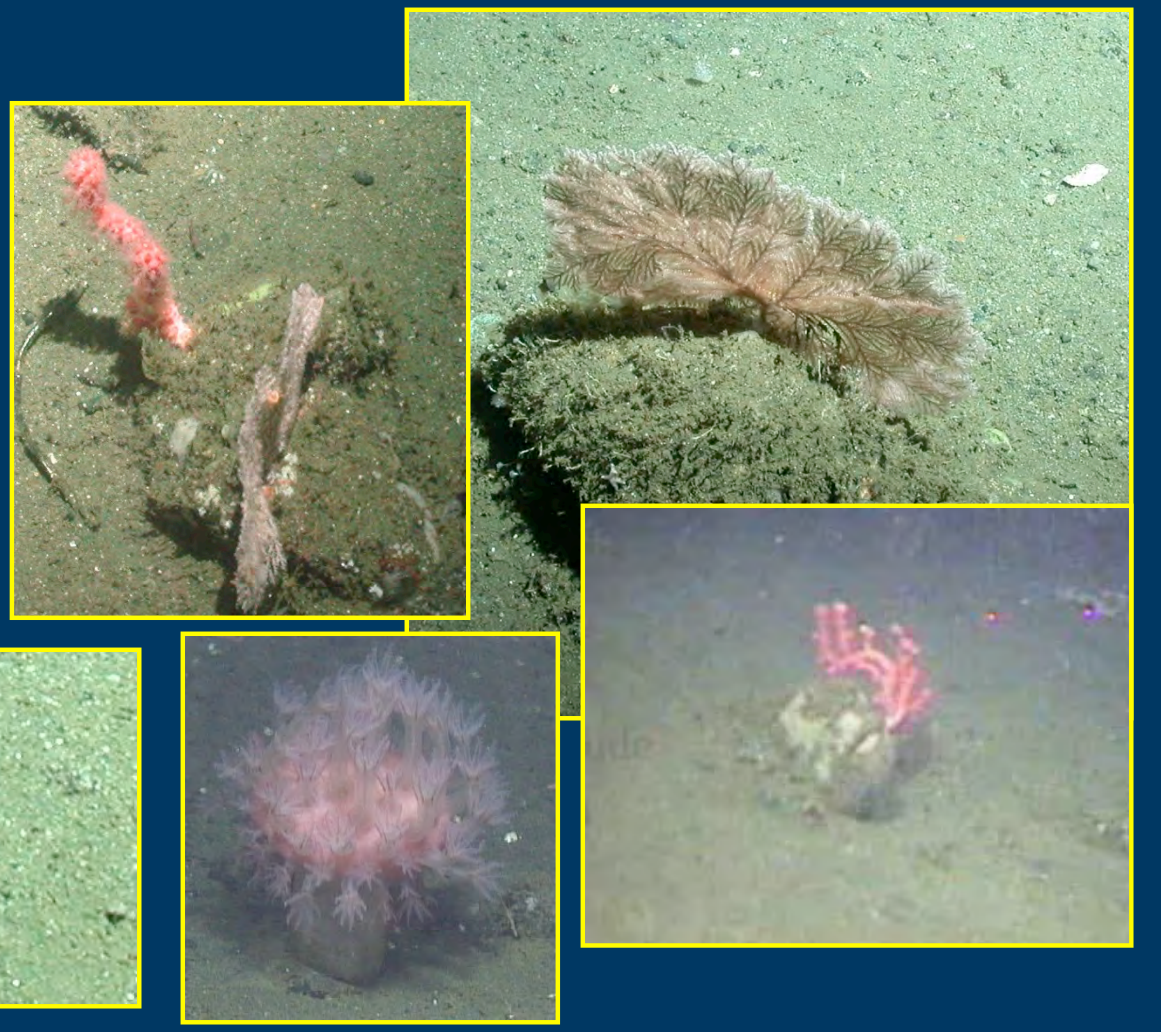
Participants:

- Dan Howard, Dale Roberts,Kaitlin Graiff (CBNMS)
- Jan Roletto, Jamie Hall (GFNMS)
- Peter Etnoyer, Jeff Hyland (NCCOS)
- Brandon Roark, Adrian Minor, Sarah Stryker (Texas A & M University)
- Guy Cochrane (USGS)
- ROV Team

LEG 2

- Habitat: sand/cobble w/ some boulder below 200 m; boulder fields/bedrock above 200 m
- Over 100 observations of 6 different species of DSC (4 new to Sanctuary; most were small)
- Very few barrel sponges

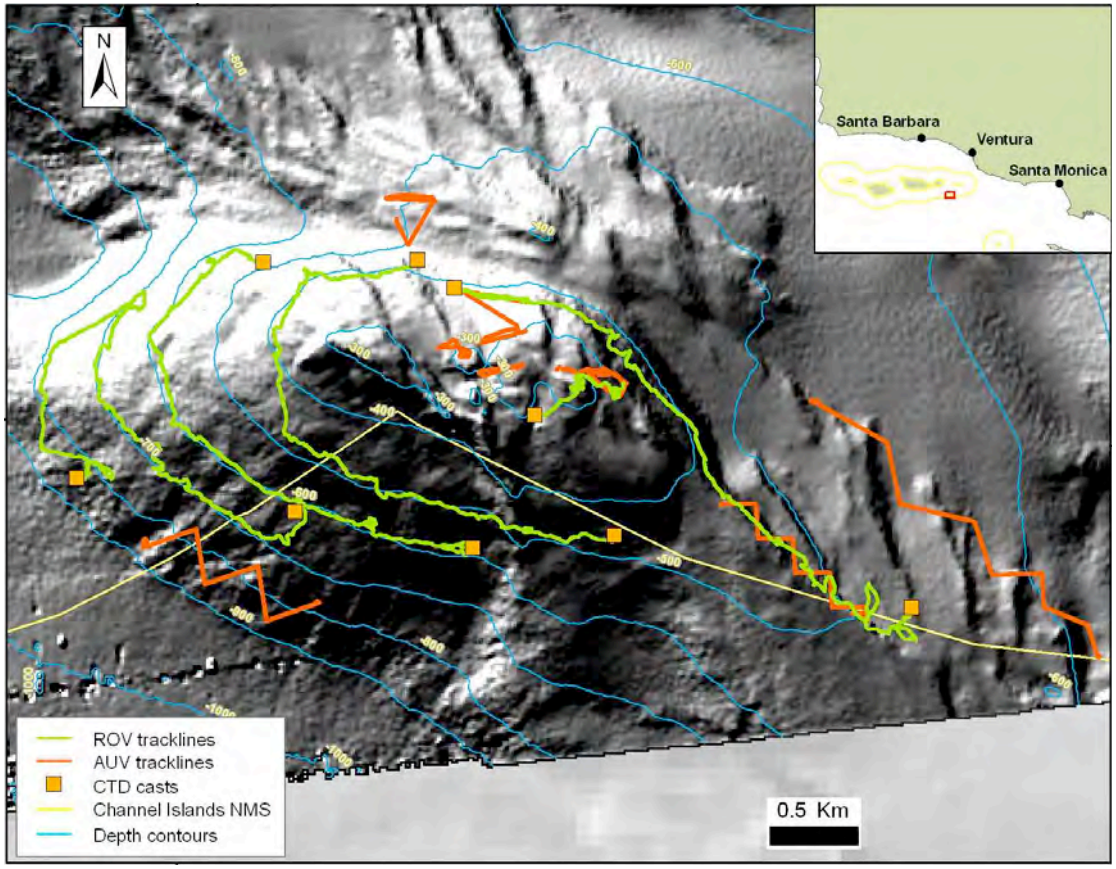
1. Primnoid: *Plumarella* sp. (dominant habitat-forming coral)
2. *Paragorgia* sp. (n = 3)
3. *Anthomastus ritteri*
4. Sea pen
5. *Swiftia* sp.
6. orange cup corals



NOAA's Deep Sea Coral Program - West Coast

McArthur II Cruise: Leg 3 June 27 - July 2, 2010

Focus on assessing coral and sponge habitat in area of Piggy Bank, a deep rocky bank within CINMS and EFH Conservation Area in Southern CA Bight



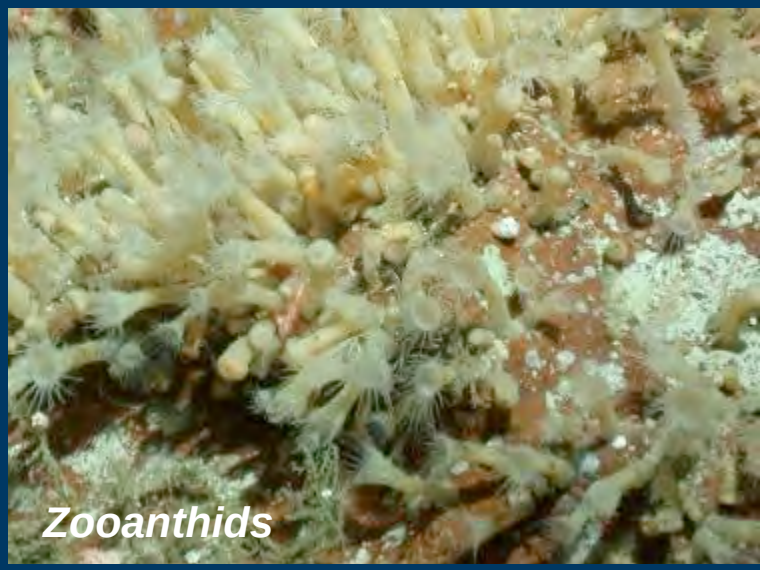
- 6 ROV daytime dives (280 - 890 m); 136+ taxa of demersal organisms; 22+ taxa of corals; 1000+ of DSC & sponge observations; 45+ hrs HDV
- 8 AUV night-time missions (284 - 888 m); 12.5 survey hrs; 16,784 digital images
- 9 CTD casts and 130 water samples (DIC, nutrients; 280-775 m)
- 33 samples collected (16 corals, 10 sponges, 7 other inverts)

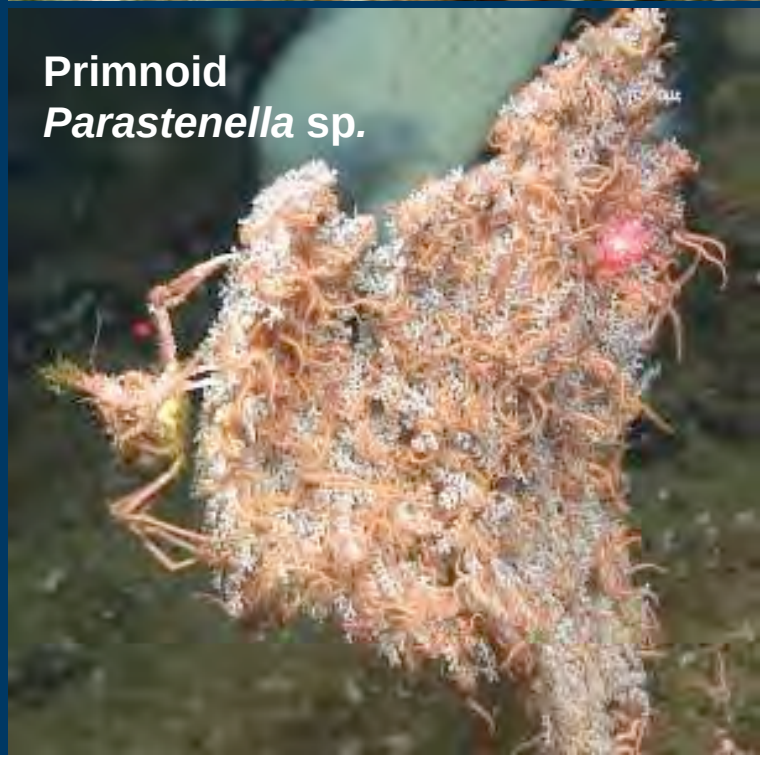
Participants

- Mary Yoklavich, Tom Laidig, Lisa Krigsman, Di Watters (SWFSC)
- Liz Clarke, Curt Whitmire, Erica Fruh (NWFSC)
- Jeff Anderson & Jeremy Taylor (PIFSC)
- Milton Love (UCSB)
- Lonny Lundsten (MBARI)
- Dani Lipski & Steve Katz (CINMS)
- ROV team (University Connecticut)

Common Coral taxa on high-relief rock pinnacles & boulders on top of Piggy Bank

Common Coral taxa on hard substrata at mid-to-bottom of Piggy Bank





Common Coral taxa on soft sediments at mid-to-bottom of Piggy Bank

Halipteris* sp. with *Asteronyx sp.
(brittle star)

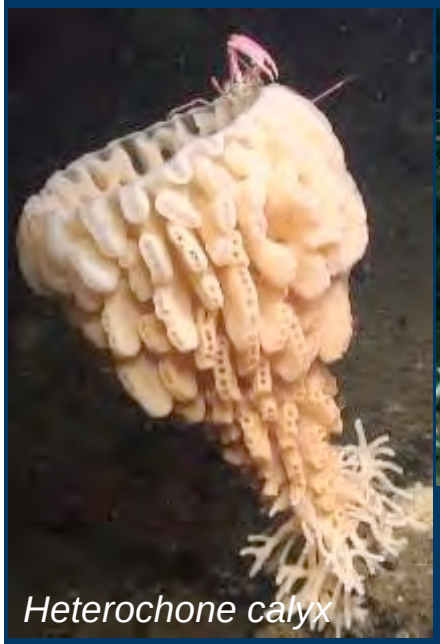
Anthoptilum grandiflorum
and *Sebastolobus sp.*

Umbellula lindhali

Pennatula phosphorea

Sea pen (UNID) and
Pannychia moseleyi

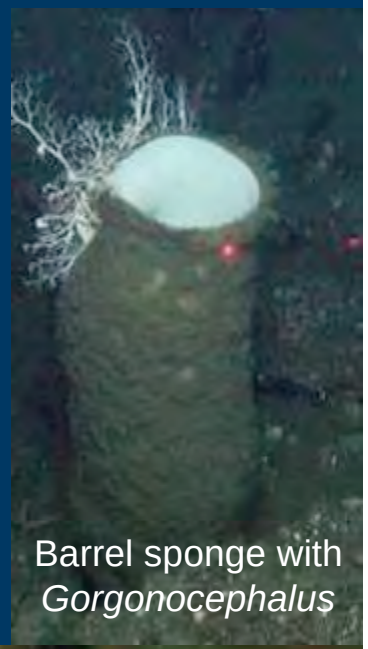
Sponges on Piggy Bank



Heterochone calyx

Dead *Heterochone calyx*

Staurocalyptus sp.



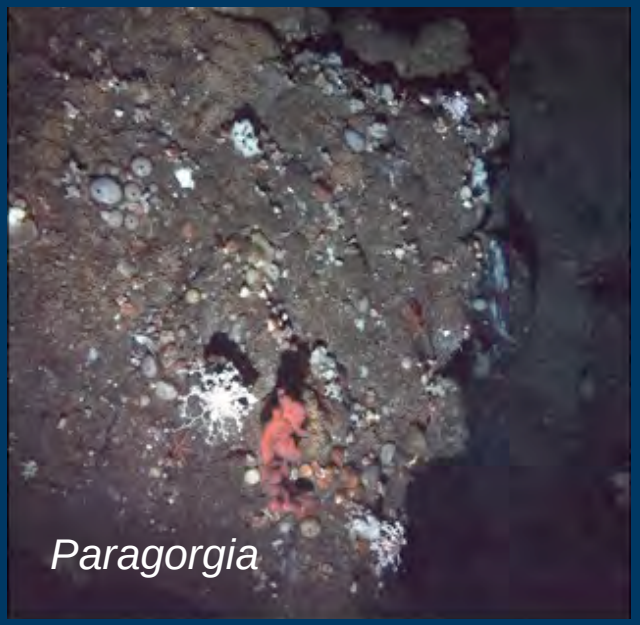
Barrel sponge with *Gorgonocephalus*

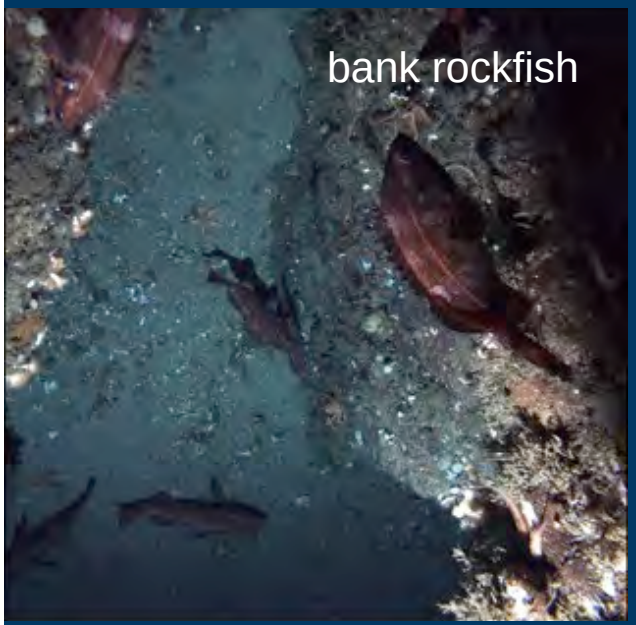
Vase sponge with *Liponema brevicornis*

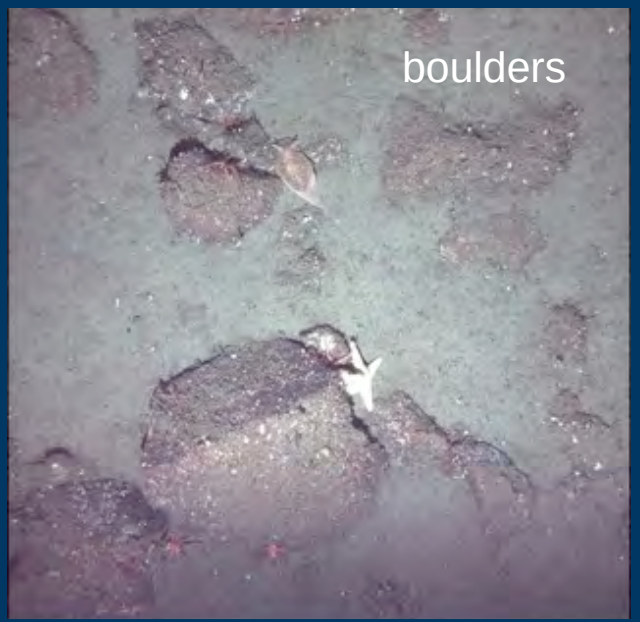
Vase sponge with hagfish

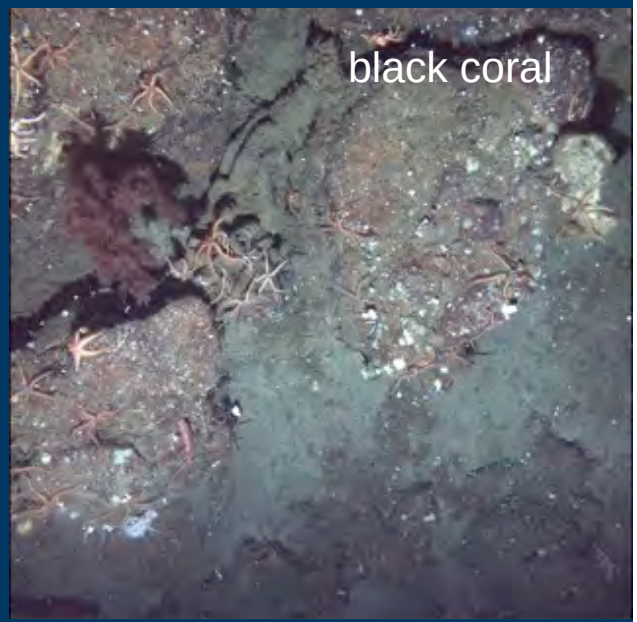
Cloud sponge *Farrea occa*

Leg 3: Images from AUV









Sample Distribution

		Genetics
Coral		
Lophelia	Sandra Brooke; Stephen Cairns	x
Paragorgia (peppermint coral)	Peter Etnoyer	x
Parastenella spp (white polyps grey skeleton)	Stephen Cairns	x
Primnoa (yellow, golden)	Stephen Cairns	x
Primnoid (pale pink)	Stephen Cairns	x
Scleractinia	Stephen Cairns	x
Pennatula phosphorea (white, maroon)	Gary Williams	x
sea pen (purple/maroon)	Gary Williams	x
sea pen (white rachis, pink polylps)	Gary Williams	x
Telestula (Clavulariidae; white)	Gary Williams	x
Swiftia pacifica	Beth Horvath	x
Swiftia sp (dark pink)	Beth Horvath	x
Sponge		
yellow space ship sponge	James Weaver	
Poecilosclerida (stalked sponge)	James Weaver	x
2 cream sponges	James Weaver	
palm frond sponge	James Weaver	
pipe sponge	James Weaver	
cauliflower sponge	James Weaver	
puff ball sponge	James Weaver	
misc items - sponges (2), brittle stars, worms	James Weaver	
goiter sponge (juvenile)	James Weaver	
sponge (cream white)	James Weaver	
Zoanthid		
Zoanthid (tan)	Timothy Swain	x
Zoanthid (tan)	Timothy Swain	x
Tunicate		
tunicate (yellow, green neon)	Karen Sanamyan	
tunicate (white)		
tunicate (clear, pale yellow)		
Invertebrate		
radio tower worms (red bodies, black tubes)	Leslie Harris/Greg Rouse	
sea cucumber (white)	Greg Rouse?	
nudibranch (Dendronottid, orange)	Terry Gosliner	
nudibranch (Aloliod?, white with pink cirri)	Terry Gosliner	
brittle stars assoc. w/puffball sponge	Gordon Hendler?	

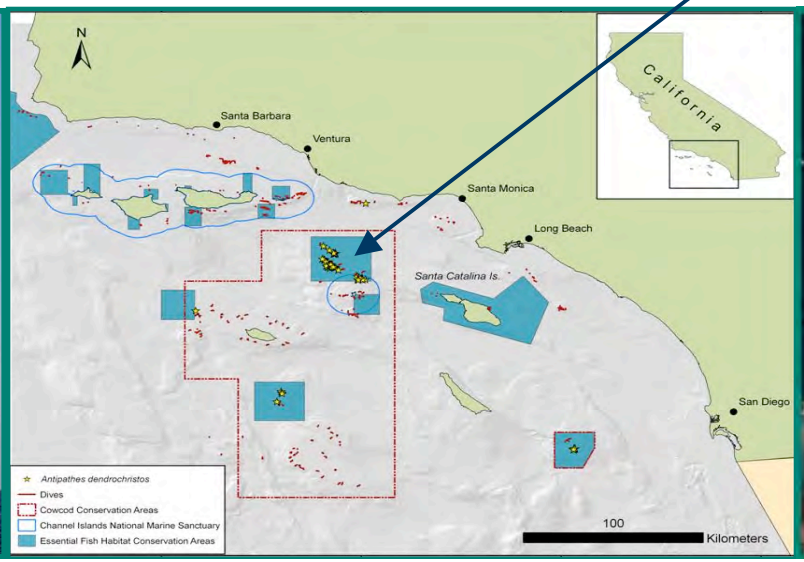
NOAA's Deep Sea Coral Program - West Coast

Cruise 2: 4-10 October 2010

- Specific Research Objectives:
  - Quantify habitat-specific abundance and size composition of Christmas tree black corals
  - Evaluate change in coral community 8 yrs after initial baseline
  - Determine fish associations with black corals (understand corals as EFH)

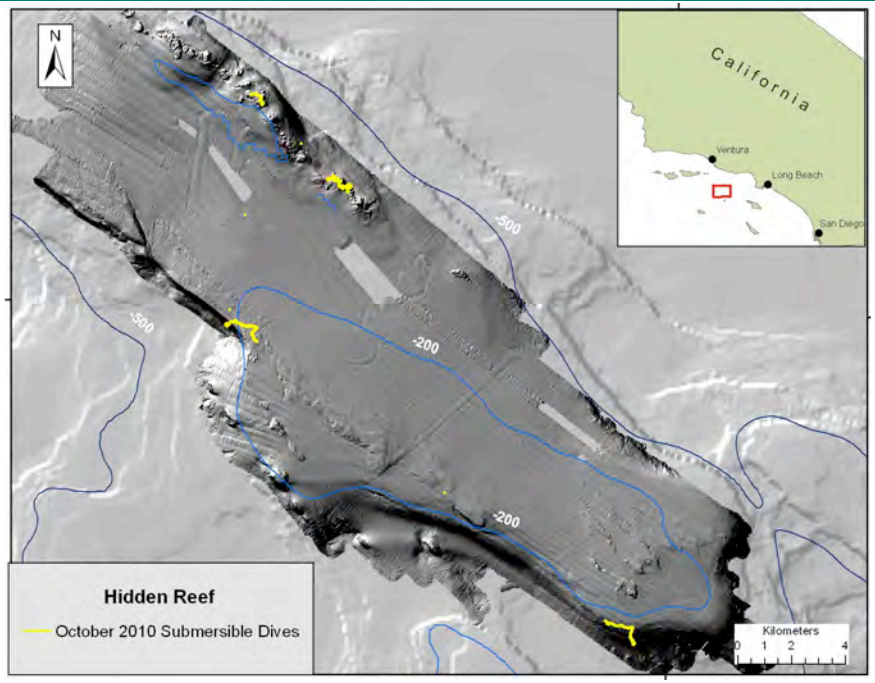
- Survey tools: *Dual Deepworker* manned research submersible and F/V *Velero*

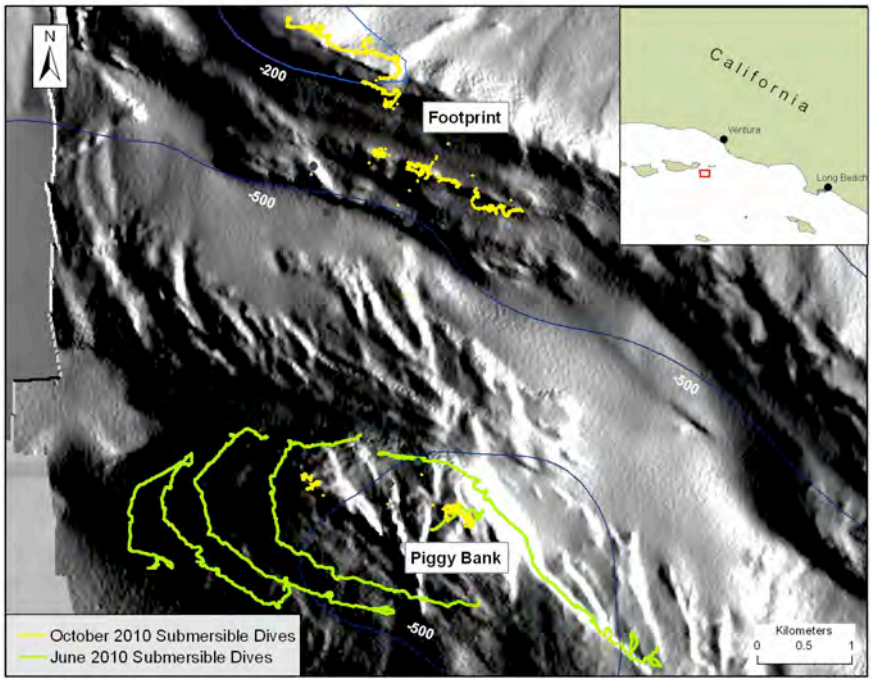
- Primary Study Site: Christmas tree coral hotspot (Hidden Reef, 100-350 m, Southern CA Bight)



NOAA's Deep Sea Coral Program - West Coast

Cruise 2: 4-10 October 2010





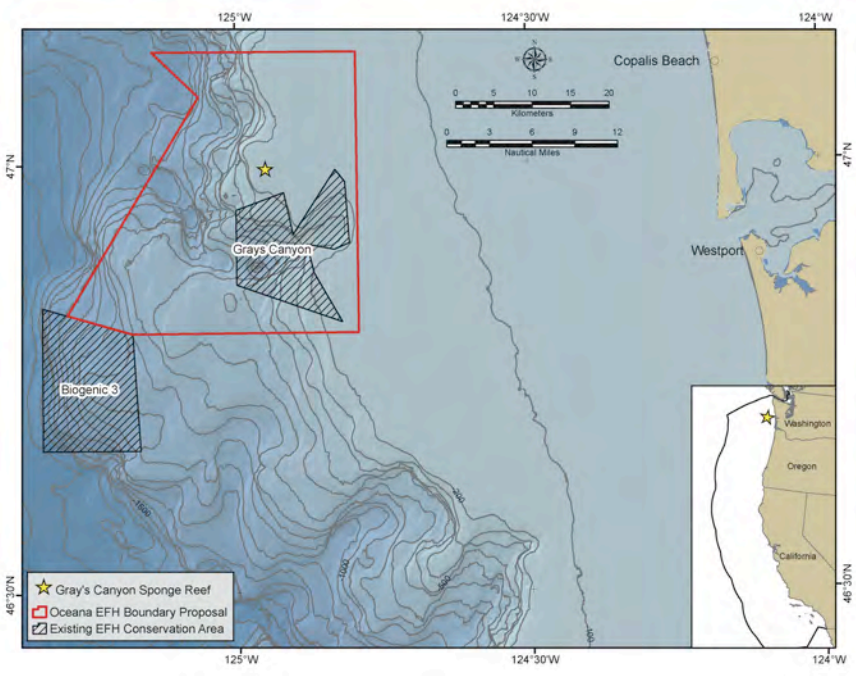
- 11 submersible dives (110 - 475 m) at Hidden Reef, Footprint and Piggy Banks
- 1000+ observations of DSC & sponges
- 17 hrs annotated High-Definition Video
- 11 CTD casts (temp, salinity, depth, O^2) along dive tracks
- 3 collections (Primnoid, *Lophelia*, and *Paragorgia* corals; sponges)

Participants

- Mary Yoklavich, Tom Laidig, Lisa Krigsman, Di Watters, Andrew Taylor (SWFSC)
- Milton Love, Linda Snook, Mary Nishimoto (UCSB)

NOAA's Deep Sea Coral Program - West Coast

Cruise 3: July (multibeam) and September (AUV)



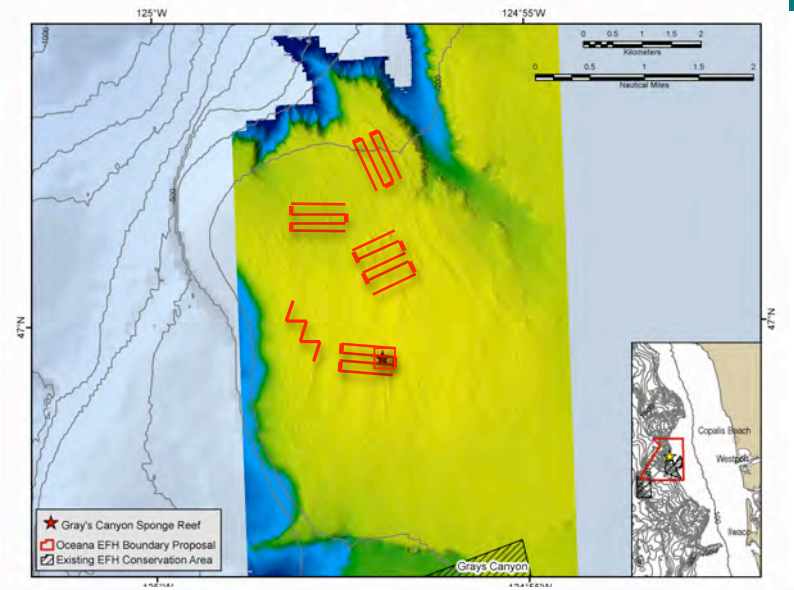
- **Study Site:** Glass sponge reefs associated with methane plumes in Grays Canyon on Washington coast

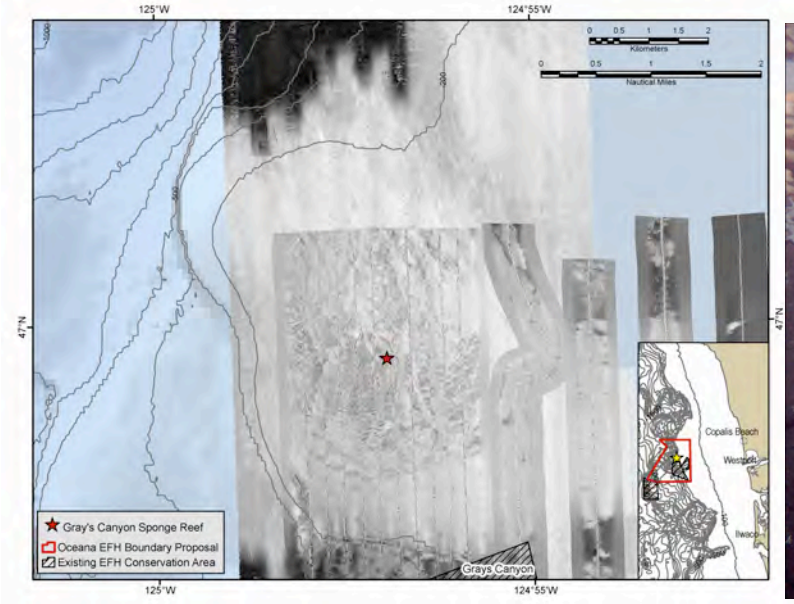
- **Specific Research Objectives:**
  - Map extent of sponge reefs
  - Describe associated fish and invertebrate community
  - Evaluate role of sponge reefs as EFH
  - Provide Pacific Council with information to decide on EFH proposals for protection of reefs

- **Survey tools:** NMFS Seabed AUV; contracted multibeam gear and support vessel

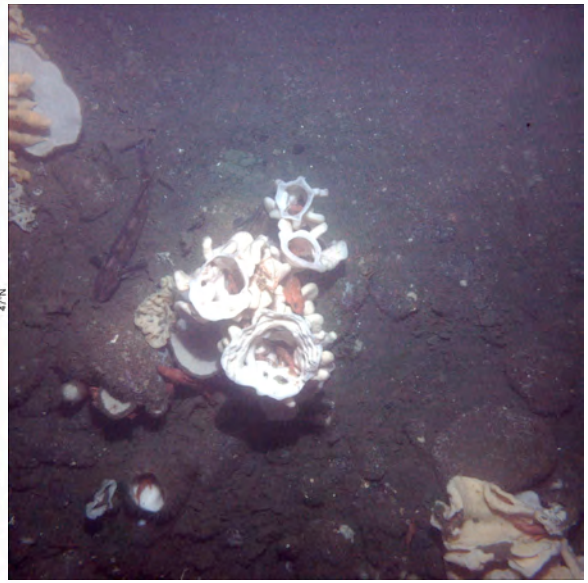
NOAA's Deep Sea Coral Program - West Coast

Cruise 3: July (multibeam) and September (AUV)





- Detailed multibeam of sponge area
- 7 AUV dives in sponge reef area
- Over 24,000 Digital Still images of sponges, habitat and groundfish
- 7 temp, salinity, depth along dive tracks
- Detailed images and multibeam for photomosaic over original site
- Participants from Woods Hole Oceanographic, Oregon State University, NWFSC and PIFSC



NOAA FISHERIES SERVICE

Summary

The Council is a key partner. In the first year, research took place in areas identified as being of potential management interest. Results are still being analyzed, but initial observations suggest the following:

- There are important coral habitats in the Channel Islands and in the area of the Olympic Coast Sanctuary
- The glass sponge habitats off Washington extend beyond the initial site that was identified several years ago
- Planning for year 2 & 3 of the field research is underway
- In addition to field research, the DSCRTP is supporting analysis of existing information that can inform management and that will continue beyond the 3 year field research.
- We look forward to continuing to work closely with the Council.

Science, Service, Stewardship

2010 West Coast Deep-Sea Coral and Sponge Research

Presentation to the
Pacific Fishery Management Council
November 4, 2010

NOAA CORAL REEF CONSERVATION PROGRAM

NOAA FISHERIES SERVICE

NOAA FISHERIES SERVICE

Deep Sea Coral Research and Technology Program: National Overview

Magnuson-Stevens Fisheries Conservation and Management Act 2006

- **Sec. 408**: Established the Deep Sea Coral Research and Technology Program
- **Sec. 303(b)(2):** New discretionary authority to protect deep-sea coral areas identified by the Program from damage by fishing gear

Program funded in FY 2009

- $1.5 million in FY 2009
- $2.5 million in FY 2010

Collaboration among NMFS, NOS, OAR and NESDIS

Based on sound science and targeted to address NOAA's deep-sea coral *management* responsibilities under Magnuson-Stevens Act, and provides ancillary benefits to management efforts in
- National Marine Sanctuaries
- Ecosystem Based Management

NOAA FISHERIES SERVICE

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;

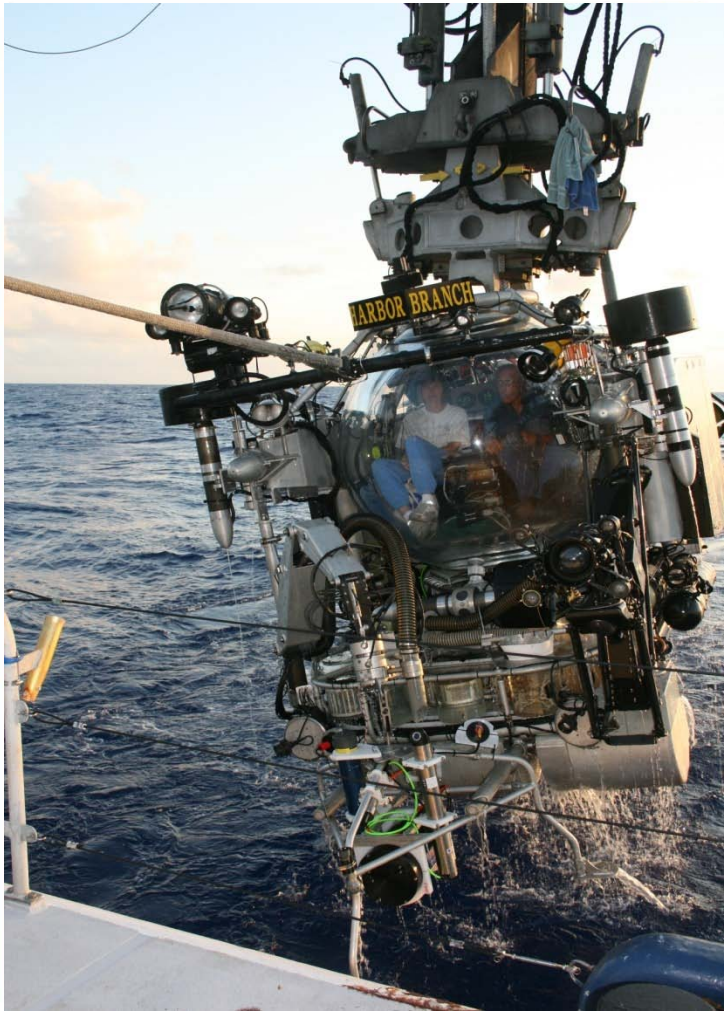
(5) to develop technologies or methods designed to assist fishing industry participants in reducing interactions between fishing gear and deep-sea corals; and

(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.

NOAA FISHERIES SERVICE

Deep-Sea Coral Research and Technology Program: National Overview

- Identify existing research on, and known locations of, deep-sea corals
  - Develop GIS databases to manage deep-sea coral information
  - Analyze existing information
- Monitor activity in deep-sea coral locations
  - Analyze distribution and intensity of fishing using bottom-contact gear
  - Develop methods to enhance information from bycatch
- Conduct research and locate and map locations of deep-sea corals:
  - Major regional field research initiatives in U.S. Southeast and West Coast



Deep-Sea Coral Field Research and Mapping

Alaska
2012-2014

Northeast U.S.
2013-2015

West Coast
2010-2012

Southeast U.S.
2009-2011

Stony Coral Gorgonian Black Coral Gold Coral Lace Coral

Structure-Forming Deep-Sea Corals of the U.S.

NOAA CORAL REEF CONSERVATION PROGRAM

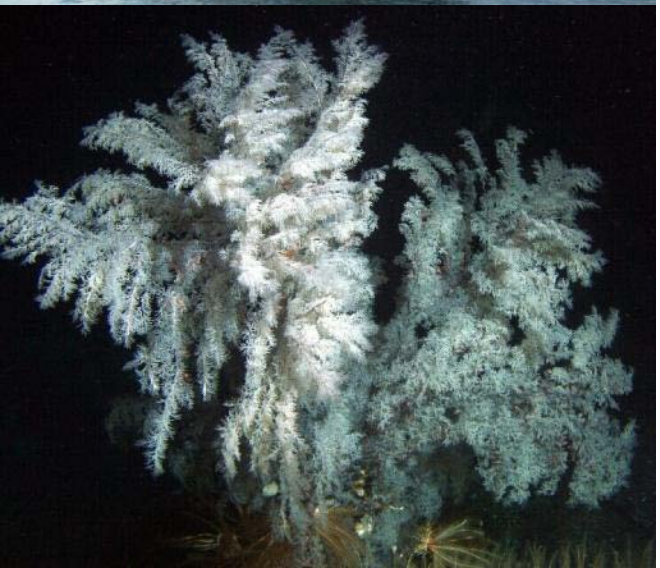
NOAA FISHERIES SERVICE

Regional Expert Workshops: Research Priorities

Rank	Southeast U.S. 2009	West Coast 2010	Alaska 2010
1	Complete multi-beam sonar surveys for proposed Deepwater Coral MPAs	Map and characterize deep-sea coral and sponge distributions	Mine existing info on coral & sponge distributions; Conduct new mapping
2	Association of deep-sea corals and sponges with other species	Association of deep-sea corals and sponges with other species	Functions corals & sponges provide for managed species
3	Map and characterize deep-sea coral and sponge distributions	Biology of deep-sea corals (taxonomy, life history, connectivity)	Habitat suitability modeling
4	Anthropogenic impacts	Habitat suitability modeling	Coral and sponge population characteristics
5	Habitat suitability modeling	Anthropogenic impacts	Fishing impacts, bycatch & closed areas

NOAA FISHERIES SERVICE

2010 – 2012 West Coast Field Research



Why the West Coast?

- Inform Council's 5-year EFH Review
- Describe deep-sea coral locations for discretionary deep sea coral zones
- Address petitions for conservation of corals and sponge reefs
- Contribute to sanctuary planning
- Study systems across large geographic ranges to inform ecosystem management plans

NOAA's Deep Sea Coral Program - West Coast

- **Priority EFH sites off WA and CA**
- **Research Objectives**
  - Characterize distribution & abundance of DSC communities
  - Understand factors that influence DSC distribution and condition
  - Evaluate proposed changes to EFH and Sanctuary boundaries
  - Evaluate function of DSC as fish habitat
- **Diverse investigators and participants:**
  - NOAA Fisheries, Sanctuaries, NCCOS
  - Academia & Research Institutes
  - USGS
  - Tribal
- **Multiple underwater tools & support vessels:**
  - U Conn *Kraken 2* ROV, NMFS *Seabed* AUV, multibeam sonar, *Dual Deepworker* manned submersible
  - NOAA *McArthur II*, R/V *Pacific Storm,* F/V *Velero*

***Kraken 2* Remotely Operated Vehicle (ROV)**

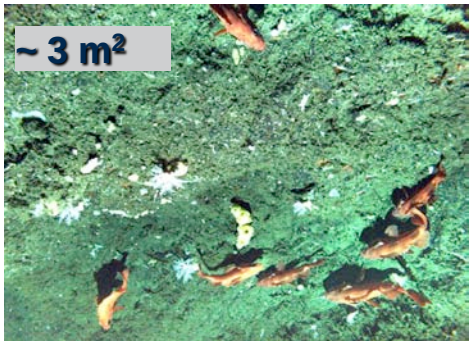
- Owned/operated by University Connecticut
- Real-time imaging of corals, sponges, demersal fishes, and habitats
- Control of sampling and decision-making by science team and pilots
- Collection of HD digital video imagery,digital still photos, CTD data, and samples for species ID and genetics

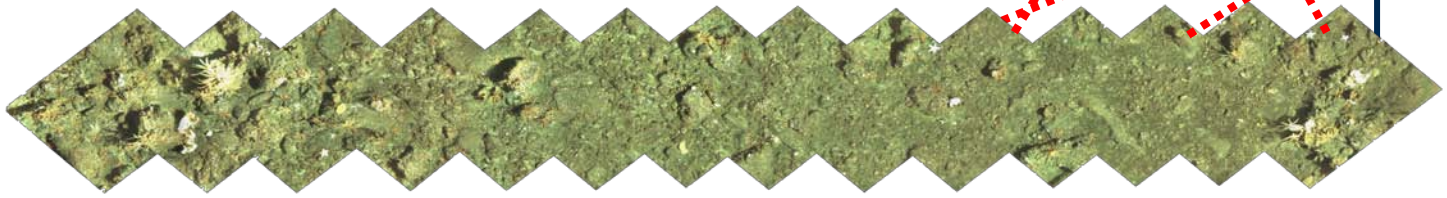
Nuytco Dual Deepworker Manned Submersible

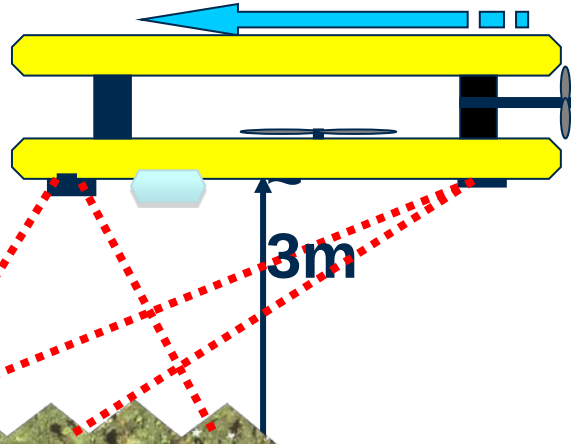
- Owned/operated by Nuytco Research
- Real-time imaging and observations of corals, sponges, demersal fishes, and habitats
- Collection of HD digital video imagery, digital still photos, CTD data, and samples for species ID and genetics

Lucille Autonomous Underwater Vehicle (AUV)

- AUV developed and operated jointly by NOAA Fisheries NWFSC & PIFSC (collaboration with WHOI)
- Non-extractive surveys of corals, sponges, demersal fishes, and habitats
- High resolution still cameras (downward and oblique facing), paired lasers, strobe lighting

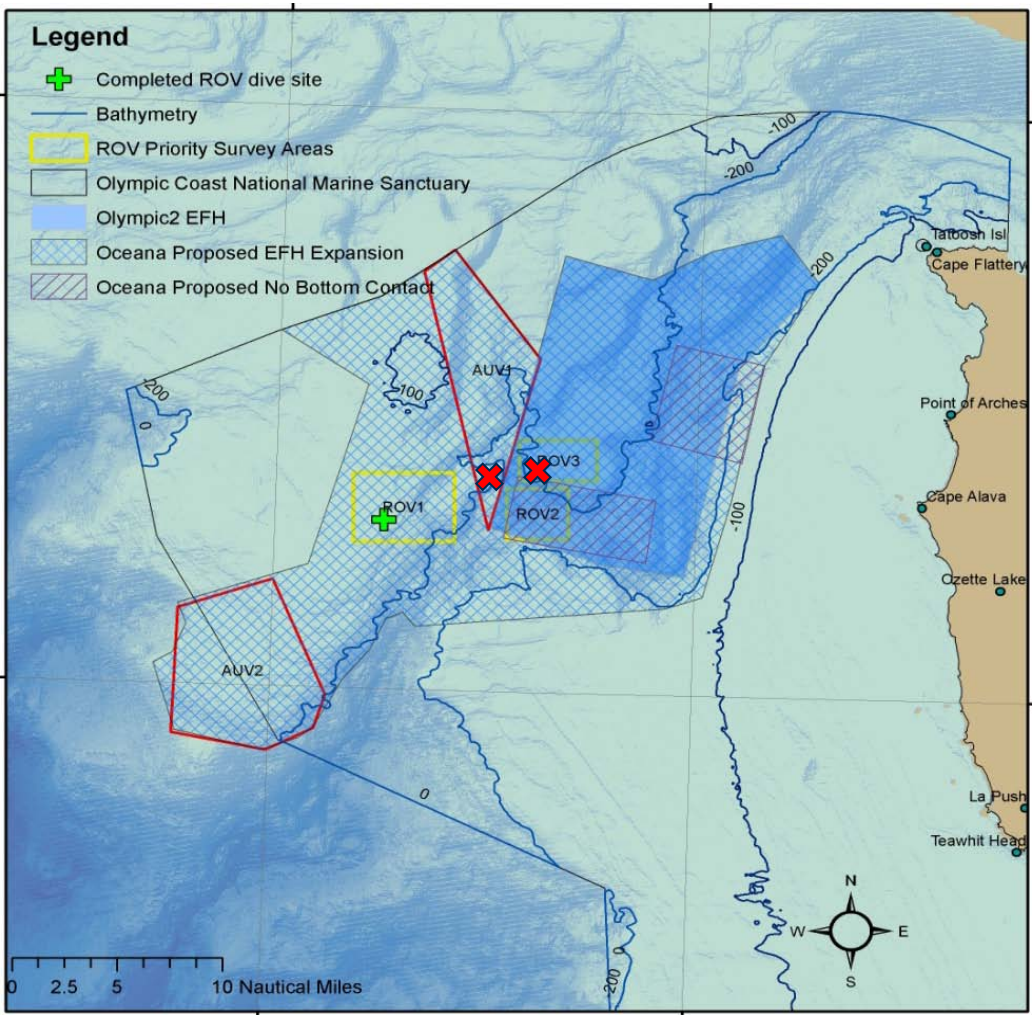






NOAA's Deep Sea Coral Program - West Coast

McArthur II Cruise: Leg 1 June 10-16,2010



- Focus on obtaining coral and sponge information to inform proposed modifications of Olympic 2 EFH
- 1 ROV test dive (inside Straits)
- 1 ROV daytime survey dive in priority area (9 hrs; 120 m depth)
- 2 AUV night-time survey dives in priority areas
- Number of dives limited by adverse weather

Participants:

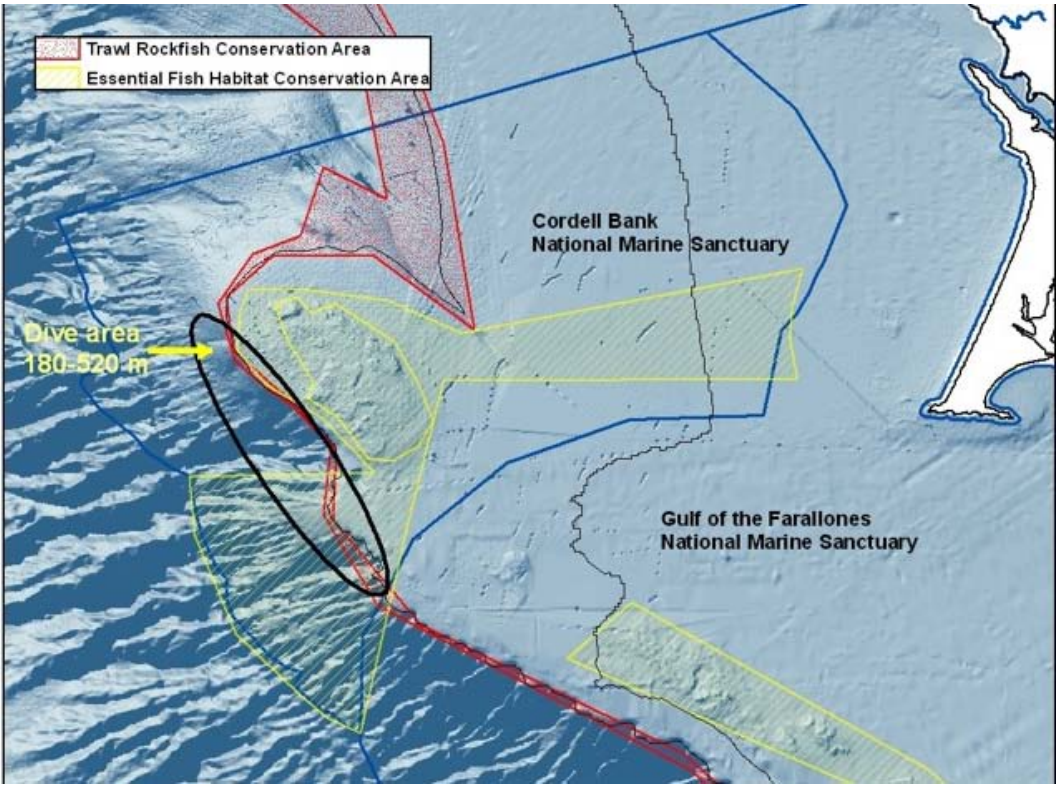
- Ed Bowlby, Jennifer Bright, & Janet Lamont (OCNMS)
- Peter Etnoyer (NCCOS)
- Colby Brady (Makah Tribe)
- Sean Rooney (WSU)
- Elizabeth Clarke, Curt Whitmire, Erica Fruh (NWFSC)
- Jeff Anderson & Jeremy Taylor (PIFSC)
- ROV team (University Connecticut)

LEG 1

- ROV Habitat: mostly boulder fields with attached crinoids
- Primary coral species: small colonies of *Swiftia beringi*
- Primary sponge: green lunar sponge (*Latrunculia* sp.)
- Primary fish species: yelloweye, yellowtail, and canary rockfish

NOAA's Deep Sea Coral Program - West Coast

McArthur II Cruise: Leg 2 June 19- 25,2010



- Focus on assessing coral habitat in Cordell Bank and Gulf of the Farallones National Marine Sanctuaries
- 1 ROV daytime survey dive in priority area (11 hrs; 180-520 m …*number of dives limited by adverse weather)*
- 3 quantitative transects (300-400 m) for fishes, corals, other inverts
- Water chemistry at night: 5 CTD stations on shelf and slope (100-1000 m); water samples (salinity, nutrients, dissolved inorganic carbon, total alkalinity)

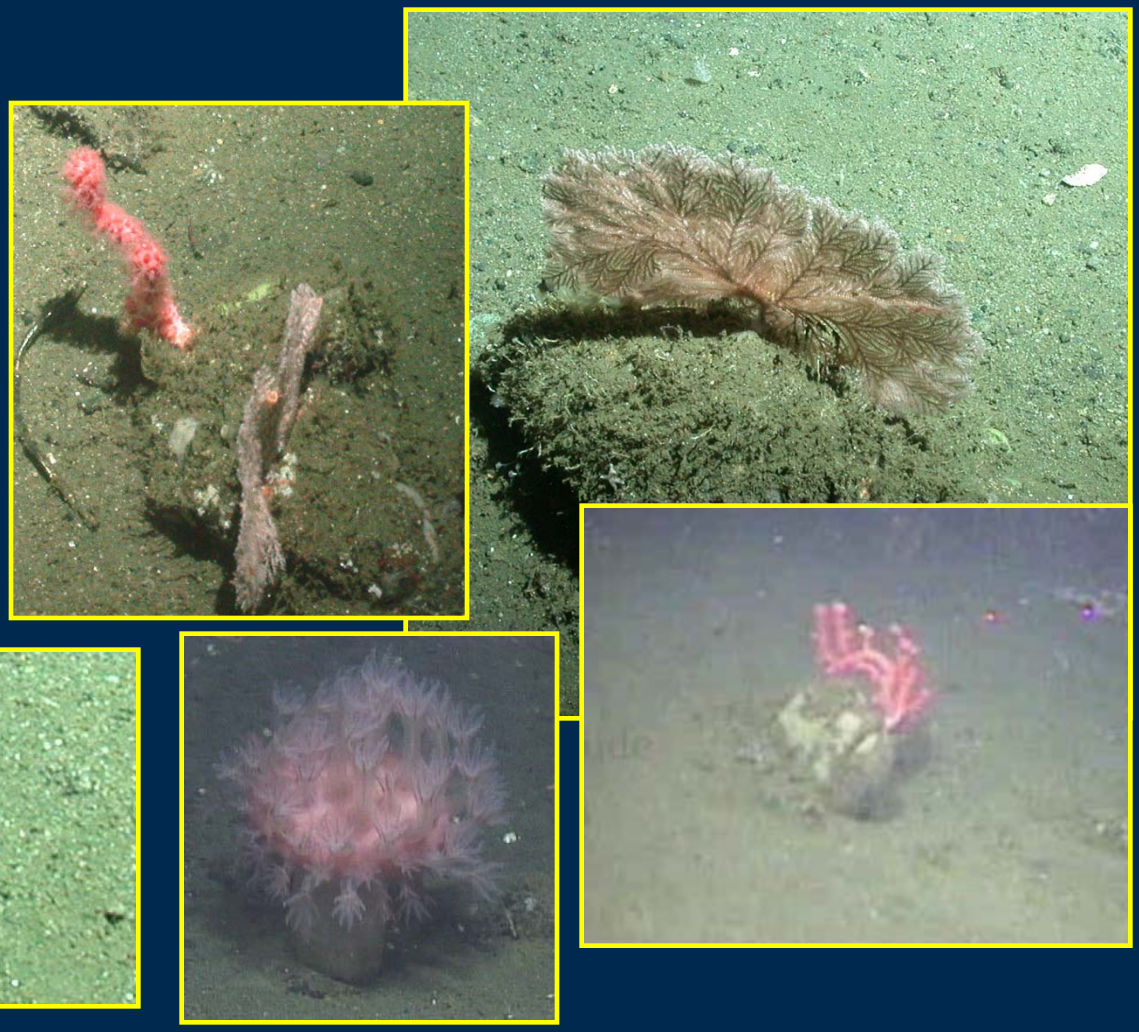
Participants:

- Dan Howard, Dale Roberts,Kaitlin Graiff (CBNMS)
- Jan Roletto, Jamie Hall (GFNMS)
- Peter Etnoyer, Jeff Hyland (NCCOS)
- Brandon Roark, Adrian Minor, Sarah Stryker (Texas A & M University)
- Guy Cochrane (USGS)
- ROV Team

LEG 2

- Habitat: sand/cobble w/ some boulder below 200 m; boulder fields/bedrock above 200 m
- Over 100 observations of 6 different species of coral (4 new to Sanctuary; most were small)
- Very few barrel sponges

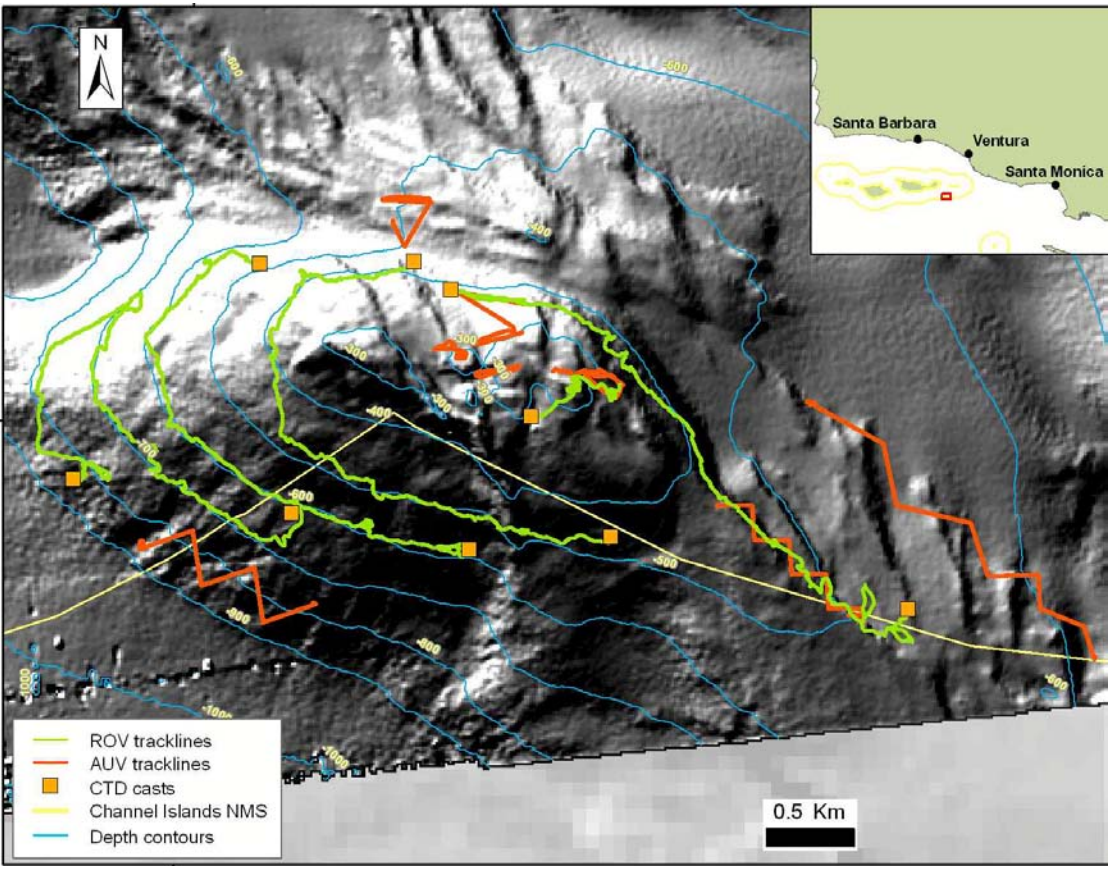
1. Primnoid: *Plumarella* sp. (dominant habitat-forming coral)
2. *Paragorgia* sp. (n = 3)
3. *Anthomastus ritteri*
4. Sea pen
5. *Swiftia* sp.
6. orange cup corals



NOAA's Deep Sea Coral Program - West Coast

McArthur II Cruise: Leg 3 June 27 - July 2, 2010

Focus on assessing coral and sponge habitat in area of Piggy Bank, a deep rocky bank within CINMS and EFH Conservation Area in Southern CA Bight

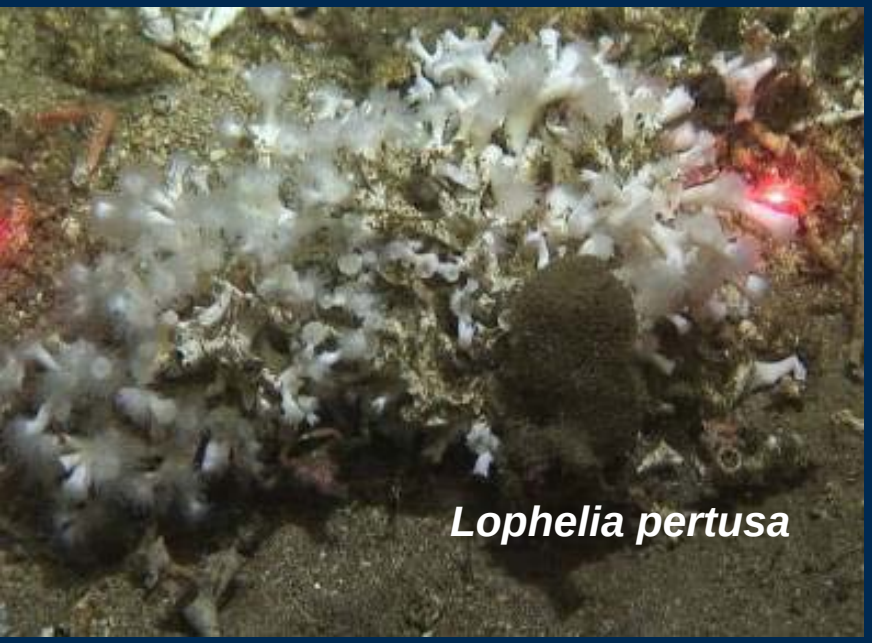


- 6 ROV daytime dives (280 - 890 m); 136+ taxa of demersal organisms; 22+ taxa of corals; 1000+ of deep-sea coral & sponge observations; 45+ hrs high-definition video
- 8 AUV night-time missions (284 - 888 m); 12.5 survey hrs; 16,784 digital images
- 9 CTD casts and 130 water samples (DIC, nutrients; 280-775 m)
- 33 samples collected (16 corals, 10 sponges, 7 other inverts)

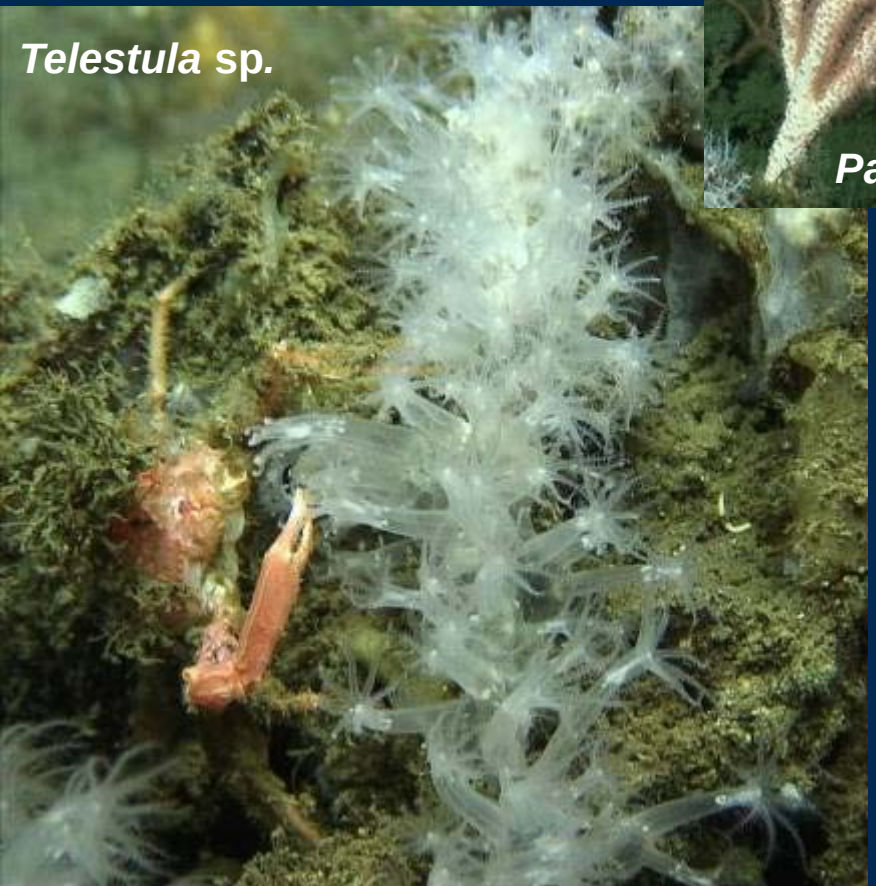
Participants

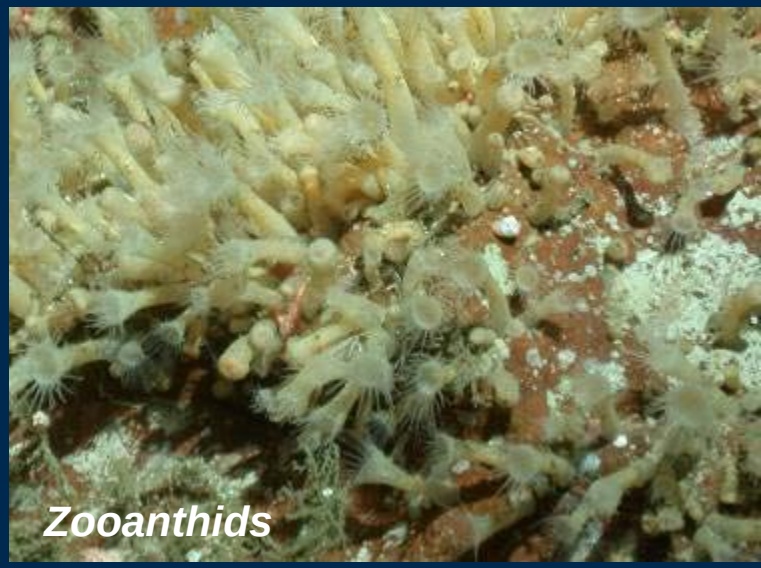
- Mary Yoklavich, Tom Laidig, Lisa Krigsman, Di Watters (SWFSC)
- Liz Clarke, Curt Whitmire, Erica Fruh (NWFSC)
- Jeff Anderson & Jeremy Taylor (PIFSC)
- Milton Love (UCSB)
- Lonny Lundsten (MBARI)
- Dani Lipski & Steve Katz (CINMS)
- ROV team (University Connecticut)

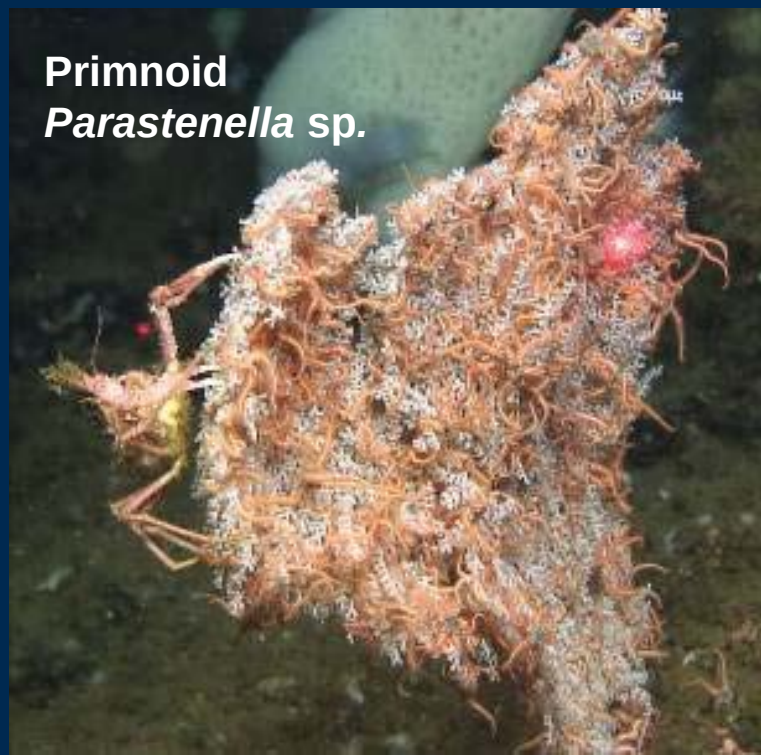
Common coral taxa on high-relief rock pinnacles and boulders on top of Piggy Bank



Common coral taxa on hard substrata at mid-to-bottom of Piggy Bank







Common coral taxa on soft sediments at mid-to-bottom of Piggy Bank

Sponges on Piggy Bank


Heterochone calyx


Dead *Heterochone calyx*


Staurocalyptus sp.

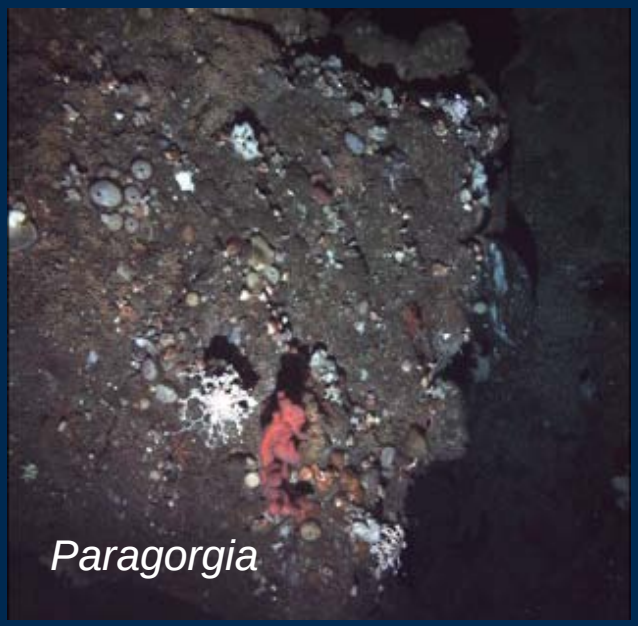

Barrel sponge with *Gorgonocephalus*

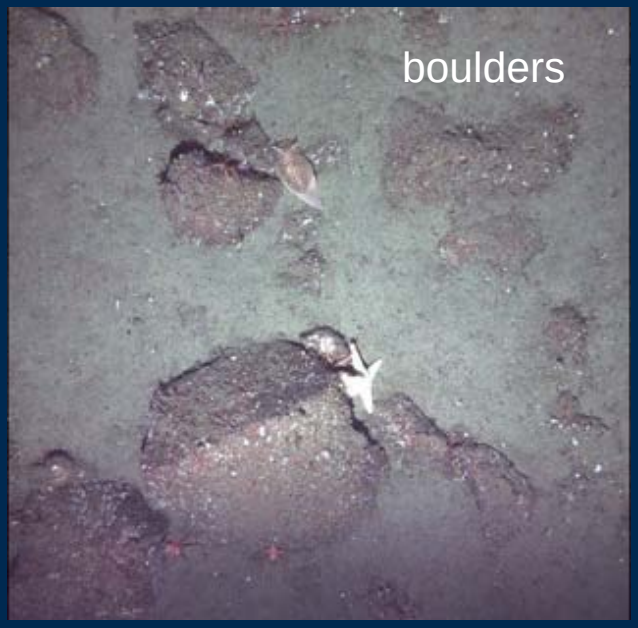

Vase sponge with *Liponema brevicornis*


Vase sponge with hagfish


Cloud sponge *Farrea occa*

Leg 3: Images from AUV





Sample Distribution

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Parastenella spp (white polyps grey skeleton)	Stephen Cairns	x
Primnoa (yellow, golden)	Stephen Cairns	x
Primnoid (pale pink)	Stephen Cairns	x
Scleractinia	Stephen Cairns	x
Pennatula phosphorea (white, maroon)	Gary Williams	x
sea pen (purple/maroon)	Gary Williams	x
sea pen (white rachis, pink polylps)	Gary Williams	x
Telestula (Clavulariidae; white)	Gary Williams	x
Swiftia pacifica	Beth Horvath	x
Swiftia sp (dark pink)	Beth Horvath	x
Sponge		
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Poecilosclerida (stalked sponge)	James Weaver	x
2 cream sponges	James Weaver	
palm frond sponge	James Weaver	
pipe sponge	James Weaver	
cauliflower sponge	James Weaver	
puff ball sponge	James Weaver	
misc items - sponges (2), brittle stars, worms	James Weaver	
goiter sponge (juvenile)	James Weaver	
sponge (cream white)	James Weaver	
Zoanthid		
Zoanthid (tan)	Timothy Swain	x
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Tunicate		
tunicate (yellow, green neon)	Karen Sanamyan	
tunicate (white)		
tunicate (clear, pale yellow)		
Invertebrate		
radio tower worms (red bodies, black tubes)	Leslie Harris/Greg Rouse	
sea cucumber (white)	Greg Rouse?	
nudibranch (Dendronottid, orange)	Terry Gosliner	
nudibranch (Aloliod?, white with pink cirri)	Terry Gosliner	
brittle stars assoc. w/puffball sponge	Gordon Hendler?	

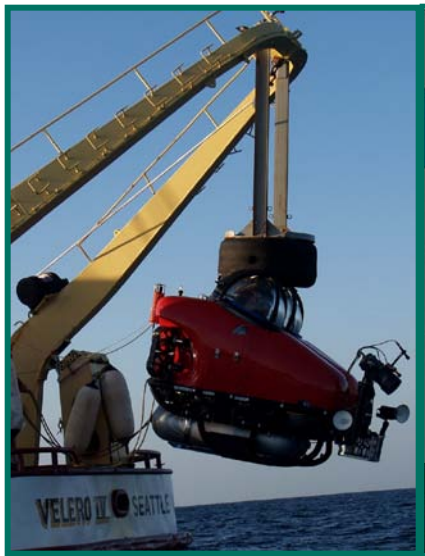
NOAA's Deep Sea Coral Program - West Coast

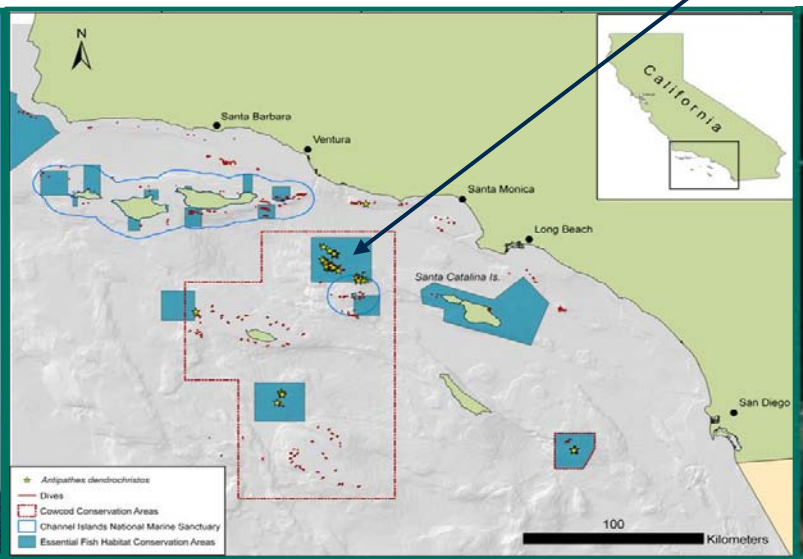
Cruise 2: October 4-10, 2010

- Specific research objectives:
  - Quantify habitat-specific abundance and size composition of Christmas tree black corals
  - Evaluate change in coral community 8 yrs after initial baseline
  - Determine fish associations with black corals (understand corals as EFH)

- Survey tools: *Dual Deepworker* manned research submersible and F/V *Velero*

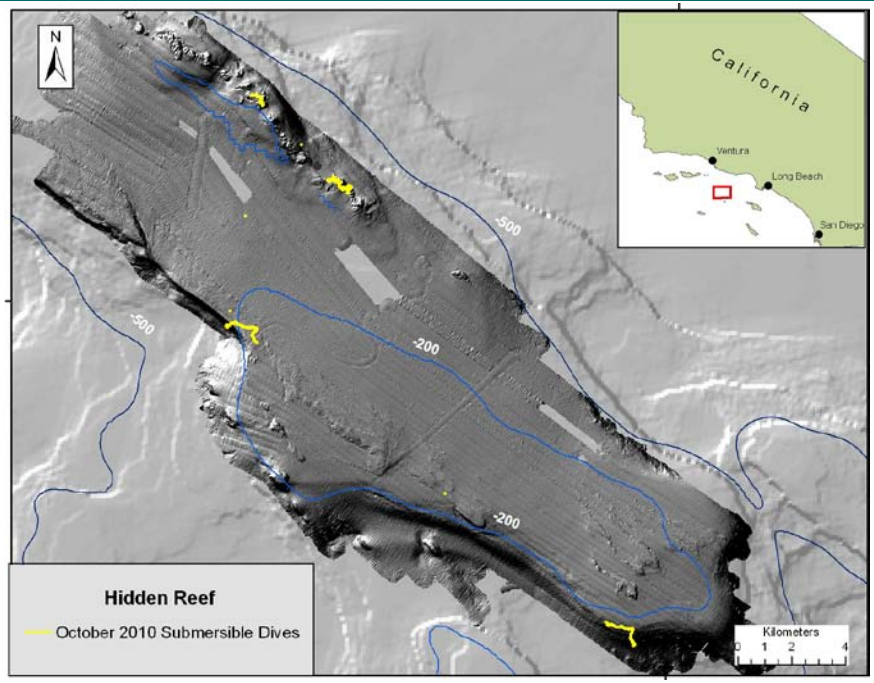
- Primary study site: Christmas tree coral hotspot (Hidden Reef, 100-350 m, Southern CA Bight)

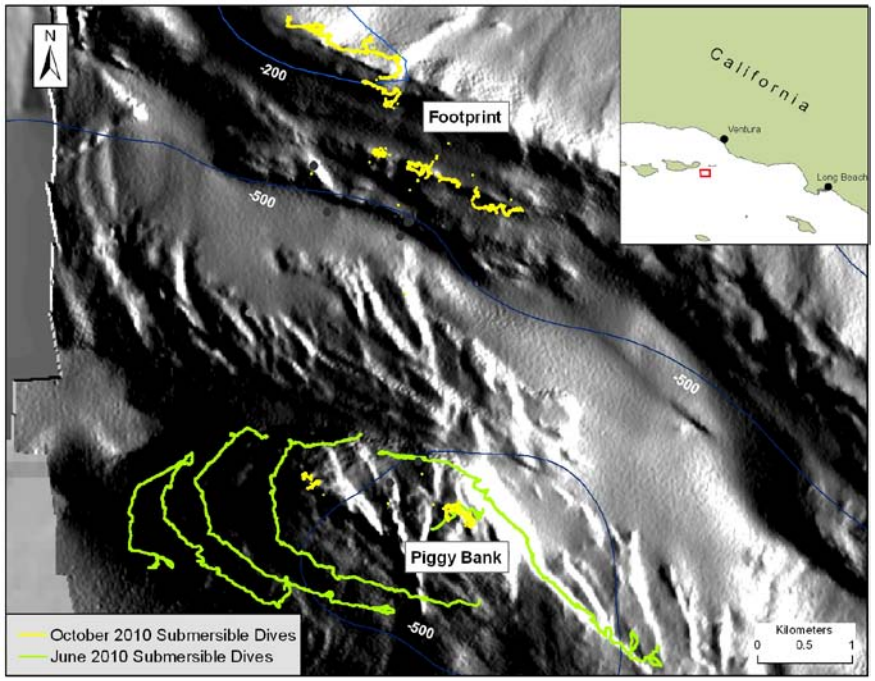




NOAA's Deep Sea Coral Program - West Coast

Cruise 2: October 4-10, 2010





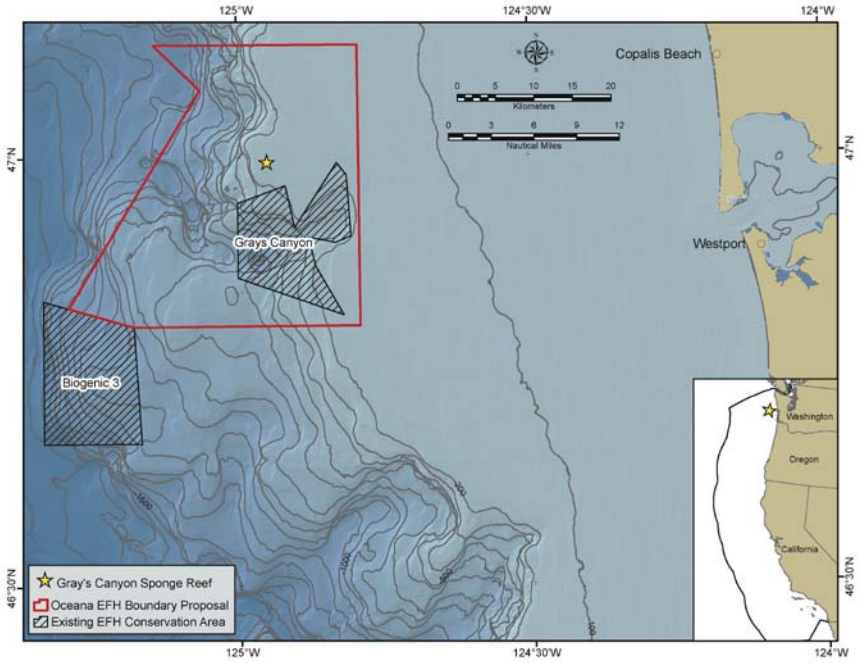
- 11 submersible dives (110 - 475 m) at Hidden Reef, Footprint and Piggy Banks
- 1000+ observations of deep-sea corals & sponges
- 17 hrs annotated high-definition video
- 11 CTD casts (temp, salinity, depth, O_2) along dive tracks
- 3 collections (Primnoid, *Lophelia*, and *Paragorgia* corals; sponges)

Participants

- Mary Yoklavich, Tom Laidig, Lisa Krigsman, Di Watters, Andrew Taylor (SWFSC)
- Milton Love, Linda Snook, Mary Nishimoto (UCSB)

NOAA's Deep Sea Coral Program - West Coast

Cruise 3: July (multibeam) and September (AUV)



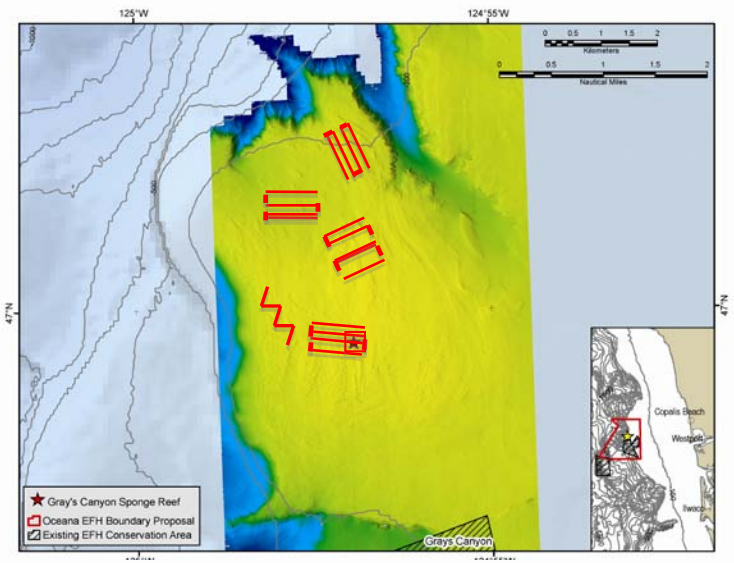
- **Study Site:** Glass sponge reefs associated with methane plumes in Grays Canyon on Washington coast

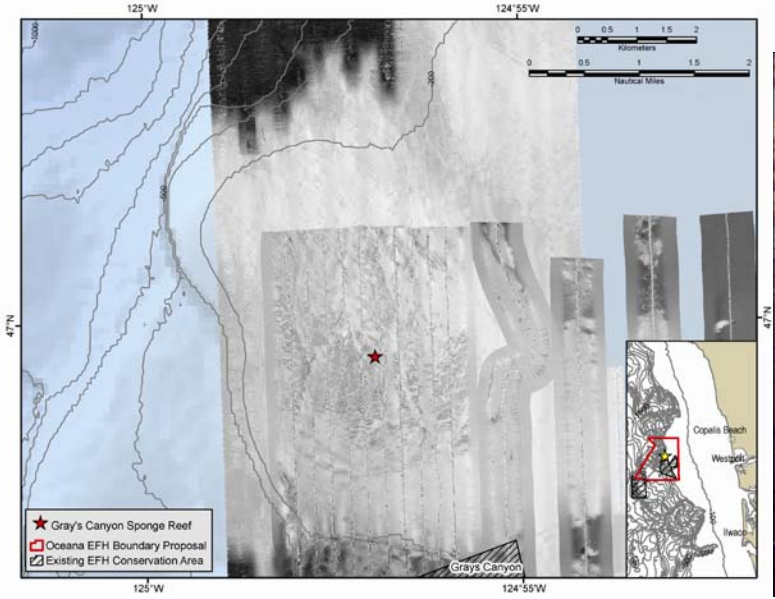
- **Specific Research Objectives:**
  - Map extent of sponge reefs
  - Describe associated fish and invertebrate community
  - Evaluate role of sponge reefs as EFH
  - Provide Pacific Council with information to decide on EFH proposals for protection of reefs

- **Survey Tools:** NMFS Seabed AUV; contracted multibeam gear and support vessel

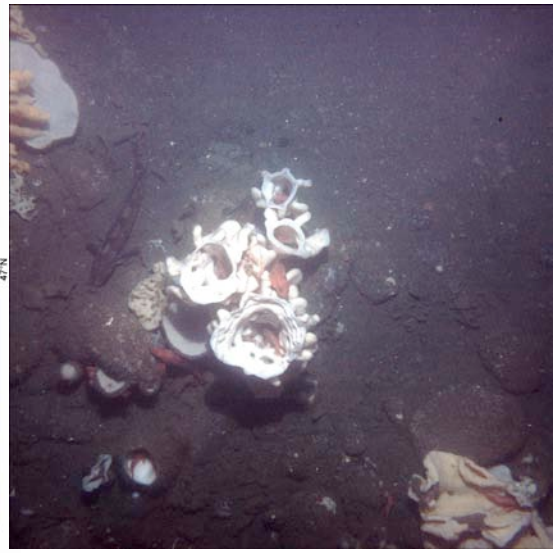
NOAA's Deep Sea Coral Program - West Coast

Cruise 3: July (multibeam) and September (AUV)





- Detailed multibeam of sponge area
- 7 AUV dives in sponge reef area
- Over 24,000 digital still images of sponges, habitat and groundfish
- Temp, salinity, depth along dive tracks
- Detailed images and multibeam for photomosaic over original site
- Participants from Woods Hole Oceanographic, Oregon State University, NWFSC and PIFSC



NOAA FISHERIES SERVICE

Summary

- The Council is a key partner, and the first year of research targeted areas already identified as being of potential management interest. Results are still being analyzed, but initial observations suggest the following:
  - There are structure-forming coral habitats in the Channel Islands and in the Olympic Coast Sanctuary
  - The glass sponge habitats off Washington extend beyond the point site identified several years ago
- Planning for years 2 & 3 of the field research is just beginning
- In addition to the field research, the deep-sea coral program is supporting analysis of existing information that can inform management and that will continue beyond the 3-year field research.
- We look forward to continuing to work closely with the Council.

NOAA
FISHERIES
SERVICE

Thank you

Agenda Item E.2.c
Supplemental HC Report
November 2010

HABITAT COMMITTEE REPORT ON DEEPWATER CORAL INFORMATION

The Habitat Committee (HC) heard an informational report on the NOAA Fisheries' Deep-Sea Coral Research and Technology Program (DSCRTP) from Ms. Fan Tsao, a deep-sea coral information specialist with the NMFS Office of Habitat Conservation. Ms. Tsao gave a Powerpoint presentation on the program's West Coast expert workshop on research priorities (held January 2010 in Portland), and a summary of the first field season of West Coast deep sea coral research during the summer of 2010 (the same presentation that the Council received from Dr. Elizabeth Clarke). The Council's Habitat Committee received a briefing on this topic in October 2009, and Council staff attended the DSCRTP's January 2010 workshop and provided input to the development of research priorities.

As the Council heard in Dr. Clarke's presentation, this research is aimed at improving understanding of the distribution, density, abundance, and biology of corals and sponges; and ultimately will help to inform management decisions in West Coast waters. Under Magnuson-Stevens Act Section 303(b)(2), the Council has new discretionary authority to protect deep-sea coral areas identified by the DSCRTP through fishing gear interactions.

During the presentation, the HC learned that the DSCRTP needs input on field work priorities by mid-December. The HC discussed a few ideas for focusing the 2011 and 2012 field research efforts:

- Characterize deep-sea corals and sponges in essential fish habitat (EFH) closed areas placing a priority on multibeam surveyed areas.
- Examine associations among deep-sea corals and sponges, groundfish, and substrata in EFH closed areas.
- Resurvey priority areas that were under sampled in 2010.
- Work in other areas that have multibeam surveys to further develop data that will contribute to habitat suitability models.
- Work in areas where trawl survey work and observer data show high coral bycatch or coral interactions.

The HC suggests a priority on currently unfunded research mandates, i.e., evaluation of EFH closed areas.

PFMC
11/04/10

Agenda Item E.2.c
Supplemental Tribal Comment
November 2010

PACIFIC COAST TREATY TRIBES' TESTIMONY ON DEEPWATER CORAL

The Coastal Treaty Tribes continue to be concerned that the Coral Reef Conservation Program's (CRCP) research activities are not meeting the management needs of the PFMC or its members. Specific to the Pacific Coast Treaty Tribes; a significant portion of this research is occurring within and adjacent to the tribes' usual and accustomed areas (U&A's). As part of the Council's role in providing recommendations to NMFS regarding the management of corals and sponges, in our view, this task will be difficult and not effective with the current research design being to examine individual proposals (EFH/HAPC) or individual outcroppings. How and what information will the current research provide to the Council to assist in the development and implementation of appropriate management measures with respect to coral and sponges?

As we communicated to CRCP and Council recently, in addition to meaningful consultation with the Tribes, we believe it would be beneficial for the CRCP to work with the SSC and other Council Advisory Bodies. This type of communication would ensure that research activities meet the data standards necessary to begin to comprehensively assess the distribution, abundance, density, and diversity of coral and sponge resources in the California Current large marine ecosystem, particularly in the EEZ. This was highlighted as the primary management need in the West Coast coral workshop and would align the CRCP research activities with both the NOAA Strategic Plan and the PFMC's management requirements. We highly recommend these conversations begin during the planning phase of the next two years of the CRCP's West Coast activities

The Council has already taken steps to protect areas of known coral and sponge abundance as well as freezing the trawl footprint to protect unassessed areas as a precautionary measure. We now need to move toward inventories of these resources throughout their range to measure impacts and manage them through regional and ecosystem-wide approaches. The Tribes would like to see the Council move forward working with the CRCP to develop research activities that will meet those needs.

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Forks WA 98331

Makah Tribe
P.O. Box 115
Neah Bay, WA 98357

Quileute Tribe
P.O. Box 279
LaPush, WA 98350

Quinault Indian Nation
P.O. Box 189
Taholah, WA 98587

September 23, 2010

National Oceanic Atmospheric Administration
Coral Reef Conservation Program
1315 East-West Highway
SSMC 3, Room 14149
Silver Spring, MD 20910
301-713-4300 ext. 178

Dear Maile Sullivan, Kacky Andrews, and Tom Hourigan:

The four coastal treaty tribes - the Hoh Tribe, the Makah Tribe, the Quileute Tribe, and the Quinault Nation request a meeting to discuss with the Coral Reef Conservation Program what its research plans are for the west coast over the next two years. This meeting should be timely as the first year's research cruises are largely concluded for the season. We wish to hear how the program intends to achieve its objective of locating and mapping the distribution of deepwater coral and sponge communities along the west coast.

As you recall, the highest priority topic identified in the West Coast Regional Priorities Workshop was the identification of deep-sea coral species distribution, abundance, densities, and diversity throughout the California Current Large Marine Ecosystem. We believe this should be the research program's primary focus for the next two years. This coincides with the most pressing management concern of how these species are distributed by depth and latitudinally throughout the California Current. The other identified research needs from the workshop, increasing the understanding of deep-sea coral and sponge biology and their ecological role within the ecosystem, while important, are lower management priorities. In addition, these issues will take longer to address than the two years the program intends to remain focused on the west coast region.

The identified top priority from the workshop also coincides with NOAA's Deep Sea Coral Research and Technology Program's mission of providing information on deep-sea coral to the Regional Fishery Management Councils and other resource managers to enhance the conservation of these species. We are interested in hearing how the survey cruises are being designed to provide this information. We are aware that the Statistical and Scientific Committee of the Pacific Fishery Management Council has extended an offer to work with the program on its research design. It is important from our standpoint

that the Statistical and Scientific Committee be involved in the survey design so that there is as much confidence as possible in the data and information that result from this coast wide assessment. Our expectation is that the program will work with the Pacific Council's technical committees to ensure that their data standards are being met.

A coordinated regional management approach is necessary for effective conservation efforts to occur on species so widely distributed as deep water coral and sponges. The tribal co-managers have been working within the Pacific Fishery Management Council process to achieve this result. It is our desire to have data from coast wide assessment to inform the Pacific Council's deliberations for the next 5-year Essential Fish Habitat review cycle. We look forward to hearing from you on how the program is progressing on this task. Our contacts for this issue are Joe Gilbertson (Hoh Tribe: joseph@centurytel.net), Steve Joner (Makah Tribe: gofish@olypen.com), Jennifer Hagen (Quileute Tribe: Jennifer.hagen@quileutenation.org), Joe Schumacker (Quinault Nation: jschumacker@quinault.org), and Craig Bowhay (NWIFC: cbowhay@nwifc.org). We request that a joint meeting be coordinated through your staff at the earliest convenience.

Sincerely,

Russ Svec
Makah Tribe
Fisheries Department

Ed Johnstone
Quinault Indian Nation
Department of Natural Resources

Lonnie Foster
Quileute Tribe
Department of Natural Resources

David Hudson
Hoh Tribe
Department of Natural Resources

cc: John Coon, Pacific Fishery Management Council
Frank Lockhart, NOAA Fisheries