
**Profiles of Activities
Deep Coral Communities
National Oceanic and Atmospheric Administration**



**Deep Coral Communities Team
NOAA Coral Reef Conservation Program**

**1st Edition
August 2005**



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

Acknowledgements: This document was prepared by members of the NOAA Deep Coral Communities Team, a working group comprised of representatives from multiple program offices within NOAA Research, NOAA Oceans and Coasts, and NOAA Fisheries. The information was compiled by programs actively engaged in deep coral research and exploration.

Cover Image: Primnoid corals in the genus *Narella* from approximately 700 m depth off the Big Island of Hawai'i. A large basket star is next to the middle colony. The colony on the far left has a small *Chirostylid* crab (*Galathaeid*). Image courtesy of Amy Baco-Taylor, Thomas Shirley, HURL pilots T. Kerby and M. Cremer, and NOAA OE.

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EXECUTIVE SUMMARY:

Overview: Given NOAA's resource management responsibilities and the expense of deep-sea operations, the agency has a vested interest in fostering the integration of efforts that further the understanding of deep coral communities. This document provides an overview of NOAA deep coral communities related activities, with the purpose of supplying a tool for identifying connections and potential collaborations among programs. It contains profiles for 18 program offices, science centers, and sanctuaries that include information on recent and upcoming deep coral community activities (FY 2003-2006). It is intended to be an evolving document, used to solicit additional input from other NOAA programs involved in deep coral community issues. The document will be updated periodically as additional profiles are submitted. If you are interested in contributing information from your organization to this report, please review *Appendix F. Profile Template and Instructions*, and contact Tim Birdsong (301.713.9444 x120, Timothy.Birdsong@noaa.gov) or Gabrielle Dorr (301.713.0299 x193, Gabrielle.Dorr@noaa.gov).

INTRODUCTION:

Background: Deep corals are fragile, long-lived and slow growing organisms found worldwide in dark, cold, oceanic waters. Similar to shallow water coral reefs, deep corals are highly diverse, and include species of stony corals, black corals, hydrocorals, gorgonians, soft corals and precious corals. Deep corals have been observed at depths between 50 and 2000 m, both as large aggregates and as individual colonies. Although the existence of deep corals has been documented in the scientific records for hundreds of years, scientists are just beginning to record their distributions and understand their ecological importance as habitat for various life-history stages of fishes and invertebrates. Several NOAA programs have been involved in funding, coordinating and executing projects related to exploration, research and management of deep corals in various regions of the world's oceans, but knowledge of the location, distribution, ecology, biology, structure and function of deep corals remains somewhat limited.

Profiles: The profiles of deep coral communities activities were developed by representatives of the NOAA program offices directly involved in the acquisition and analysis of deep coral communities data. The following describes the major categories of information presented in the profiles:

Contact information: Provides information on the primary point of contact within the program who is most knowledgeable about the deep coral activities and priorities.

Research Information: Includes the Region(s) of Interest, Major Research Interests, Recent Deep Coral Communities Research Projects (FY 2003-2004), Upcoming Deep Coral Communities Research Projects (FY 2005-2006), and Long-term Research Plans.

Region(s) of Interest: Provides a quick reference to the program's primary areas of interest.

Major Research Interests: Provides an overview of the program's deep coral communities research activities (i.e., biology, ecology, etc.).

Recent Deep Sea Coral Research Projects (FY 2003-2004): Lists deep coral communities research projects that each organization was recently involved in and any associated deliverables.

Upcoming Deep Sea Coral Research Projects (FY 2005-2006): Plans for upcoming deep coral communities activities and any associated deliverables.

Long-term Research Plans: Identifies research plans that are specific to each program to meet their current and future goals.

Major Equipment and Facilities: Provides a list of any equipment that the program office uses, or plans to use. Focuses on vessels that the program typically has access, not desired vessels.

NOAA Partners: Provides a list of NOAA program offices that are critical partners for acquiring and processing deep coral communities data, as well as developing products and deliverables.

External Partners: Provides a list of external institutions that are critical partners for acquiring and processing deep coral communities data, as well as developing products and deliverables.

References: Provides a list of any relevant plans that drive the deep coral communities effort (titles of the plans), as well as any relevant web sites where additional information on the deep coral communities effort can be found.

NOAA Oceans and Coasts

Activities of Flower Garden Banks National Marine Sanctuary



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Region(s) of Interest: Northwestern Gulf of Mexico reefs and banks

Major Research Interests:

Identify and characterize deep coral communities in the NW Gulf of Mexico, identify threats and regulatory needs, develop habitat maps, and produce regional catalogs of major benthic invertebrate groups in the area.

Recent Deep-Sea Coral Research Projects (FY 2003-2004):

Conducted 6 dedicated ROV cruises specifically focused on characterizing the habitats and biological assemblages of the reefs and banks of the northwestern Gulf of Mexico. A total of 110 ROV surveys over a period of 154 hours have yielded over 5000 high resolution digital still images, over 150 hours of digital video, and 218 biological and geological specimens – all of which are georeferenced. All of these data are input into our GIS project, with the ultimate goal being the development of higher resolution habitat maps of the areas, which will include species lists. We have targeted benthic groups to sample and collect in-situ photographs of the specimen for identification, in order to develop a series of regional catalogs – antipatharian, gorgonian and sponge samples have been obtained, and we are collaborating with the Smithsonian Institute and California Academy of Sciences to obtain identifications. Over 1100 square km of high resolution multibeam bathymetry was obtained in the region during a cruise on board the NOAA Ship Thomas Jefferson in 2004. Several drop camera surveys were conducted to ground-truth bathymetry, and to determine habitat and biology in areas of interest.

Upcoming Deep-Sea Coral Research Projects (FY 2005-2006):

Continue ROV cruises, drop camera surveys, and collection of targeted species for identification and regional catalog development, including deep corals. Finalize habitat maps and species lists for protected areas.

Long-term Research Plans:

Develop management strategies, if necessary, to protect deep water habitat, including deep coral communities.

Major Equipment and Facilities:

FGBNMS Sanctuary vessel R/V PT. GLASS

M/V FLING and M/V SPREE (contracts)

NOAA Ship NANCY FOSTER

NURC/UNCW Phantom S2 ROV

Technical SCUBA diving

NOAA Partners:

NURC-UNCW

External Partners:

Dr. Mary Wicksten, Texas A&M University

Dr. Stephen Cairns, Smithsonian Institute

Dr. Dennis Opresko, Smithsonian Institute

Dr. Gary Williams, California Academy of Science

Dr. Jim Gardner, University of New Hampshire

USA/NASA

References:

Flower Garden Banks NMS research plan

FGBNMS Deepwater Fish Habitat Cruise Workbooks

<http://walrus.wr.usgs.gov/pacmaps/wg-index.html>

NOAA Oceans and Coasts

Activities of Cordell Bank National Marine Sanctuary



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Region(s) of Interest: Northern California / Cordell Bank

Major Research Interests:

As the manager of Cordell Bank National Marine Sanctuary (CBNMS), I am interested in information that would contribute to better protection of sanctuary resources. This includes developing an inventory of sanctuary resources, documenting the distribution and abundance of species within the sanctuary and describing affinities between animals and their habitat. The western boundary of Cordell Bank National Marine Sanctuary (CBNMS) is the 1000 fathom isobath. This encompasses the depth range published for several species of west coast deep sea corals.

Recent Deep-Sea Coral Research Projects (FY 2003-2004):

Since 2001, CBNMS has used the submersible Delta to characterize benthic habitats and conduct quantitative surveys for fishes and invertebrates on and around Cordell Bank. We are currently working with Dr. Brian Tissot and one of his graduate students from Washington State University to characterize the invertebrate fauna (*Lophogorgia* spp.). We have presented a poster at the Western Groundfish Conference (fish/habitat) and the Western Society of Naturalist meeting (invertebrates/habitat). Deliverables from our Washington State contract includes databases and maps.

Upcoming Deep-Sea Coral Research Projects (FY 2005-2006):

We recently submitted an OE proposal to map deep water habitats in CBNMS. We will be continuing our monitoring cruises using the Delta and were recently contacted by U.C. Davis about collaborating with them to conduct directed research sampling of deep water corals to create a historical description of climate change in the northeast Pacific.

Long-term Research Plans:

CBNMS is committed to long term monitoring of sanctuary resources including deep sea corals. Our critical need at this point is to conduct habitat mapping so we can direct research efforts and stratify sampling.

Major Equipment and Facilities:

Sanctuary vessel – 33 foot vessel, winch with conducting wire, A-frame, davit

Towed camera sled with video camera and lights

Phantom ROV – needs navigation and sonar to be fully functional

NOAA Partners:

NOAA – OE

NMFS

NMSP

External Partners:

USGS

UC Davis

Delta Oceanographics

Moss Landing Marine Laboratory

References:

CBNMS management plan drives DSC research effort for CBNMS

NOAA Oceans and Coasts

Activities of Gulf of Farallones National Marine Sanctuary



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Region(s) of Interest:

The Gulf of the Farallones includes portions of the Gulf of the Farallones and Monterey Bay National Marine Sanctuaries. Two areas within the Gulf of the Farallones have been identified as areas of high species richness, hard substrate, and potential deep-sea coral habitats.

- 1) The Farallon Escarpment is a mixed habitat west of the Farallon Archipelago, located at the continental shelf break to the slope.
- 2) The area known as the Farallon Archipelago is a mid-shelf series of islands and submerged rocks and other hard substrate bottoms. Anecdotal information has shown this area to potentially have benthic coral-like structures.

Major Research Interests:

The GFNMS Management Plan identifies several major research areas needed to further enhance resource protection. Exploration of deep-sea corals is consistent with our goals to enhance efforts to characterize the habitats of the sanctuary and exchange data and information through integration of education, outreach, and data management tasks. Specific goals and objectives include:

- 1) Assess the Sanctuary's information base to identify gaps in knowledge that can affect our ability to manage the area;
- 2) Conduct studies of species or marine communities to identify resources most at risk or in need of management attention;
- 3) Promote the Sanctuaries as a site for management related marine research by providing financial and logistical support for scientific investigations that address critical marine resource protection issues;

- 4) Design research projects that are responsive to management concerns and contribute to improved management of the Sanctuary;
- 5) Make effective use of research results by incorporating them into interpretive and resource protection programs;
- 6) Encourage information exchange and cooperation among all the organizations and agencies undertaking management related research in the Sanctuaries to promote more timely and informed management.

Recent Deep-Sea Coral Research Projects (FY 2003-2004):

There are no current or near future deep-sea coral investigations planned for the GFNMS region.

Upcoming Deep-Sea Coral Research Projects (FY 2005-2006):

There are no future deep-sea coral investigations planned for the GFNMS region.

Long-term Research Plans:

Currently, limited areas of the GFNMS and northern portion of the MBNMS have been characterized and mapped. Exploration for deep-sea corals will produce additional habitat maps, bottom substrate characterization and aid in identifying essential fish, seabird and marine mammal habitats.

Major Equipment and Facilities:

MBARI – RV Western Flyer and ROV Tiburon

USGS - towfish

CINMS – RV Shearwater

RV Volero IV and DELTA submersible

NOAA Ship McArthur II

CSUMB - RV w/multibeam system

Moss Landing Marine Laboratory - RV Point Sur w/sidescan system

Surveying the escarpment will require a dedicated platform with CTD, bathymetric mapping and submersible camera systems. If underwater sampling is required, a submersible with a manipulator arm and sample drawer is needed. Multibeam or sidescan technology is required to develop a preliminary map of target dive locations where suitable substrate for deep-sea coral habitat exists.

Potential NOAA Partners:

NMFS-SWFSC

Cordell Bank NMS

Monterey Bay NMS

Potential External Partners:

USGS

UC

SFSU

NPS

References:

Priorities for research and exploration in the sanctuary are derived from the Sanctuary Joint Management Plan, developed in collaboration with hundreds of vested community stakeholders. The Joint Management Plan is available at:

<http://www.sanctuaries.noaa.gov/jointplan/welcome.html>

NOAA Oceans and Coasts

Activities of Gray's Reef National Marine Sanctuary



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Region(s) of Interest: South Atlantic Bight

Major Research Interests: Charleston Bump; Savannah Scarp

Recent Deep-Sea Coral Research Projects (FY 2003-2004):

From the Estuary to the Abyss: Exploring Along the Latitude 31-30 Transect (Sedberry and Bohne, OE funded research cruise 2004)

Upcoming Deep-Sea Coral Research Projects (FY 2005-2006):

Analysis of video transect data from the 2004 cruise will continue in FY 2005. It is expected that the analysis will reveal the specific needs that require additional research activity in late FY2005 and in FY2006.

Long-term Research Plans:

As the 31-30 Regional Science Plan is developed and implemented, investigations of Charleston Bump and Savannah Scarp will continue to further characterize the Deep Sea Corals found along this latitudinal transect. As important findings are realized, a concerted education and outreach program will be utilized to disseminate this information.

Major Equipment and Facilities:

Access to NOAA ships independent of OE time
Smaller GRNMS support vessels
Access to Skidaway Institute of Oceanography (SkIO) vessel R/V Savannah
ROV (150 meter depth capability)

NOAA Partners:

NCCOS CCMA Biogeography

NCCOS CCEHBR

NCCOS CCFHR

External Partners:

South Carolina DNR

Savannah State University

NOAA Oceans and Coasts

Activities of Monterey Bay National Marine Sanctuary



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Region(s) of Interest: Davidson Seamount, Central California

Major Research Interests:

In 2002, a week-long cruise surveyed the biology at all depths of the Davidson Seamount using the remotely operated vehicle *Tiburon*. This expedition was the initial effort to characterize the biology and geology of the Davidson Seamount, 1,250 – 3,700 meters deep off Central California. Using 90 hours of Digital Betacam video imagery, 234 taxa were recorded and the exact locations of 19 coral taxa were plotted. Coral ages were determined for two species, ranging from 115 years (the precious coral *Corallium* sp.) to greater than 200 years (the bamboo coral *Keratoisis* sp.). Many results and products from this cruise are relevant to OE, including ocean science issues, education, outreach, and resource management.

Recent Deep-Sea Coral Research Projects (FY 2003-2004):

The MBNMS did not conduct research on deep-sea corals in FY 2003-2004. During that time, however, we continued to produce reports and presentations, and receive attention and requests for more information (see attached). Of particular management and policy importance, the sanctuary is continuing work on the Joint Management Plan Review that includes the Davidson Seamount Action Plan to provide protection of the seamount with National Marine Sanctuary status.

Upcoming Deep-Sea Coral Research Projects (FY 2005-2006):

Building off the successes of an Office of Exploration (OE) expedition to Davidson Seamount in 2002, we have submitted a proposal to OE for FY2005 to focus on deep-water corals. The objectives of the proposed 2005 cruise would be to expand on the exploratory results of our last seamount expedition to investigate processes that generate coral distribution patterns. We will use a simple model derived from results of the last cruise to test our understanding of coral distribution, and use this model to guide exploration in other regions of the Seamount (still over 99.98% unexplored). Specific regions of the seamount will be targeted based on a topographic index, substratum type, and coral species depth records. Complementary studies of the biodiversity and population dynamics of seamount fauna will include collections of corals for taxonomic studies, and age and growth studies of corals using innovative radiometric techniques. Addressing the public interest in seamounts, corals, and exploration, the British Broadcasting Corporation (BBC) will record imagery from Davidson Seamount to feature in an upcoming television series, co-produced with the Discovery Channel, for broadcast in the United States and internationally. The Sanctuary West Coast Visitor Center and Monterey Bay Aquarium have plans to feature seamounts and corals in future exhibits, and high definition video imagery, as well as research findings will be pivotal in the exhibit development. We will produce reports for peer-review,

expand the seamounts section of the SIMoN website, refine our coral distribution maps and GIS layers, and expand our high-resolution images inventory.

Long-term Research Plans:

If the Davidson Seamount becomes part of the National Marine Sanctuary Program, the Davidson Seamount Action Plan of the Joint Management Plan Review outlines the research to be conducted, including: 1) complete geologic and biological characterization using existing video transects; 2) conduct benthic monitoring; 3) conduct deep-water coral aging and restoration studies; 4) identify taxonomy and natural history of rare or new species; and 5) understand the distribution and abundance of corals.

Major Equipment and Facilities:

Monterey Bay Aquarium Research Institute's (MBARI) RV *Western Flyer*

MBARI's ROV *Tiburon* and associated sample collection devices

MBARI's digital video system (Sony Digital Betacam™ format)

MBARI's high-quality digital camera (Nikon® Coolpix®)

MBARI's on-board video annotation system VICKI (Video Information Capture with Knowledge Inferencing)

MBARI's digital video lab (including VICKI annotation system)

Moss Landing Marine Laboratories' (MLML) radiochemistry lab

NOAA Partners:

Monterey Bay National Marine Sanctuary

National Marine Sanctuary Program

NOAA Office of Ocean Exploration

NOAA Fisheries

External Partners:

Monterey Bay Aquarium Research Institute

Chesapeake Biological Laboratory (UMA)

Monterey Bay Aquarium (MBA)

Moss Landing Marine Laboratories

California Academy of Sciences

National Museum of Natural History, Smithsonian

Woods Hole Oceanographic Institute

British Broadcasting Corporation

References:

FY2005 OE Proposal -- Deep-water corals of the Davidson Seamount: Habitat Suitability, Taxonomy, Age and Growth.

Andrews, A.H. G.M. Cailliet, L.A. Kerr, K.H. Coale, C. Lundstrom, and A. DeVoglaere. *In Press*. Investigations of age and growth for three deep-sea corals from the Davidson Seamount off central California. Proceedings of the Deep Sea Coral Symposium, Erlangen, Germany.

DeVoglaere, A.P., E.J. Burton, T. Trejo, C.E. King, D.A. Clague, M.N. Tamburri, G.M. Cailliet, R.E. Kochevar, and W.J. Douros. *In Press*. Deep sea corals and resource protection at the Davidson Seamount, California, U.S.A. Proceedings of the Deep Sea Coral Symposium, Erlangen, Germany.

<http://oceanexplorer.noaa.gov/explorations/02davidson/davidson.html>
www.mbnms-simon.org/sections/seamounts/overview.php?sec=s
www.mbnms-simon.org/sections/seamounts/projects.php?sec=s

NOAA Oceans and Coasts

Activities of Olympic Coast National Marine Sanctuary



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Region(s) of Interest: Northeast Pacific Ocean, off the coast of Washington state

Major Research Interests:

With a mandate to inventory and characterize living marine resources, we are very interested in locating and documenting the distribution and abundance of deep-sea coral and sponge communities in the Sanctuary. In addition to mapping the communities using both acoustic and video protocols, we are also engaged in assessing anthropogenic risks to these communities, including consideration of management options. Samples are being collected to confirm species identification and to assess health parameters. Lastly we plan to conduct public education and outreach campaigns, both to the lay public as well as to fishers, to highlight the importance of deep-sea corals and sponges to associated communities of fish and other invertebrates.

Recent Deep-Sea Coral Research Projects (FY 2003-2004):

In June 2004, OCNMS and NCCOS teamed up to conduct exploratory deep-sea dives (80-350m) off the Washington coast. Using the NOAA Ship *McArthur II* and the Navy Phantom DHD2+2 remotely operated vehicle (ROV), we conducted video sweeps of areas that either had been acoustically surveyed (side-scan or multibeam) as hard bottom and/or high relief, or we had reason to believe from fishing logbook information that these areas harbored coral or sponge communities. We successfully documented the presence of several deep-sea gorgonian and sponge species as well as collected specimens of what we believe is the hard coral *Lophelia pertusa* (in process of being confirmed). The locations of these finds were in areas of high fishing effort and many specimens were distinctly damaged or dead. A draft cruise report is being finalized and we plan to publish a peer-reviewed note once we confirm identification.

Upcoming Deep-Sea Coral Research Projects (FY 2005-2006):

NCCOS & OCNMS has secured time aboard the NOAA Ship *McArthur II* (8 DAS) and have submitted several proposals for chartering another ROV in order to conduct a June 2005 survey for deep-sea coral and sponge communities off the Washington coast. OCNMS is also participating in a NURP sponsored workshop (Nov. 29 - Dec. 2, 2004) on 'The Pacific Northwest Initiative: Puget Sound/Georgia

Basin/Strait of Juan de Fuca and Olympic Coast National Marine Sanctuary Initiative for Underwater Research Studies' for planning long-term research initiatives for deep-sea research programs in the Pacific Northwest.

Long-term Research Plans:

OCNMS plans to continue long-term efforts to map areas of deep-sea coral and sponge communities and to document associated macroinvertebrate and fish species. This includes more side-scan and multibeam mapping efforts as well.

Major Equipment and Facilities:

We frequently have access to NOAA ships as platforms for ROV or submersible dives. We also charter ships and ROVs to conduct benthic monitoring of deep-sea, fiber optic cables. OCNMS has bottom grab equipment (Smith-Mac and Van Veen), video-recording equipment (mini-DV decks, monitors, Horita and time-wedge recording systems). We also annually secure NOAA ship time for acoustic survey efforts in the Sanctuary.

NOAA Partners:

NOAA/NOS/NCCOS/CCEHBR

External Partners:

Naval Facilities Engineering Service Center Canadian
Scientific Submersible Facility
Delta Oceanographics

References:

Bowlby, E., M.S. Brancato and J. Hyland. Exploration for Deep Sea Coral & Sponge Communities in the Olympic Coast National Marine Sanctuary. 2005 funding proposal submitted to NOAA's Office of Ocean Exploration.

Bowlby, C.E. 2004. Preliminary report on deep-sea coral and sponge survey results off the Washington coast. Presentation to the Olympic Coast National Marine Sanctuary Advisory Council, September 24, 2004.

Brancato, M.S. and C.E. Bowlby. 2002. Survey of fishing gear and fiber optic cable impacts to benthic habitats in the Olympic Coast National Marine Sanctuary. Proceedings of the Symposium on Effects of Fishing Activities on Benthic Habitats: Linking Geology, Biology, Socioeconomics, and Management. Nov. 12-14, 2002, Tampa Florida.

Hyland, J. 2003. Evaluation of Critical Offshore Habitats and their Susceptibility to Fishing & Harvest Impacts at the Olympic Coast National Marine Sanctuary (OCNMS). NCCOS/NMSP funding award for FY04.

Hyland, J., C. Cooksey, E. Bowlby, and M.S. Brancato. 2004. Survey of Deepwater Coral/Sponge Assemblages and their Susceptibility to Fishing/Harvest Impacts at the Olympic Coast National Marine Sanctuary (OCNMS). Draft cruise Report for the NCCOS/NMSP Project aboard the NOAA Ship MACARTHUR II Cruise AR-04-04.

Hyland, J., and E. Bowlby. 2004. NCCOS-ONMS Deep Coral/Sponge Study at OCNMS – Year 2. Successful proposal securing ship time on NOAA Ship *McArthur II* for June 2005 survey.

NOAA Research

Activities of the Office of Ocean Exploration



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Regions of Interest: OE supports a wide variety of mapping and characterization efforts focused on deep coral communities in all areas of the world's oceans. Decisions on where to explore for deep coral communities are based on proposals selected through a peer-review process, as well as the availability of vessels and submersibles capable of conducting the required work. Based on strategic planning efforts with partners in both the U.S. and abroad, recent exploration for deep corals has focused on areas such as the Gulf of Mexico, U.S. east coast, Gulf of Alaska, and the Hawaiian Archipelago.

Major Research Interests:

The OE program supports peer-reviewed deep coral projects that focus on investigating areas that are suspected to contain deep coral communities, but have never been visited before. In addition, OE supports projects that investigate known deep coral communities for the purpose of describing their biology, ecology, and to discover the processes that support their development (underlying geology, oceanographic setting, etc.).

The principal investigators of the projects selected have the primary responsibility for collecting the information and developing the products that meet the objectives of their proposal. In most cases the scientists survey deep coral targets using mapping instruments such as multibeam and side scan sonars, then investigate specific sites using manned and unmanned submersibles to collect visual imagery (video and still photography), as well as samples of rocks and sediment, corals, and associated species. Scientists also collect a variety of oceanographic data in the vicinity of where the deep coral communities are found.

Recent Deep-Sea Coral Research Projects (FY 2003-2004):

A total of 20 deep coral exploration and research projects were funded by NOAA's Office of Ocean Exploration in 2003 and 2004. These expeditions focused on locating and characterizing deep coral habitats, mapping areas suspected to contain deep corals, and efforts to increase our understanding of deep coral biology and ecology.

2003 Deep Coral Expeditions included:

Title: Mountains in the Sea: Exploring the New England Seamount Chain
<http://www.oceanexplorer.noaa.gov/explorations/03mountains/welcome.html>

PI: Babb

Region: Western North-Atlantic

Title: Ecology and Biology of Deep Water Habitats and Communities of the Charleston Bump: Investigating Highly Dynamic Environments
<http://www.oceanexplorer.noaa.gov/explorations/03bump/welcome.html>

PI: Sedberry

Region: South Atlantic Bight

Title: Biological and Geological Characterization of Deep Water Habitats Found on Relict Salt Domes
<http://www.oceanexplorer.noaa.gov/explorations/03mex/welcome.html>

PI: Schmahl

Region: Gulf of Mexico

Title: Documenting the Diversity of Deep-Sea Corals
<http://www.oceanexplorer.noaa.gov/explorations/03mex/welcome.html>

PI: Etnoyer

Region: Gulf of Mexico

Title: Occurrence and Ecology of Deep Water Corals and Associated Communities
<http://www.oceanexplorer.noaa.gov/explorations/03mex/welcome.html>

PI: Schroeder, Brooke, and Olsen

Region: Gulf of Mexico

Title: Investigating *Lophelia pertusa* Reefs and Bioherms of the Continental Shelf and Slope
<http://oceanexplorer.noaa.gov/explorations/03edge/welcome.html>

PI: Ross and Sulak

Region: South Atlantic Bight

Title: Submarine Canyon Scavenger Communities in the Main and Northwest Hawaiian Islands
<http://oceanexplorer.noaa.gov/explorations/03nwhi/welcome.html>

PI: Vetter and Smith

Region: Hawaii

Title: Northern Mid-Atlantic Ridge Census of Marine Life
<http://oceanexplorer.noaa.gov/explorations/03mountains/welcome.html>

PI: Vecchione

Region: North Atlantic

Title: Investigating the Biodiversity of Bear Seamount
<http://oceanexplorer.noaa.gov/explorations/03mountains/welcome.html>

PI: Vecchione

Region: New England

Title: Regional Productivity of the Northwest Hawaiian Islands
<http://oceanexplorer.noaa.gov/explorations/03nwhi/welcome.html>

PI: Parrish

Region: Hawaii

Title: Population Genetics of Deep-Sea Precious Corals
<http://oceanexplorer.noaa.gov/explorations/03nwhi/welcome.html>
PI: Baco-Taylor
Region: Hawaii

Title: Characterization of Deep-Sea Coral Communities of the Northwest Hawaii Seamounts
<http://oceanexplorer.noaa.gov/explorations/03nwhi/welcome.html>
PI: Baco-Taylor
Region: Hawaii

2004 Deep Coral Expeditions included:

Title: Estuary to the Abyss: An Assessment of Habitat Variation with Depth Off the Coast of South Carolina
<http://www.oceanexplorer.noaa.gov/explorations/04etta/welcome.html>
PI: Sedberry
Region: South Atlantic Bight

Title: Population Genetics of Deep-Sea Precious Corals
<http://www.oceanexplorer.noaa.gov/explorations/04coral/welcome.html>
PI: Baco-Taylor
Region: Hawaii

Title: Biodiversity of the Mid-Atlantic Ridge
PI: Gailbraith
Region: Northern Mid-Atlantic

Title: Habitat Variation and Distribution of Invertebrates on George's Banks
PI: Fogarty
Region: New England

Title: Southeast Atlantic Shelf and Slope Habitats: Investigation of *Lophelia pertusa* Reefs and Bioherms and High-Relief Habitat
<http://www.oceanexplorer.noaa.gov/explorations/04edge/welcome.html>
PI: Ross and Sulak
Region: South Atlantic Bight

Title: Biology and Biogeography of Deep-Sea Corals
<http://www.oceanexplorer.noaa.gov/explorations/04alaska/welcome.html>
PI: Etnoyer
Region: Gulf of Alaska

Title: Deep-Sea Corals of the Gulf of Alaska
<http://www.oceanexplorer.noaa.gov/explorations/04alaska/welcome.html>
PI: Shirley
Region: Gulf of Alaska

Title: Geology and Geomorphology of Unexplored Alaska Seamounts: Functional Relationships with Coral and Sponge Habitat
<http://www.oceanexplorer.noaa.gov/explorations/04alaska/welcome.html>
PI: Keller
Region: Gulf of Alaska

Upcoming Deep-Sea Coral Research Projects (FY 2004-2005):

Title: Deep-sea Stepping Stones: Linking the New England Seamounts and Mid-Atlantic Ridge

<http://www.oceanexplorer.noaa.gov/explorations/explorations.html#2005Explorations>

PI: Auster

Region: North Atlantic

Title: Stepping Stones across the Atlantic: Pathways and Barriers to the Dispersal and Evolution of Deep-Sea Corals and Associated Fauna

<http://www.oceanexplorer.noaa.gov/explorations/explorations.html#2005Explorations>

PI: Shank

Region: North Atlantic

Title: Continental Slope Coral Banks of the Southeastern United States: Exploring the distributions, ecology, and biology of deep coral habitats and associated fauna

<http://www.oceanexplorer.noaa.gov/explorations/explorations.html#2005Explorations>

PI: Ross

Region: South Atlantic Bight

Title: Mapping & Habitat Characterization of a Deepwater Coral Site on the West Florida Slope

<http://www.oceanexplorer.noaa.gov/explorations/explorations.html#2005Explorations>

PI: Schroeder

Region: Gulf of Mexico

Title: Deep water corals of the Davidson Seamount: Habitat Suitability, Taxonomy, Age and Growth

<http://www.oceanexplorer.noaa.gov/explorations/explorations.html#2005Explorations>

PI: DeVogelaere

Region: Eastern North-Pacific

Title: REEF Exploration in the Western Gulf of Mexico

<http://www.oceanexplorer.noaa.gov/explorations/explorations.html#2005Explorations>

PI: Akins

Region: Gulf of Mexico

Title: Studies on Lophelia Coral Reef on Blake Plateau: Ecological Characterization

<http://www.oceanexplorer.noaa.gov/explorations/explorations.html#2005Explorations>

PI: George

Region: South Atlantic Bight

Title: Mapping and Characterization of Deep Sea Coral Ecosystems off the Coast of Florida

<http://www.oceanexplorer.noaa.gov/explorations/explorations.html#2005Explorations>

PI: Brooke

Region: South Atlantic Bight, Florida Straits and Gulf of Mexico

Title: High-Resolution Benthic Habitat Mapping Using Laser Line Scan

<http://www.oceanexplorer.noaa.gov/explorations/explorations.html#2005Explorations>

PI: Brainard

Region: Northern Mid-Pacific

Title: North Pacific Paleoclimate Studies Using NOAA-Collected Deep Sea Corals

<http://www.oceanexplorer.noaa.gov/explorations/explorations.html#2005Explorations>

PI: Dunbar

Region: Northern Pacific

Title: Geological Mapping on a Shallow Continental Shelf for Essential Fish Habitat
<http://www.oceanexplorer.noaa.gov/explorations/explorations.html#2005Explorations>

PI: Lindberg

Region: Gulf of Mexico

Title: Exploration for Deep Sea Coral & Sponge Communities in the Olympic Coast National Marine Sanctuary
<http://www.oceanexplorer.noaa.gov/explorations/explorations.html#2005Explorations>

PI: Bowlby

Region: Eastern North Pacific

Long-Term Research Plans:

Long-Term Research Plans – In FY 2005 OE plans to support seven projects that specifically focus on deep coral communities, including a series of cruises from the Gulf of Mexico, along the east coast of the U.S., and out to the Mid-Atlantic Ridge, which are all using similar tools and techniques and focusing on similar objectives including: (1) assessing biogeographical changes between sites; (2) assessing habitat function; (3) assessing recruitment patterns; (4) assessing natural and anthropogenic effects; and (5) collecting samples to aid in the development of paleoclimate models.

In FY 2006 and 2007, in addition to supporting peer-reviewed proposals, OE is engaged in a joint effort with the Minerals Management Service (MMS) to investigate deep hard bottom communities in the Gulf of Mexico.

Major Equipment and Facilities:

Vessels:

NOAA Ship Ronald H. Brown

NOAA Ship Nancy Foster

NOAA Ship Hi'ialakai

WHOI R/V Atlantis

UHI R/V KoK

HBOI R/V Seward Johnson

UWA R/V Thompson

Equipment:

Multibeam Sonar

Side Scan Sonar

ROV Hercules (owned and operated by IFE)

Industry ROVs

WHOI Alvin Submersible

HBOI Johnson-Sea-Link Submersible

HURL Pisces Submersibles

NOAA Partners:

OAR/NURP

NOS/NMSP

NOS/NCCOS

NMFS/Habitat Conservation

NMFS/Science & Technology

NMFS/Regional Centers

External Partners (Other than funded institutions):

US Geological Survey (USGS)

Minerals Management Service (MMS)

National Aeronautics and Space Administration (NASA)

US Navy

Woods Hole Oceanographic Institution (WHOI)

Harbor Branch Oceanographic Institution (HBOI)

University of Washington (UWA)

University of Hawaii (UHI)

References:

<http://www.oceanexplorer.noaa.gov>

<http://www.explore.noaa.gov>

Note: See websites associated with the projects listed above.

NOAA Research
NOAA Undersea Research Program
Activities of the Caribbean Marine Research Center



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Region(s) of Interest:

The Wider Caribbean Region is a broad area of coastal and marine habitats of the Caribbean Sea and the south Atlantic, and includes several U.S. Territories, coastal areas of Mexico and Central and South American nations, the Greater and Lesser Antilles, The Bahamas, and the Turks and Caicos Islands. The primary facility of the Caribbean Marine Research Center offering field- and shore-based operations is located at Lee Stocking Island, Bahamas. High priority areas for operations are Lee Stocking Island, Bahamas, Puerto Rico, and the U.S. Virgin Islands.

Major Research Interests:

NOAA's Undersea Research Program (NURP) supports strategic research targeted at the information needs of NOAA's resource managers and provides scientists with access to advanced underwater technologies (e.g., human occupied submersibles, remotely operated vehicles, undersea laboratories, technical diving, etc.) to conduct cutting-edge research through a competitive peer-reviewed proposal process.

NURP's research interests are to understand patterns of distribution and abundance of deep-sea corals, and their ecological role, in the region of interest. This includes identifying species distributions in deep sea coral habitat, developing an understanding of the factors that mediate distribution and abundance, patterns of recruitment, reproductive biology, population genetics, bio-prospecting, and basic ecology

and systematics. In addition, understanding the ecological role of deep sea corals requires an understanding of the role they play as habitat for fishes of economic and ecological importance.

Recent Deep-Sea Coral Research Projects (FY 2003-2004):

Title: Using technical diving to study the ecology of deep coral communities

Investigator: Michael Lesser (University of New Hampshire)

Region: Bahamas

Objectives: A research project has been initiated to examine the diversity and biology of corals and sponges found in deep-water habitats (>30 m), also known as the Coral Reef “Twilight Zone” using the emerging technology of mixed gas technical diving (TRIMIX and closed-circuit rebreathers). This project conducted by Dr. Michael Lesser (University of New Hampshire) uses mixed gas open circuit SCUBA down to a depth of 90 m to (1) quantitatively record the total biodiversity of deep reef communities at depths from 45 to 150 m with particular emphasis on the deep coral and sponge communities; (2) examine the trophic biology and growth rates of the dominant sponges; *Agelas conifera*, *Agelas clathroides*, and *Aplysina fistularis*; and (3) examine the photophysiology and population genetics of two species of coral, *Montastraea cavernosa* and *Agaricia lamarcki*.

This proposal will address several of the stated research priorities by NOAA, including: contributing to Marine Life Inventories by cataloging any new species of coral reef invertebrates, particularly corals and sponges; using both the technical diving and submersible will provide habitat characterization of these deep reef communities using video and still photography; initiating important studies on the biology and ecology of corals found on deep reefs; discovering new ocean resources in the form of bioactive compounds that may have benefits in clinical medicine for humans; and in fact related to Marine Protected areas, as deep fore reefs appear to be critical habitat, or refugia, for corals, other invertebrates, and fish. *This project is partially funded by the NOAA Coral Reef Conservation Program.*

Upcoming Deep-Sea Coral Research Projects (FY 2005-2006):

At this time projects for 2005 include continuation for the above stated project with the possibility to include additional research on deep sea corals should funding levels permit.

Long-term Research Plans:

Long-term research plans focus on understanding the ecology and distribution of deep-sea corals, understanding the effects of human-caused disturbance and recovery dynamics, and understanding the ecological role of corals in terms of habitat characterization, patterns of biological diversity, and bio-prospecting.

Major Equipment and Facilities:

NURP-supported investigators utilize the following equipment:

Tri-mix and closed-circuit rebreather diving

Manned submersibles including the Delta, Johnson-Sea Link I and II, Clelia, Alvin, NR-1

Remotely Operated Vehicles

NOAA Partners:

NOAA Office of Ocean Exploration

NOAA Coral Reef Conservation Program

NOAA Fisheries

External Partners:

Perry Institute for Marine Science

Harbor Branch Oceanographic Institution

Delta Oceanographics

University of New Hampshire

NOAA Research

NOAA Undersea Research Program

Activities of the NOAA Undersea Research Center



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Affiliation: OAR/NURP – Director, NOAA Undersea Research Center at the University of North Carolina at Wilmington, Southeast Atlantic and Gulf of Mexico region.

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Region(s) of Interest:

South Atlantic Bight (NC to FL), Florida Keys, and Gulf of Mexico

Major Research Interests:

NOAA's Undersea Research Program (NURP) supports strategic research targeted at the information needs of NOAA's resource managers and provides scientists with access to advanced underwater technologies (e.g., human occupied submersibles, remotely operated vehicles, undersea laboratories, technical diving, etc.) to conduct cutting-edge research through a competitive peer-reviewed proposal process.

SEGM is interested in understanding patterns of distribution and abundance of deep-sea corals, and their ecological role, in the region of interest. This includes mapping of potential coral habitat, developing an understanding of the factors that mediate distribution and abundance, patterns of recruitment, reproductive biology, population genetics, and basic systematics. In addition, understanding the ecological role of corals requires an understanding of how corals mediate local patterns of diversity of associated taxa, defining obligate and facultative relationships with other taxa, and, in particular, understanding the role they play as habitat for fishes of economic and ecological importance. In addition to research, the center works actively with the South Atlantic and Gulf of Mexico Fishery Management Councils to support management information needs, and with local communities to support education and outreach activities related to deep sea corals.

Recent Deep-Sea Coral Research Projects (FY 2003-2004):

2003

Title: Oculina Banks 2003: Characterization of Habitat and Benthic Community in the *Oculina* Habitat Area of Particular Concern

Principle Investigators: John Reed

Region: South Atlantic Bight

Objectives: Objectives were to characterize condition of the coral habitat, and quantify associated megafauna with 30 different target dive areas targeted on the 2002 multi-beam survey chart selected using the Oculina GIS (www.uncw.edu/oculina). Remotely operated vehicle dives were conducted at 20 of these different target dive sites. Several transects were run twice, including stations that were run in day and night, and a station run on the east and west flanks of a string of coral pinnacles.

Title: Grouper demographics and habitat engineering in the shelf-edge MPAs in the Gulf of Mexico

Principle Investigators: Felicia Coleman

Region: Gulf of Mexico

Objectives: Evaluate effectiveness of marine protected areas (MPAs, closed to all bottom fishing) in augmenting fishery management; live-bottom reefs, including corals, are critical habitat (what is being protected) in these areas. The two MPAs involved are Madison Swanson and Steamboat Lumps; each about 100 square nautical miles in size and located on the shelf edge of the eastern Gulf of Mexico. Project objectives included: (1) To compare spawning site demographics of gag and scamp groupers within and outside of Madison-Swanson MPA (10 sites inside and 10 outside) during the spawning season (February through early April). (2) To compare the physical appearance, geological characteristics, and associated biota of shelf-edge excavations of red grouper already described for Steamboat Lumps with those recently discovered in Madison-Swanson and adjacent sites. (3) To conduct grouper removal experiments to document possible ecosystem changes that could result from the absence of active excavation (e.g., sediment accumulation, changes in fish and invertebrate assemblages).

Title: Structure, function, and biological/physical coupling of deep reef communities in the northeastern Gulf of Mexico

Principle Investigators: Ken Sulak

Region: Eastern Gulf of Mexico (West Florida Shelf)

Objectives: Ongoing joint research project with USGS to survey hard bottom areas, including coral beds, on the West Florida shelf and quantify abundance of fishes and benthic invertebrates using ROV exploration of high-resolution bathymetric survey completed in 2002. Objectives included:

- Obtain video transects for quantification of fishes and benthic invertebrates.
- Obtain still photographs of the bottom in plan view to quantify percent cover of benthic organisms.
- Collect fish specimens for age and growth studies via rotenone application.
- Precisely map the location of all organisms via high-resolution navigation system.

Title: Habitat characterization of Pulley Ridge and the Florida Middle Grounds

Principle Investigators: Felicia Coleman

Region: Gulf of Mexico, Florida Middle Grounds

Objectives: Evaluate two areas of essential fish habitat in the northeastern Gulf of Mexico, Florida Middle Grounds, northernmost extent of octocorals in the Gulf of Mexico. Developing habitat

characterizations of these areas is critical in a time when this area of the Gulf is likely to experience significant changes due to increased coastal development and offshore oil and gas exploration, both of which can have profound influences even in remote areas. Efforts in the Middle Grounds were directed towards monitoring and assessment. Objectives included: to establish a status and trends benthic habitat-monitoring program for the Florida Middle Grounds using ROV-video transects and wet-diving sampling. Stations for study were drawn from historical (25 years ago) studies of the Florida Middle Grounds, some of which occur in an area where multibeam bathymetry already exists. Site positions were recorded in a Geographic Positioning System (GPS).

Title: The effects of natural seep proximity and substrate size on colonization pattern on artificial seep substrates: Gulf of Mexico and Carolina Slope

Principle Investigators: Robert Carney

Region: Gulf of Mexico

Objectives: A decade of NURP-sponsored research of the Gulf of Mexico chemosynthetic communities has shown that the dominant species in these systems differ from the surrounding deep-sea ecosystem, yet are ecologically linked with background slope biota. However, of more than 1000 species which inhabit the upper continental slope, individuals of only three species from outside the seep sites have actually been examined—most studies focused on the chemo-communities. Therefore, the degree of seep-background interaction is poorly known. Also, these systems have been studied under the assumption that they are controlled by unusual geochemical phenomena; that they are trophically self-contained, and that biological control of populations did not occur. If, as this project seeks to determine, they are closely linked to the surrounding ecosystem, then we may better understand their initiation and persistence. Deep sea corals inhabit these areas, in part, because of the presence of authigenic carbonate rock, which they inhabit. Objective of study was to understand extent to which seep productivity supports populations of species in the surrounding typical deep-sea. Submersible Johnson SeaLink sampling was conducted from the edge of seep communities up to a distance of 1 km, including sampling of infauna, epifauna, and benthopelagic fauna, and both predator/scavengers and detritivores.

Title: Structure of upper slope cold seep communities in the Gulf of Mexico: temporal change and biogeographic diversity

Principle Investigators: Charles Fisher

Region: Gulf of Mexico

Objectives: Continue Johnson-Sea-Link submersible collections from seep communities to describe the ecology of these communities and provide essential information to determine their potential contribution to deep-sea productivity, including deep sea coral communities that inhabit authigenic carbonate rock substrata. Focus of this study was vestimentiferan tubeworm aggregations using new tools that enable high-quality and quantitative collections of intact vestimentiferan aggregations including all associated fauna. These devices are capturing many species never before collected virtually every time they are used. Data allows first-ever quantitative analysis of vestimentiferan aggregations and communities of associated fauna. This device may have similar applications in deep sea coral beds. Major goal was to test hypothesis that young vestimentiferan aggregations support the highest biomass of associated fauna and that associates dominated by endemic species. Older, but vital aggregations (between 50 and 150 years old) support significantly higher species richness, but lower total biomass of associates. Very old, “senescent”, aggregations support much lower biomass of associates, of similar diversity to the young aggregations, but unlike young aggregations, colonists and vagrants will dominate associates. Second goal was to describe the biodiversity of vestimentiferan communities on the Upper Louisiana Slope;

expecting to find significant variation in key species, perhaps including the ecosystem engineering vestimentiferans. Also looked at water chemistry in and among the communities, and continued investigations of population genetics and biogeography of vestimentiferan and seep-mussel species in the Gulf of Mexico.

Title: Ecological consequences of egg production in cold-seep polychaetes

Principle Investigators: Craig Young

Region: Gulf of Mexico

Objectives: Chemosynthetic communities at bathyal depths in the Gulf of Mexico are temporally stable sites of continuous primary production. They export energy and fixed carbon to the surrounding benthic and planktonic communities. An unknown portion of this exported energy is in the form of gametes spawned freely into the water column and probably consumed by planktivorous fishes and invertebrates. *Lamellibrachia* sp., a tubeworm whose longevity has recently been estimated at more than 200 years, reproduce continuously and may be among the most fecund animals in the sea. To date, however, lifetime fecundity has not been measured in any deep-sea animal with continuous breeding. This proposal used a variety of in situ methods, including egg traps and time-lapse video records of spawning frequency, to estimate lifetime fecundity of tubeworms. The rate of egg production in other species of polychaetes, including hydrate “ice worms” and deep sea corals (*Lophelia pertusa*) will also be studied, using electron microscopy. This project will help ecologists understand a potentially important path by which the benthic and pelagic realms are coupled and may help to explain how deep-water plankton populations persist even during seasons when detritus input from the surface is negligible.

2004

Title: Examination of Proposed MPAs in the U.S. South Atlantic

Principle Investigators: Andrew David

Region: South Atlantic

Objectives: Deep-water Marine Protected Areas are now being considered for closure across the southeast US. Most of these sites include shelf-edge, live-bottom reefs with coral component, including some coral bioherms (e.g., *Lophelia* banks). Prioritized objectives included:

(1) ROV visual survey of benthic habitats within and adjacent to proposed MPA sites with emphasis on discerning abundance and distribution of snowy grouper (*Epinephelus niveatus*), yellowedge grouper (*E. flavolimbatus*), warsaw grouper (*E. nigritus*), speckled hind (*E. drummondhayi*), misty grouper (*E. mystacinus*), tilefish (*Lopholatilus chamaeleonticeps*), and blueline tilefish (*Caulolatilus microps*). (2) Stationary video surveys of targeted reef fish inside and outside proposed MPA sites following a targeted sampling design based upon ROV surveys. (3) Conduct linear bathymetric survey of proposed MPA sites. (4) Chevron trap collection of targeted reef fish species for aging and reproductive analysis. (5) Neuston net collection of ichthyoplankton associated with proposed MPA sites. (6) Otter trawl collections of reef and demersal fish associated with proposed MPA sites.

In addition to these research projects, the center engaged in other 2003-2004 deep-sea coral related activities including:

(1.) Development of a deep-sea coral GIS-based inventory (geo-referenced records of deep-sea corals including habitat descriptions) to be integrated into the South Atlantic Fishery Management Council (SAFMC) Coral and Habitat Management Information System.
(2.) The Center drafted an education and outreach plan for the Oculina Banks marine protected area, which was funded in 2004 through the Coral Reef Conservation Program, and has been adopted by the

SAFMC Information and Education Advisory Panel as their long-term outreach campaign for the Oculina Habitat Area of Particular Concern.

Upcoming Deep-Sea Coral Research Projects (FY 2005-2006):

2005

Title: Regional assessments of deep coral communities: South Atlantic Bight, Caribbean, and Gulf of Mexico

Principle Investigators: Andrew Shepard

Region: South Atlantic Bight, Caribbean, and Gulf of Mexico

Objectives: The Center is administering the development of three sections of the NOAA *State of the U.S. Deep Coral Communities Report*. Each section will consist of 8-10 page assessments written by experts on the South Atlantic Bight, Caribbean, and Gulf of Mexico.

Title: Grouper demographics and habitat engineering in the shelf-edge MPAs in the Gulf of Mexico

Principle Investigators: Felicia Coleman

Region: Gulf of Mexico

Objectives: Evaluate effectiveness of marine protected areas (MPAs, closed to all bottom fishing) in augmenting fishery management; live-bottom including corals is critical habitat in these areas. The two MPAs involved are Madison Swanson and Steamboat Lumps; each about 100 square nautical miles in size and located on the shelf edge of the eastern Gulf of Mexico. Project objectives included:

(1) To compare spawning site demographics of gag and scamp groupers within and outside of Madison-Swanson MPA (10 sites inside and 10 outside) during the spawning season (February through early April). (2) To compare the physical appearance, geological characteristics, and associated biota of shelf-edge excavations of red grouper already described for Steamboat Lumps with those recently discovered in Madison-Swanson and adjacent sites. (3) To conduct grouper removal experiments to document possible ecosystem changes that could result from the absence of active excavation (e.g., sediment accumulation, changes in fish and invertebrate assemblages).

Title: Effectiveness of Oculina HAPC: Monitoring coral health and use of closed and adjacent areas by groupers.

Principle Investigators: Margaret Miller

Region: South Atlantic Bight

Objectives: Objective 1-- Document grouper spawning and other reproductive activities on a living Oculina reef; Objective 2-- Monitor and compare live coral cover, fish populations, and biodiversity in and outside the OHAPC; Objective 3: Divers will collect coral samples from the OHAPC for genetic analysis.

Title: Mapping the Oculina Banks Marine Protected Area: Acoustic mapping, benthic habitat characterization, and integration into GIS

Principle Investigators: Andrew David

Region: South Atlantic Bight

Objectives: In 2000, the OHAPC area closed to trawling was doubled (to 28-30 N). The 2002 survey included 3 lines in this northern area (about 9 nm²). We estimate that there is at least another 50 nm² of un-surveyed coral habitat inside the reserve and a similar unprotected amount west of the OHAPC. We propose to finish the survey in the OHAPC and survey this adjacent Oculina habitat approximately 64

nm2 in 6 days of survey time. We propose to conduct the survey in June using UNCW's 70-foot ship, R/V Cape Fear. Survey equipment includes the support ship's Digital Geographic Positioning System (DGPS), and MBES-related equipment provided by Seafloor Systems Inc. (www.seafloorssystems.com). The MBES includes: Meridian gyrocompass with heave, pitch and roll sensors; SeaBird CTD; Simrad EM3002 Multi-beam Echosounder System (MBES), 300 khz, 101 individual 1.5 x 1.5 degree beams, calibrated to provide both XYZ depth and XYAmplitude (XYA) backscatter data. Survey resolution and swath coverage depends on depth. Sub-meter resolution at 50 m depth, degrades to about 2 m at 100 m. Swath coverage varies from 2 (at 180 m) to 7 times (at 50 m) the depth in the OHAPC. ISIS Sonar Data Acquisition and image processing system with Triton Elrics packaging will be used to provide: real-time, georeferenced mosaics as survey occurs; XYZ data, corrected for sound velocity and tides; XYA backscatter data; and colored, shaded geotiff images of the survey, with and without draped backscatter data.

Title: Multi-beam mapping of 5 proposed MPAs on the continental shelf in the South Atlantic Bight

Principle Investigators: Andrew David

Region: South Atlantic Bight

Objectives: It should be noted the South Atlantic Fishery Management Council has proposed nine sites for area closure to protect seven reef fish species (snowy, warsaw, misty, and yellowedge grouper, speckled hind, tilefish and blueline tilefish). This project proposes to map five of the nine proposed MPAs. Two are remote from the other seven and excluded from the incumbent project due to logistic concerns. These proposed sites will be established to ameliorate heavy fishing pressure on deep reef species, and mapping of the areas is a crucial step in designing a robust evaluation of this management tool. Increased awareness of the habitat in these areas will provide a wide variety of researchers the information needed to execute far more robust research projects and answer many questions which would not be possible to do without the precise information available in high resolution multi-beam bathymetric and backscatter maps.

2006

Title: An investigation of the deep coral *Lophelia pertusa* in the Northern Gulf of Mexico

Principle Investigators: Harry Roberts

Region: Gulf of Mexico

Objectives: Azooanthellate coral buildups of the Gulf of Mexico (GOM) have never been the subject of serious scientific study even though they are known to occur on the northern Gulf's continental slope both east and west of the Mississippi River. The coral *Lophelia pertusa* is a known mound-builder in deep water settings worldwide. It occurs in the Gulf within the depth range 200-1000 m. This observed lower limit of known occurrence has been largely established by the diving limitation of the most used manned submersibles employed in GOM slope research. The proposed research is designed not only to study known *Lophelia* sites within this depth range, but to also investigate hard bottom habitats below 1000 m for *Lophelia* occurrence. Fundamental science questions asked are: (1) Is *Lophelia* dependent or partially dependent on methane as a trophic resource as has been suggested by studies elsewhere? (2) Why do *Lophelia* Communities occur on some hard bottoms and not others? (3) Does *Lophelia* extend over the full depth range of the slope? (4) How fast does *Lophelia* grow and at what rate?

In addition to the research projects, other upcoming 2005-2006 DSC related activities include:

(1.) Launching of the new NURP Explorer 2200 m AUV for ocean mapping. This new asset will be owned by the National Institute for Undersea Science and Technology at the Universities of Mississippi and Southern Mississippi and operated by the NURP Center at UNCW. Payloads will include EM2000

multi-beam, CTD, ADCP, digital camera, and seismic hydrophone. Primary mission tasks will be to conduct habitat mapping and shallow sub-bottom profiling of cold seep and gas hydrate areas. Initial target survey areas include DSC sites off the southeast, which are also proposed MPAs. Expected delivery date is October 2005 with offshore operations to commence in 2006.

Long-term Research Plans:

Long-term research plans focus on understanding the distribution and population status of deep-sea corals, understanding the effects of human-caused disturbance and recovery dynamics, and understanding the ecological role of corals in terms of mediating patterns of biological diversity (including fishes).

Major Equipment and Facilities:

Remotely operated vehicle systems (40-330m)

Technical SCUBA diving to 100 m

Explorer 2200 m AUV with multi-beam (delivery in late 2005)

Aquarius Undersea Laboratory

NOAA Partners:

OAR Office of Ocean Exploration

NOS National Marine Sanctuary Program

NMFS National Marine Fisheries Service

OAR/NURP NIST

External Partners:

South Atlantic Fisheries Management Council

Minerals Management Service

U.S. Geological Survey

Florida State University

Harbor Branch Oceanographic Institution

University of Southern Mississippi

Louisiana State University

Penn State University

Smithsonian Institution

References:

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Koenig, C.C., A.N. Shepard, J.K. Reed, F.C. Coleman, S.D. Brooke, J. Brusher, and K. Scanlon (2004) Habitat and fish populations in the deep-sea *Oculina* coral ecosystem of the Western Atlantic. Benthic Habitat American Fishery Society Meeting, Special Publication.

Manning, C.B. 2003. Use of Geographic Information System to Document and Assess Change in a Marine Protected Area. Masters thesis, University of North Carolina at Wilmington, Wilmington, NC.

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Young, C.M., D.L. Manahan, P. Leong, A. Metaxas, and E. Vazquez. (In Press) Larval energetics, behavior and dispersal potential of a cold-seep vestimentiferan, *Lamellibrachia* sp. *Biol. Bull.*

A complete listing of NURC/UNCW publications is on-line at www.uncw.edu/nurc.

NOAA Research

NOAA Undersea Research Program

Activities of the West Coast and Polar Regions Undersea Research Center



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Region(s) of Interest:

U.S. West Coast, including California, Oregon, Washington, and Alaska; northeastern Pacific; and the polar regions.

Major Research Interests:

NOAA's Undersea Research Program (NURP) supports strategic research targeted at the information needs of NOAA's resource managers and provides scientists with access to advanced underwater technologies (e.g., human occupied submersibles, remotely operated vehicles, undersea laboratories, technical diving, etc.) to conduct cutting-edge research through a competitive peer-reviewed proposal process.

The West Coast & Polar Regions Undersea Research Center (WCPR) supports competitive, peer-reviewed research directed toward NOAA's Ecosystem Mission Goal. The Center covers the U.S. West Coast, northeastern Pacific, and polar regions. Eligible research projects employ some form of *in situ* observations, such as manned submersible or remotely operated vehicle dives.

Recent Deep-Sea Coral Research Projects (FY 2003-2004):

FY 2004

In July-August, 2004, the West Coast & Polar Regions Undersea Research Center (NURP) conducted an expedition to the western Gulf of Alaska and Aleutian region of Alaska. The main research tool was the deep-diving ROV *Jason2*. A major project supported in this expedition focused on deep-water corals in the central Aleutians. A second, exploratory study of deep-water corals was conducted as a 'piggyback' operation during a series of geology dives on Derikson and Sirius Seamounts.

Title: Distribution of deep-water corals and associated communities in the Aleutian Islands.

Investigators: Robert Stone and Jon Heifetz (NOAA Fisheries, Auke Bay Laboratory), Douglas Woodby (Alaska Dept of Fish & Game), and Jennifer Reynolds (Univ Alaska Fairbanks).

Region: Western Gulf of Alaska and Aleutian region

Objectives: Major fisheries presently occur throughout the Aleutian Island Archipelago and down the submarine slopes to at least a depth of 1500 m. Summaries of archived data and recently acquired fisheries bycatch specimens indicate that the Aleutians may harbor the highest abundance and diversity of temperate water corals in the world. However, these data revealed little about the distribution of corals in relation to the overall underwater landscape and the importance of corals to marine ecosystems. Multibeam bathymetry \pm backscatter basemaps of representative sites were acquired in 2003 under separate funding from the North Pacific Research Board. This study used the ROV *Jason2* to make *in situ* observations, and collect video data and biological and rock samples on transects as deep as 3000m. These dives extended earlier observations (shallow *Delta* submersible dives supported by NOAA Fisheries) to the full depth range of the coral species, and documented habitat associations and benthic environments in representative sites along the central Aleutians. Ultimately, the goal is to construct a model that predicts the distribution and density of coral habitat throughout the Aleutian Islands based on depth, geological features, substrate type, habitat type, oceanographic parameters, and modifications related to fishing intensity.

Title: Population genetics of Gulf of Alaska seamount invertebrates: the deep-water corals.

Investigators: Amy Baco-Taylor and Timothy Shank (Woods Hole Oceanographic Inst.)

Region: Western Gulf of Alaska and Aleutian region

Objectives: These investigators piggybacked onto a series of geology dives, and used the ROV *Jason2* to gather data on the biogeography and genetics of deep-water corals on two seamounts in the far western Gulf of Alaska. The dive targets were Derikson and Sirius Seamounts, located south of the tip of the Alaska Peninsula, with summit depths of 3000m and 2700m, respectively. The results extend these investigators' growing database from other seamounts stretching eastward across the Gulf of Alaska.

Upcoming Deep-Sea Coral Research Projects (FY 2005-2006):

FY 2005

Second year of Stone 2004 project (see above for information).

FY 2006

TBD.

Long-term Research Plans:

The West Coast & Polar Regions Undersea Research Center intends to run a workshop on seamount biology in 2005, focusing on the U.S. West Coast. Deep-water corals on seamounts are an important topic in seamount ecology, and will be addressed at the workshop. The workshop will be open to U.S. researchers from academia, government agencies, and private organizations.

Major Equipment and Facilities:

WCPR does not own assets, but has several long-term relationships with different institutes to lease equipment.

DSV *Alvin* and ROV *Jason2*

ROV *Tiburon* and *Ventana*

DSV *Delta*

NOAA Partners:

NOAA Fisheries - Alaska Fisheries Science Center - Auke Bay Laboratory
National Marine Sanctuaries Program

External Partners:

Alaska Department of Fish & Game - Juneau
Moss Landing Marine Laboratories - Center for Habitat Studies
Woods Hole Oceanographic Institution
Monterey Bay Aquarium Research Institute
Delta Oceanographics

References:

Web site with background on deep-water coral issues in Alaskan waters:

<http://www.afsc.noaa.gov/abl/MarFish/coral.htm>

Two web sites with additional information on the NURP-funded central Aleutian project described above (Stone et al.):

<http://www.afsc.noaa.gov/abl/MarFish/coralscruise.htm>

<http://www.alaskascienceoutreach.com/index.php/coral>

NOAA Research
National Undersea Research Program
Activities of the Hawai'i Undersea Research Laboratory



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Region(s) of Interest:

The waters of the Main and Northwestern Hawaiian Islands including Cross Seamount, and the U.S. Territories and Freely-Associated States of the Western Pacific.

Major Research Interests:

NOAA's Undersea Research Program (NURP) supports strategic research targeted at the information needs of NOAA's resource managers and provides scientists with access to advanced underwater technologies (e.g., human occupied submersibles, remotely operated vehicles, undersea laboratories, technical diving, etc.) to conduct cutting-edge research through a competitive peer-reviewed proposal process.

The Hawai'i Undersea Research Laboratory (HURL) at the University of Hawai'i is the NURP Center for Hawai'i and the Western Pacific. HURL provides a critical service to scientists by making available two deep-diving submersibles, the *Pisces IV and V*, for research. The Pisces submersibles make up two of the four human occupied deep-diving vehicles in the U.S., the other two being the U.S. Navy's Alvin and NR-1 nuclear submarine. Research supported by HURL addresses NOAA's mission goals and priorities, as well as those outlined in the Ocean Commission Report (2004), including ecological assessments and diversity studies of: deep-sea precious corals and how this resource interacts with the invasive snowflake coral (*Carijoa riisei*); endangered monk seal habitat; the bottomfish fishery; and other macroinvertebrates. In addition, deep-sea coral researchers are using HURL facilities to collect specimens for genetic analysis to study reproduction, development, and re-colonization activities while other scientists are using these corals to determine climate variability on a decadal to centennial time scale.

Recent Deep-Sea Coral Research Projects (FY 2003-2004):

Title: Reproductive biology and population genetics of Hawaiian precious corals

Principle Investigators: Amy Baco-Taylor and Timothy Shank

Region(s): Northwestern Hawaiian Islands

Objectives: Obtain samples of precious corals (i.e., gold coral, *Gerardia sp.*, red coral, *Corallium regale*, and pink coral, *Corallium secundum*) for a genetic analysis of their population structure throughout the Hawaiian Archipelago and for a study of their reproductive biology.

Title: Seamount Surveys of Deep-Water Coral Distributions as Related to Geological Setting in the Northwestern Hawaiian Islands

Principle Investigators: Amy Baco-Taylor, Timothy Shank, John R. Smith, and Christopher Kelley

Region(s): Northwestern Hawaiian Islands

Objectives: The general objective of the project was to characterize the fauna and geology of three unexplored seamounts in the NWHI. The specific objectives were (1) Investigate a recently mapped rift zone and two seamounts and prepare detailed geological maps. (2) Fill in data gaps in bathymetric maps using multibeam system. (3) Survey these features for benthic fauna, focusing primarily on gorgonian and scleractinian corals. (4) Relate the distribution of the corals to the geological characteristics of the seamounts.

Title: Characterization of deepwater fish and precious corals on the seamounts neighboring Hawaii's most remote monk seal colonies

Principle Investigators: Frank Parrish

Region(s): Northwestern Hawaiian Islands

Objectives: The focus of the work was to compare subphotic fish communities and precious coral beds in the southern portion of the NWHI to those in the northern NWHI where oceanic productivity is the highest. This was of particular interest because the endangered Hawaiian monk seals are known to feed on fish species in precious coral beds and, in the south, exhibit poor survivorship compared to those in the north, which has fueled speculation about differing prey availability between the regions. *This project is conducted in partnership with NOAA Fisheries.*

Title: The ecology and ecological impact of a highly invasive marine invertebrate in Hawaii's coral reef communities

Principle Investigators: Richard Grigg, Sam Kahng, and Rob Toonen

Region(s): Main Hawaiian Islands

Objectives: The purpose of this project was to continue ongoing research efforts on the ecology of the introduced teleostean *Carijoa riisei* in deep-water habitats and remote locations away from frequent anthropogenic activity (i.e., the shallow, coastal waters of the main islands). Specific objectives were to conduct deep water surveys to determine the extent of the *C. riisei* infestation on black and other deeper water corals species and reveal the lower depth & temperature limits of this species. *This project is conducted in partnership with the NOAA Coral Reef Conservation Program.*

Title: An investigation of the current status of the Hawaiian Black Coral Fishery using historical data and new perspectives

Principle Investigators: Anthony Montgomery and Scott France

Region(s): Main Hawaiian Islands

Objectives: This research will address the immediate need to gather more, current information on the status of the Hawaiian Black Coral Fishery. This information will be used for a management plan to

help keep the fishery sustainable. This will be accomplished by addressing the following five research objectives: (1) measure black coral colonies (*A. dichotoma* and *A. grandis*) to determine the current age structure in areas heavily harvested by fisherman as well as areas less heavily harvested by fisherman in the Au'au channel; (2) collect samples (*A. dichotoma*) to measure genetic relatedness of black corals across the Main Hawaiian Islands; (3) measure the density of black coral colonies in the areas sampled for population structure and compare to historical measurements; (4) determine the growth rate of *A. dichotoma* and compare with the historically determined growth rate of 6.42 cm/year; and (5) develop a draft management plan based on all available information. *This project is conducted with support from the NOAA Coral Reef Conservation Program.*

Title: Deep-Sea Precious Corals as Habitat for Macroinvertebrates in Hawaii

Principle Investigators: Amy Baco-Taylor, Timothy M. Shank, and Thomas C. Shirley

Region(s): Main Hawaiian Islands, Cross Seamount

Objectives: Examine the coral-associated invertebrate and fish fauna at three large precious coral beds in the Hawaiian Archipelago, the Makapu'u Bed, on the southeast slope of Oahu, the Keahole Bed, on the western slope of Hawaii, and the Cross Seamount Bed. The answers to the following questions will be sought: 1) What is the community composition of the commensal coral fauna? 2) How does this compare between different coral beds? 3) Do any of the fauna exhibit habitat selectivity? *This project is conducted in partnership with NOAA's Office of Ocean Exploration.*

Title: Decadal to Centennial Climate Variability Revealed by Deep Sea Corals from the Central North Pacific Gyre

Principle Investigators: Robert Dunbar, Tom Guilderson, Brendan Roark and Stewart Fallon

Region(s): Main Hawaiian Islands, Cross Seamount

Objectives: The goal is to collect living and dead (fossil and sub-fossil) specimens of deep sea corals from the Hawaiian Islands region to reconstruct past variability in ocean climate in the central North Pacific.

Upcoming Deep-Sea Coral Research Projects (FY 2005-2006):

Title: Exploration of the deep slopes of the US Line and Phoenix Islands to investigate the biogeography of deepwater fish and corals, and identify paleo-shorelines

Principle Investigators: Frank Parrish, Bruce C. Mundy; Richard Pyle (Bishop Museum)

Region(s): Line and Phoenix Islands (Kingman Reef, Palmyra, Jarvis, Howland, and Baker Islands)

Objectives: Questions to answer related to deep corals include:

- Is the species diversity of deepwater slope more consistent in the Northwestern Hawaiian Islands spanning the east-west axis or the Line-Phoenix Islands that are oriented north-south?
- Is the consistency of species diversity between shallow systems more variable than diversity of deep slopes?

Title: Decadal to Centennial Climate Variability Revealed by Deep Sea Corals from the Central North Pacific Gyre

Principle Investigators: Robert Dunbar, Tom Guilderson, Brendan Roark, and Stewart Fallon

Region(s): Northwestern Hawaiian Islands,

Objectives: The goal is to collect living and dead (fossil and sub-fossil) specimens of deep sea corals from the Hawaiian Islands region to reconstruct past variability in ocean climate in the central North Pacific.

Additional Efforts Related to Deep-Sea Corals:

Title: The Impacts of Bottomfishing on the Raita and West St. Rogatien RPAs in the Northwest Hawaiian Islands Coral Reef Ecosystem Reserve

Principle Investigators: Christopher Kelley, Robert Moffitt, John R. Smith

Region(s): Northwestern Hawaiian Islands, Line Islands (Palmyra Atoll, Kingman Reef), and possibly Johnston Atoll

Objectives: To assess the impacts of commercial bottomfishing in the Raita and West St. Rogatien (i.e., first bank west of St. Rogatien) Reserve Preservation Areas (i.e., RPAs), located within the Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve (NWHICRER).

Title: Collection of live deepwater corals and invertebrates for the Waikiki Aquarium

Principle Investigators: Christopher Kelley, Robert Moffitt, John R. Smith

Region(s): Northwestern Hawaiian Islands

Objectives: This was a side activity associated with the bottomfishing impacts study above. Live specimens of soft corals (*Anthomastus sp.*), anemones, hydrozoans, urchins, seastars, and galatheid crabs were collected by the Pisces V submersible from the NWHI and maintained aboard ship for up to two weeks in an insulated, temperature controlled container. Once the KOK returned to Honolulu, the specimens were turned over to the Waikiki Aquarium. Many of these animals are still alive almost 1 year later and this initial success has prompted the aquarium to begin planning for a deep sea exhibit that would highlight corals and other animals living below the depths of SCUBA.

Title: Resurvey of Deep Artificial Reefs at Penguin Bank for Fish Community Structure and Invasive Coral Species

Principle Investigators: Raymond Boland, Frank Parrish, and Robert Moffitt

Region(s): Main Hawaiian Islands

Objectives: Goals of this proposal related to corals are to determine if *Carijoa riisei* dominates the artificial reefs, if has expanded to other reef modules, and, if so, how it has affected the deep fish community. *This project is conducted in partnership with NOAA Fisheries.*

Title: Drowned reefs off Hilo and their implications for reef development and climate change during the Late Pleistocene

Principle Investigators: Donald Potts, Jody Webster, Christina Ravelo, David Clague, Christina Gallup, James Moore

Region(s): Main Hawaiian Islands

Objectives: Describe, sample, date, and characterize reef development and associated paleoenvironmental changes during the Late Pleistocene off Hilo using an interdisciplinary team approach

Long-term Research Plans:

Continue including deep-sea corals as a research priority in upcoming requests for proposals and supporting deep-sea coral research in all areas of the Pacific serviced by HURL.

Major Equipment and Facilities:

R/V *Ka'imikai-o-Kanaloa (KoK)* with SeaBeam 210 multibeam mapping system

Pisces IV & *Pisces V* human occupied submersibles (2000 m)

RCV-150 robotic submersible (1000 m)

R/V *Kilo Moana* with multibeam systems (previous and upcoming cruises)

NOAA Ship *Hi'ialakai* (requested cruise in 2007) with eventual multibeam system

NOAA Partners:

OAR Office of Ocean Exploration
NOS NWHI Coral Reef Ecosystem Reserve
NOS National Marine Sanctuaries Program
NOS Pacific Services Center
NOAA Coral Reef Conservation Program
NMFS Pacific Islands Fisheries Service Center
NMFS Pacific Islands Regional Office

External Partners:

Western Pacific Fisheries Management Council
State of Hawai‘i Department of Land and Natural Resources
University of Hawai‘i
Hawai‘i Mapping Research group
Pacific Island Benthic Habitat Mapping Program

References:

Upcoming in October 2004 at:

<http://oceanexplorer.noaa.gov>

<http://oceanexplorer.noaa.gov/explorations/03nwhi/welcome.html>

<http://oceanexplorer.noaa.gov/explorations/02hawaii/welcome.html>

NOAA Research
NOAA Undersea Research Program
Activities of the National Undersea Research Center for the
North Atlantic and Great Lakes



*National Undersea Research Center
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Ivar Babb

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Region(s) of Interest

The Gulf of Maine, Georges Bank and the Southern New England Shelf regions of the northeast continental shelf, as well as the continental slope, canyons, rise, seamounts, and abyss within the U.S. EEZ.

Major Research Interests

NOAA's Undersea Research Program (NURP) supports strategic research targeted at the information needs of NOAA's resource managers and provides scientists with access to advanced underwater technologies (e.g., human occupied submersibles, remotely operated vehicles, undersea laboratories, technical diving, etc.) to conduct cutting-edge research through a competitive peer-reviewed proposal process.

Understanding patterns of distribution and abundance of deep-sea corals, and their ecological role, in the region of interest. This includes mapping of potential coral habitat, developing an understanding of the factors that mediate distribution and abundance, patterns of recruitment, reproductive biology, population genetics, and basic systematics. In addition, understanding the ecological role of corals requires an understanding of how corals mediate local patterns of diversity of associated taxa, defining obligate and facultative relationships with other taxa, and, in particular, understanding the role they play as habitat for fishes of economic and ecological importance.

Recent Deep-Sea Coral Research Projects (FY 2003-2004):

Title: Geo-referenced database of deep-sea coral records

Investigators: Peter Auster, Les Watling, and Ivar Babb

Region: North Atlantic coast of the U.S.

Summary: Development of a geo-referenced database of existing records of deep-sea corals in the region was initiated and Version 1.0 was published. The database still requires input after inspection of museum specimens (Yale Peabody Museum and Smithsonian Institution's Natural History Museum) and review of archived videotapes (NURC video archive). The current version of the database is in use by the New England Fishery Management Council to develop habitat conservation alternatives for fishery management plans.

Title: Biology of Octocorals in the Gulf of Maine and Outer Continental Shelf Waters of the Eastern United States

Investigators: Les Watling, Peter Auster, and Kevin Eckelbarger

Region: Gulf of Maine and Georges Bank

Summary: A two-year field project (2003-2004) was completed in the Gulf of Maine and Georges Bank submarine canyons. This project focused on understanding the distribution and abundance of deep-sea corals in the deep basins of the Gulf and along the continental margin. Collections of corals were made for systematics and taxonomy, reproductive biology, population genetics, and commensals. Video transects to understand spatial patterns in corals and associated fishes were also conducted. Inspection of material from this cruise suggests at least one species of coral new to science was collected. Data on the distribution and abundance of fishes suggests that coral habitats are functionally equivalent to other habitats with dense epibenthic (structure forming) fauna.

Title: Mapping deep-water corals using the U.S. Navy's NR-1 nuclear submarine

Investigators: Ivar Babb and Peter Auster

Region: Norfolk Canyon

Summary: A cruise was conducted with the U.S. Navy's NR-1 nuclear powered research submersible to map the distribution of corals and fishes in Norfolk Canyon. Unfortunately, due to high turbidity and currents as well as an emergency personnel transfer, no map or image products were produced from this effort. However, this project did demonstrate the willingness of the Navy to collaborate on projects related to this issue.

Title: Mountains in the Sea – Exploring the New England Seamount Chain

Investigators: Ivar Babb, Les Watling, Jon Moore, Scott France, Peter Auster

Region: New England Seamounts

Summary: A project in collaboration with the Office of Ocean Exploration was conducted to investigate the corals and associated communities in the New England Seamount chain. The Mountains-In-The-Sea research team visited Bear, Balanus, Retriever, Kelvin and Manning seamounts. The primary focus of each science dive was to collect octocoral species for taxonomic, genetic, commensal, and reproductive studies, and to videotape long transects to quantify variation in seamount landscapes in order to correlate such variation with patterns in the distribution of the octocoral colonies as well as fishes and associated nekton. This work has greatly expanded what had been known previously about the seamount fauna of the region. For example, to date 198 coral specimens have been collected and there are at least 15 species new to science. Several specimens represent the first observations of several deepwater octocoral species with fully formed eggs, and other specimens provide the first information about reproduction. Thirty-six species from 24 families of fishes have been identified from video surveys,

revealing new information on distribution and patterns of habitat use. The results of these explorations so far have produced tantalizing clues to how seamount faunas are distributed on individual peaks and how they are restricted to particular regions of the ocean by current patterns.

Upcoming Deep-Sea Coral Research Projects (FY 2005-2006):

Three projects form the core of the *NURP's 2005 Deep Sea Coral Initiative* and will be supported on a cruise of the RV *Atlantis* using the *Alvin* submersible off the northeast US. The three projects are:

Title: Recruitment Dynamics of Deep-Sea Coral

Investigators: L. Mullineaux and J. Adkins

Region: Northeast U.S.

Objectives: The objective of this study is to determine how coral communities form and persist in submarine canyons and on seamounts, in order to understand the dynamics of the component populations and their susceptibility to disturbance. To accomplish this, we need to know where and when communities form, how often they are recolonized, and whether subsequent colonists are supplied by the local populations or immigrate from remote sources. Recruitment processes will be studied directly through time-series monitoring of the appearance of new individuals in an environment, and indirectly through analysis of the age-structure of established individuals. Ages of live corals will be determined by radiometric dating, using ^{210}Pb ; in addition ^{238}U - ^{234}U / ^{230}Th dating will be conducted on older individuals to extend the mapping of age distributions in larger "patches" of coral recruitment.

Title: Microbial Ecology of Deep-Sea Corals

Investigators: F. Rohwer and O. Santos

Region: Northeast U.S.

Objectives: It is widely recognized that prokaryotes, both Bacteria and Archaea, are vital components of all marine ecosystems. Corals and other sessile organisms live within and depend on this soup of marine microbes. By associating with specific prokaryotes, a coral colony may gain important metabolic functions such as chemoautotrophy or nitrogen fixation. Tropical, reef-building corals encourage the growth of specific microbes by the secretion of specialized mucus. Several studies have applied modern microbial ecology methods to investigate the microbes living with tropical, reef-building corals. In the proposed research, these studies of microbe-coral interactions will be extended to deep sea corals to: (1) Determine how many microbes live on deep sea corals; (2) Determine how fast microbes are growing on the corals (3) Determine the types of microbes that live on deep sea corals.

Title: Developing a habitat suitability model to predict the occurrences of deep water Alcyonaceans in the U.S. Eastern EEZ.

Investigators: Les Watling and Kathy Scanlon

Region: Northeast U.S.

Objectives: The recent rediscovery of deep-water corals along the continental shelves and slopes of the United States has ignited strong public interest in their conservation. Many of the corals are long lived and others, especially those that form large bioherms, may be important habitat for a variety of invertebrates and fish, some of the latter of commercial importance. However, at the present time knowledge of the occurrences of deep corals in the U. S. is still imperfect so finding areas to target for conservation may involve best guesses or limiting ourselves to the sites already known. One solution to this problem is the development of a habitat suitability model, which can be used to predict where deep-water corals might be abundant. Using distributional data for deep-water alcyonaceans already in a GIS format, we will develop a HSI model using factors such as substrate composition and slope, bathymetry, bottom water temperature, bottom water salinity, carbonate saturation, delivery of food particles and

mass flux of all particulates. The model will be developed for at least 8 species of deep-water alcyonaceans and tested by diving in areas of the continental slope where there are currently no deep water coral records.

Long-term Research Plans

Long-term research plans focus on understanding the distribution and population status of deep-sea corals, understanding the effects of human-caused disturbance and recovery dynamics, and understanding the ecological role of corals in terms of mediating patterns of biological diversity (including fishes).

Major Equipment and Facilities

Hela and Kraken remotely operated vehicle systems (330m and 1000m capable, respectively)

Sidescan sonar

ISIS camera sled

NOAA Partners

OAR Office of Ocean Exploration

NOS National Marine Sanctuary Program

NMFS National Marine Fisheries Service

External Partners:

U.S. Geological Survey

University of Maine

Woods Hole Oceanographic Institution

University of Louisiana Lafayette

Florida Atlantic University

University of South Florida

U.S. Navy

References:

Published or in press products to date include:

Auster, P.J. In press. Are deep-water corals important habitats for fishes? In: A. Freiwald and J.M. Roberts (eds.) Deep-water Corals and Ecosystems, Springer, New York.

Watling, L. and P.J. Auster. In press. Distribution of deepwater alcyonacea off the northeast coast of the United States. In: A. Freiwald and J.M. Roberts (eds.) Deep-water Corals and Ecosystems, Springer, NY.

Auster, P.J., J. Moore, K. Heinonen, and L. Watling. In press. A habitat classification scheme for seamount landscapes: assessing the functional role of deepwater corals as fish habitat. In: A. Freiwald and J.M. Roberts (eds.) Deep-water Corals and Ecosystems, Springer, New York.

ICES. 2004. Report of the study group on cold-water corals (SGCOR). International Council for Exploration of the Seas, Advisory Committee on Ecosystems, ICES CM 2004/ACE:07 Ref. E. (contributor with 11 other authors).

Watling, L. and P. Auster. 2003. A preliminary summary of the distribution, status, and ecological role of deep-water corals off the northeast coast of the United States. White Paper for the New England Fishery Management Council.

Watling, L., P. Auster, I. Babb, C. Skinder, and B. Hecker. 2003. A Geographic Database of Deepwater Alcyonaceans of the Northeastern U.S. Continental Shelf and Slope. Version 1.0 CD-ROM. National Undersea Research Center, University of Connecticut, Groton.

NOAA Fisheries

Activities of the Northeast Fisheries Science Center



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Region of Interest: Gulf of Maine, N.C.

Major Research interests:

Coral Community Ecology, Corals as EFH, gear effects

Recent deep coral research projects:

Previous experience with DSC research and surveys in Europe / Norway and involvement with European Union research on DSCs.

On-going deep coral research projects:

Currently delegate on the ICES Advisory Committee on Ecosystems and responsible for summarizing DSC activities in the ICES area.

Long-term research plans: Coral conservation, Coral EFH

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Region(s) of Interest: Northeast Region: Gulf of Maine, southern New England and mid-Atlantic outer shelf, slope and canyons

Major Research interests:

Habitat use by demersal fishes and invertebrates, distribution of fishes and invertebrates in deep water, role of offshore habitats in overwintering of inshore-offshore migrants, physiology of migration/overwintering in fishes (lipid profiling)

Recent deep coral research projects:

With USGS collaboration, we conducted detailed exploration of tilefish habitat (including discovery of coral areas) in the mid-Atlantic outer shelf (depths >80 m in Hudson Canyon vicinity), including photo, video, and side scan sonar transects plus trawl and bottom grab sampling. We examined the role of tilefish burrows, corals, geological features, sediment biogeochemistry and canyon-associated hydrology in determining organism distribution and fisheries habitat value. We found coral distributions very different from those previously described, fish-rich habitats associated with aggregations of sea anemones (*Bolocera*), colonization by a heretofore unreported (exotic?) zoanthid (a coral relative), several species of subtropical decapods and fishes not previously reported from this northern latitude, and synchronous demersal swarming of crustaceans, larval fishes, forage fishes, and larger predatory fishes and squids around dusk.

On-going deep coral research projects:

Continued exploration of mid-Atlantic deepwater habitats, including corals and other habitat-structuring organisms, and associations of fisheries species. Funding to date has been largely via NEFSC Benthic Habitat program (~\$80k since 2001). Obtained some ancillary funding (~\$15k) from NOAA OEP and NURP (~\$5k) programs via collaboration with academic research programs.

Long-term research plans:

Habitat mapping of northeast continental shelf and adjoining upper slope and canyon fisheries habitats through the use of multibeam contour and backscatter data in combination with visual, side scan, geological and biological sampling data.

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Region of Interest: Northwest Atlantic

Major Research interests:

Taxonomy, mapping and distribution, ecology, and interactions with fisheries.

Recent deep coral research projects:

White paper for NEFSC, “An Overview Of Deepwater Corals Off The Northeast And Mid-Atlantic Coasts Of The United States And Their Relevance To NOAA Fisheries.”

On-going deep coral research projects:

Hope to be a part of some ongoing projects, including Vince Guida’s Mid-Atlantic surveys.

Long-term research plans:

Would like to see more research and mapping done in the Mid-Atlantic.

NOAA Fisheries

Activities of the Southeast Fisheries Science Center



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Region of Interest: Oculina HAPC, South Atlantic Bight, Gulf of Mexico

Major Research interests:

Fish assemblages associated with deep coral reefs, particularly those in marine protected areas.

Recent deep coral research projects:

- Oculina HAPC - mapping and habitat characterization, monitoring fish assemblages inside and outside reserve, evaluating restoration efforts
- South Atlantic Bight - preliminary investigation of fish assemblages and deep coral habitat in proposed shelf-edge MPAs
- Gulf of Mexico – evaluation of shelf-edge MPA effectiveness by examining reef fish populations, mapping of deep reef habitat

On-going deep coral research projects:

Oculina HAPC –	No direct funding to date, but have participated in several OE, CRI, and SAFMC funded projects
South Atlantic –	2004 self funded
Gulf of Mexico –	2001 Fisheries: MARFIN (\$242K), CRI (\$120)
	2001 Mapping: CRI, NOS, HQ combined funds (\$255K)
	2002 Fisheries: CRI (\$120K)
	2002 Mapping: CRI (\$100K)
	2003 Fisheries: CRI (\$180K)
	2004 Fisheries: CRI (\$185K)
	2004 Mapping: CRI (\$203K)

Long-term research plans:

- Continued monitoring of deep reef MPAs and proposed MPAs for changes in reef fish abundance and distribution.
 - Continued mapping of deep coral habitats.
 - Investigation of cross-shelf connectivity of grouper populations to determine the importance of MPAs to these economically important species.
 - Ecosystem modeling of the Oculina area.
 - Developing a long-term monitoring program using
 - Oculina as a model for examining other deep sea coral systems.
-

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Region of Interest: Gulf of Mexico, South Atlantic Bight, Oculina HAPC

Major Research interests:

Fish assemblages associated with deep coral reefs, emphasizing those in Marine Protected Areas. Connectivity between deep reef-associated fauna and shallow habitat, particularly as demonstrated through ontogenetic movement.

Recent deep coral research projects:

- NE Gulf of Mexico – efficacy evaluation of shelf-edge MPAs with respect to reef fish stock improvement, mapping of deep coral habitat.
- Oculina HAPC – monitoring of deep coral habitat, evaluation of restoration efforts, mapping, assessment of changes in reef fish populations during period of fishing restriction.
- South Atlantic Bight – preliminary investigation of proposed shelf-edge MPAs with goals of locating deep reef habitat and associated fish populations.

On-going deep coral research projects:

See Research Plan outlined above.

Long-term research plans:

Continuing assessment of changes in reef fish abundance and distribution in deep reef areas incorporated into MPAs. Examination of deep reefs as source of propagules for economically valuable and managed fish species

NOAA Fisheries

Activities of the Northwest Fisheries Science Center



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Region of Interest: U.S. West Coast (off WA, OR, CA)

Major Research interests:

- Division Director leading Fishery Resource Analysis and Monitoring Division (FRAMD) research that includes:
 - Benthic habitat characterization
 - Development of coastwide maps of coral and other biogenic species distributions
 - Trawl, acoustic, ROV and AUV surveys of groundfish and their habitats on the West Coast
 - Groundfish observer programs to monitor bycatch including coral bycatch
 - Development of new technologies to survey rocky habitats
 - Stock assessment modeling of groundfish populations
 - Spatial analysis of fisheries and ecosystem data

Recent deep coral research projects:

- “Observations of structure-forming epibenthic invertebrates from regional bottom trawl surveys conducted off the U.S. West Coast”
 - Compiled data on cold-water coral, sponge, and anemone observations from regional bottom trawl surveys including those conducted by the NW and AK Fisheries Science Centers off the U.S. West Coast
 - Funded by NW Fisheries Science Center – FRAMD

On-going deep coral research projects:

- “Observations of structure-forming epibenthic invertebrates off the U.S. West Coast”
 - Mapping distribution of cold-water corals, sponges, and anemones off U.S. West Coast
 - Funded by NW Fisheries Science Center – FRAMD
 - Continuation of #1 above

****Also see research projects of Waldo Wakefield and Curt Whitmire below.**

Long-term research plans:

- Development of targeted surveys for corals and other biogenic species throughout representative habitats.
 - Expansion and updates of mapping information on the surficial geology on the west coast
 - Continuation and expansion of coral and other biogenic species collections during bottom trawl surveys and during observations of fishing activities by the groundfish observer program. Expansion verification specific identifications by specialists.
 - Working with biochemists at collaborating academic institutions, we propose to develop a picture of the physiological potential for recovery for cold-water corals from both geochemical and biochemical analyses of age and growth as well as growth potential.
 - We propose to build upon the detailed coral maps created in other portions of our research plan to study the degree of association of rockfishes and other groundfish species with corals and to estimate the importance of corals to groundfish productivity.
-

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Region of Interest: U.S. West Coast (off WA, OR, CA)

Major Research interests:

- Team Leader for the NWFSC-FRAMD Habitat/Conservation Engineering Team
- The application of direct observation and advanced technology to the study of the distribution of benthic fishes and invertebrates and their habitat associations
- Conduct interdisciplinary research linking a range of fields of marine science to study the habitat ecology – especially the marine geology and fisheries.
- Participate in the development of a comprehensive multi-layered GIS of marine habitats for the west coast of North America
- “Distribution and abundance of fishes and megafaunal invertebrates on Heceta Bank, Oregon, 2000-2002”
 - Part of larger study – “Fisheries habitat investigations at Heceta Bank, Oregon”
 - Funded by NOAA NURP, NOAA Office of Ocean Exploration, OR Sea Grant, OAR PMEL, and SW and NW Fisheries Science Center – FRAMD

- “Distribution and abundance of fishes and megafaunal invertebrates in Astoria Canyon, Oregon, 2001”
 - Part of an ongoing NOAA Office of Ocean Exploration project to map and dive on unexplored portions of the margin of the West Coast in deep water.
 - Funded by NOAA Office of Ocean Exploration, NOAA NURP, and SW and NW Fisheries Science Center – FRAMD
 -

Long-term research plans:

See Divisional research plan outlined under Clarke

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Region of Interest: U.S. West Coast (off WA, OR, CA)

Major Research interests:

- Benthic habitat characterization and mapping using data from remote sensors and direct observations
- Spatial analysis of fisheries and ecosystem data

Recent deep coral research projects:

- “Observations of structure-forming epibenthic invertebrates from regional bottom trawl surveys conducted off the U.S. West Coast”
 - Compiled data on cold-water coral, sponge, and anemone observations from regional bottom trawl surveys including those conducted by the NW and AK Fisheries Science Centers off the U.S. West Coast
 - Funded by NW Fisheries Science Center – FRAMD

On-going deep coral research projects:

- “Observations of structure-forming epibenthic invertebrates off the U.S. West Coast”
 - Mapping distribution of cold-water corals, sponges, and anemones off U.S. West Coast
 - Funded by NW Fisheries Science Center – FRAMD
 - Continuation of #1 above

Long-term research plans:

See Divisional research plan outlined under Clarke

NOAA Fisheries

Activities of the Southwest Fisheries Science Center



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Region of Interest: West Coast, particularly central and southern California

Major Research interests:

- Improvement of Groundfish Assessments in non-trawled habitats off California
- Characterization of deep water benthic habitats and associated groundfish assemblages for stock assessment improvement and designation of EFH
- Development of new technology to map seafloor habitats
- Evaluation of MPAs for groundfish protection, research, and management

Recent deep coral research projects:

Systematics, distribution, and abundance of structure-forming invertebrates (particularly black coral, gorgonians, sponges, anemones, sea pens, etc.) in deep water (30-330 m) on major offshore rocky banks in Southern California Bight. Notably, habitat-specific studies of these structure forming invertebrates and associated fish assemblages are underway; completion of a draft manuscript is expected June, 2004.

On-going deep coral research projects:

In Situ surveys of groundfishes and structure-forming invertebrates on major non-trawled habitats (30-330 m) off southern California. Collaborators (Univ CA Santa Barbara, CA Dep Fish Game, CA Sea Grant; WA State University; OR State Univ; NOAA MPA Science Center; Oak Ridge Natl Lab; LA County Museum); Funds: NOAA Fisheries SWFSC; F/HC; F/PR; NOAA NURP; NOAA MPA Center; Packard Foundation; CA Sea Grant; CDFG.

Long-term research plans (Proposed and in need of funding):

(1.) Identify and rescue existing data on Deep Sea Corals off California, develop georeferenced web-database on distribution and abundance of DSCs and associated fishes and habitats, improve our ability

to assess and protect DSC stocks, and evaluate DSC as EFH for groundfish. Collaborators at University of California Santa Barbara, Washington State University, MBARI, Oak Ridge National Laboratory; and others).

(2.) Develop and implement new surveys of Deep Sea Corals (and other structure forming invertebrates) off California and northern Baja California to supplement our recent surveys and to characterize the geographic and bathymetric extent of DSC distribution, abundance and significance as EFH. Collaborators at UCSB, CICESE, Oak Ridge Natl. Lab, Smithsonian Museum, LA County Museum, Washington State University.

NOAA Fisheries

Activities of the Alaska Fisheries Science



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Region of Interest: Alaska

Major Research interests:

Coral fishing gear interactions, biogeography, habitat requirements of coral, fish/coral relationships, population dynamics

Recent deep coral research projects:

DSC distribution and habitat in the Aleutian Archipelago

On-going deep coral research projects:

DSC distribution and habitat in the Aleutian Archipelago

Funding: NMFS Auke Bay Lab, NURP, NPRB

Long-term research plans:

Continue DSC coral research in Aleutians and throughout Alaska waters. Habitat mapping in combination with in situ observations.

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Region of Interest: Alaska, Northeast Pacific

Major Research Interests: Alaskan invertebrate distributions, Marine zooplankton, Ocean Carrying Capacity, Effects climate and environmental change on marine ecosystems.

Recent deep-sea coral research projects

- Identification of corals collected by crab fishery observes, trawl surveys and longline surveys by National Marine Fishery Service and Alaska Department of Fish and Game.
- Development of reference collection of Alaskan corals
- Growth rates of *Calcigorgia spiculifera*

On-going deep coral research projects:

Development of a field guide to Alaskan Corals funded by National marine Fisheries Service (Bruce L. Wing) and Alaska Department of Fish and Game (David R. Barnard)

Long-term Research Plans: Examine habitat requirements, growth rates, and associated fishes and invertebrates of Alaskan corals.

References:

<http://www.afsc.noaa.gov/Publications/AFSC-TM/NOAA-TM-AFSC-146.pdf> (A Field Guide to Alaskan Corals)

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Region of Interest: North Pacific Ocean

Major Research interests:

Deep-sea (DS) coral and sponge distribution, life history, and effects of fishing on structure-forming benthic biota.

Recent deep coral research projects:

Distribution of DS corals in Aleutian Islands, growth of gorgonians in the Gulf of Alaska

On-going deep coral research projects:

- 1) "Distribution of deep-sea corals and associated communities in the Aleutian Islands" funded by NURP and AfSC.
- 2) "Deep sea coral distribution and habitat in the Aleutian Archipelago" funded by North Pacific Research Board (NPRB) and AFSC.

- 3) “Growth of an Alaskan shallow-water gorgonian” funded by AFSC.
- 4) “Occurrence of *Primnoa* sp. in shallow-water in the Gulf of Alaska: evidence of deep-sea emergence” funded by AFSC.
- 5) “Reproduction of hydrocorals and scleractineans from the Aleutian Islands” funded by the AFSC and NPRB. Coauthor with Sandra Brooke.
- 6) “Reproduction of gorgonian corals from the Aleutian Islands” funded by AFSC and NPRB. Coauthor with Anne Simpson and Les Watling.
- 7) “Micro-associates of deep-sea corals in the Aleutian Islands” funded by AFSC and University of Maine. Coauthor with Les Watling and Gordon Hendler.
- 8) “Taxonomy of deep-sea gorgonians from the Aleutian Island Archipelago using molecular techniques” funded by the AFSC and University of Louisiana. Coauthor with Scott France.
- 9) “Effects of simulated trawl disturbance on Pennatulacen corals” funded by AFSC. Coauthor with Patrick Malecha.
- 10) “Growth rate and age validation of three species of Pennatulaceans in the Gulf of Alaska” funded by AFSC. Coauthor with Don Mortenson.

Long-term research plans:

Continuation of ongoing research projects and focus on western Aleutian Islands and deep-sea sponge communities. Delineation of *Primnoa* sp. thickets in the Gulf of Alaska using in situ observations for the purpose of defining “habitat areas of particular concern”.

NOAA Fisheries

Activities of the Pacific Islands Fisheries Science



national marine fisheries service

Pacific Islands Fisheries Science Center

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Region(s) of Interest: Hawaii and the Western Pacific (Line and Phoenix, CNMI, American Samoa, Micronesia)

Major Research interests:

Assessment and ecological role of corals (to fish, monk seals etc)
Environmental parameters (growth, recruitment, dispersion)
Information in support of deepwater coral fisheries

Recent deep coral research projects:

- (1.) Monk seals-NURP funded submarine time.
- (2.) Fish association with Black coral-NMFS vessel provided for support.
- (3.) Fish association with Precious coral-NURP and OE funded submarine time.
- (4.) Productivity survey of the NWHI-Ocean Exploration funded submarine time

Ongoing Deep-Sea Coral Projects:

Aug 05 - Continued collaborative work with the State of Hawaii on Hawaiian Black coral.
Leveraged resources of NMFS, State and NURP
2005 – Survey of the Line and Phoenix Islands - NURP funded submarine time

Long-term research plan:

- Begin long-term monitoring of established study sites in Hawaii.
- Verify coral fishery parameters *Gerardia* sp. colonies are marked for monitoring growth.
- Archival monitoring of environmental parameters of corals
- Thermographs, flow meters, acoustic receivers (for monk seals) and archival cameras
- Extend coral assessments to Samoa and CNMI

References:

Parrish F.A., K. Abernathy, G.J. Marshall and B.M. Buhleier 2002. Hawaiian monk seals (*Monachus schauinslandi*) foraging in deep-water coral beds. *Marine Mammal Science* 18(1):244-258.

Boland R.B. and F.A. Parrish In review. A description of the fish assemblages in the black coral beds off Lahaina, Maui. *Pacific Science*.

Parrish F.A. In prep. Fish association with Precious Corals, 2004 NWHI Sym. *Atoll Research Bulletin*

Mundy B.C. and F. A. Parrish 2004. New Records of the fish genus *Grammatonotus* (teleostei: Perciformes: Percoidei: Callanthiidae) from the Central Pacific, Including a spectacular species in the Northwestern Hawaiian Islands. *Pacific Science* 58 (3) 403-417.

Appendix A. Table 1. Vessels, equipment and users listed in the Deep Coral Communities Profiles.

Vessels and Equipment	Flower Garden Banks NMS	Cordell Bank NMS	Gulf of Farallones NMS	Gray's Reef NMS	Monterey Bay NMS	Olympic Coast NMS	Ocean Exploration	NURP CMRC	NURP NURC - UNCW	NURP WCPRUC	NURP HURL	NURP NURC NA & GL	NOAA Fisheries: NEFSC	NOAA Fisheries: SEFSC	NOAA Fisheries: NWFSC	NOAA Fisheries: SWFSC	NOAA Fisheries: AKFSC	NOAA Fisheries: PIFSC
Aquarius Undersea Laboratory									X									
AUV Explorer									X									
ISIS camera sled												X						
M/V Fling	X																	
M/V Spree	X																	
NOAA Ship Albatross II													X					
NOAA Ship David Star Jordan																X		
NOAA Ship Deleware II													X					
NOAA Ship Hi'ialakai							X				X							
NOAA Ship McArthur II			X			X										X		
NOAA Ship Nancy Foster	X						X											
NOAA Ship Ronald H. Brown							X											
NOAA Ship Thomas Jefferson	X																	
R/V Atlantis							X		X			X						
R/V C. Magister		X																
R/V Cape Fear									X									
R/V CSUMB w/ multibeam system			X															
R/V Ka'imikai-o-Kanaloa							X				X							
R/V Kilo Moana											X							
R/V Pisces									X									
R/V Point Sur w/sidescan system			X															
R/V Private Glass	X																	
R/V Research Diver									X									
R/V Roger Revelle										X								
R/V Savannah				X														
R/V Seward Johnson							X											
R/V Shearwater			X															
R/V Thompson							X											
R/V Tiburon			X															
R/V Towfish			X															
R/V Volero IV			X															
R/V Western Flyer			X		X													
ROV - Gray's Reef NMS				X														
ROV - Hela												X						
ROV - Jason2										X								
ROV - Kraken												X						
ROV - Hercules							X											

ROV - NR-1								X										
ROV - Phantom 300									X									
ROV - Phantom S2	X	X				X			X									
ROV - RCV-150											X							
ROV - Tiburon			X		X					X								
ROV - Ventana										X								
Submersible - Alvin							X	X	X	X		X						
Submersible - Clelia								X										
Submersible - Delta		X	X					X	X	X								
Submersible - Johnson Sea Link I							X	X	X									
Submersible - Johnson Sea Link II							X	X	X									
Submersible - NR-1												X						
Submersible - Pisces IV							X				X							
Submersible - Pisces V							X				X							
Technical SCUBA Diving	X							X	X									
Towed Camera Sled		X																
Multibeam Sonar							X											
Side Scan Sonar							X											

Appendix B. Table 1. List of Deep Coral Communities Team members and contact information.

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Appendix C. Table 1. Contributors of NOAA Deep Coral Communities Profiles.

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Frank Parrish	NMFS/PIFSC	808-983-5391	frank.parrish@noaa.gov

Appendix D. Table 1. References from NOAA Deep Coral Communities Profiles.

References	Web Sites
<p>OAR- Office of Ocean Exploration</p> <ul style="list-style-type: none"> Discovering Earth's Final Frontier: A U.S. Strategy for Ocean Exploration Integrated Ocean Mapping Actionable Plan 	<p>http://oceanexplorer.noaa.gov</p>
<p>OAR – NURP – Caribbean Marine Research Center</p>	<p>www.cmrc.org</p>
<p>OAR – NURP – NURC – UNCW</p> <ul style="list-style-type: none"> Brooke, S. and C.M. Young (2003) Reproductive ecology of a deep-water scleractinian coral, <i>Oculina varicosa</i>, from the southeast Florida shelf. Continental Shelf Research 23: 847-858. Koenig, C.C., A.N. Shepard, J.K. Reed, F.C. Coleman, S.D. Brooke, J. Brusher, and K. Scanlon (2004) Habitat and fish populations in the deep-sea <i>Oculina</i> coral ecosystem of the Western Atlantic. Benthic Habitat American Fishery Society Meeting, Special Publication. Manning, C.B. 2003. Use of Geographic Information System to Document and Assess Change in a Marine Protected Area. Masters thesis, University of North Carolina at Wilmington, Wilmington, NC. Reed, J.K., A.N. Shepard, K. Scanlon, C. Koenig, and G. Gilmore. (2004, in press). Mapping and Habitat Characterization of the Deep-water <i>Oculina</i> Coral Reef Marine Protected Area: Past and Present. Proceedings of the Second Annual International Symposium on Deep Sea Corals, Erlangen, Germany. Young, C.M., D.L. Manahan, P. Leong, A. Metaxas, and E. Vazquez. (In Press) Larval energetics, behavior and dispersal potential of a cold-seep vestimentiferan, <i>Lamellibrachia sp.</i> Biol. Bull. 	<p>www.uncw.edu/nurc</p>
<p>OAR – NURP – West Coast & Polar Regions Undersea Research Center</p> <ul style="list-style-type: none"> Web site with background on deep-water coral issues in Alaskan waters Two web sites with additional information on the NURP-funded central Aleutian project described above (Stone et al.) 	<p>http://www.afsc.noaa.gov/abl/MarFish/coral.htm</p> <p>http://www.afsc.noaa.gov/abl/MarFish/coralscruise.htm</p> <p>http://www.alaskascienceoutreach.com/index.php/coral</p>
<p>OAR – NURP - Hawaii Undersea Research Lab</p>	<p>http://www.soest.hawaii.edu/HURL/</p> <p>http://oceanexplorer.noaa.gov</p> <p>http://oceanexplorer.noaa.gov/explorations/03nwhi/welcome.html</p> <p>http://oceanexplorer.noaa.gov/explorations/02hawaii/welcome.html</p>
<p>OAR – NURP – NURC North Atlantic & Great Lakes</p> <ul style="list-style-type: none"> Auster, P.J. In press. Are deep-water corals important habitats for fishes? In: A. Freiwald and J.M. Roberts (eds.) Deep-water Corals and 	<p>www.nurc.uconn.edu</p>

<p>Ecosystems, Springer, New York.</p> <ul style="list-style-type: none"> • Watling, L. and P.J. Auster. In press. Distribution of deepwater alcyonacea off the northeast coast of the United States. In: A. Freiwald and J.M. Roberts (eds.) Deep-water Corals and Ecosystems, Springer, NY. • Auster, P.J., J. Moore, K. Heinonen, and L. Watling. In press. A habitat classification scheme for seamount landscapes: assessing the functional role of deepwater corals as fish habitat. In: A. Freiwald and J.M. Roberts (eds.) Deep-water Corals and Ecosystems, Springer, New York. • ICES. 2004. Report of the study group on cold-water corals (SGCOR). International Council for Exploration of the Seas, Advisory Committee on Ecosystems, ICES CM 2004/ACE:07 Ref. E. (contributor with 11 other authors). • Watling, L. and P. Auster. 2003. A preliminary summary of the distribution, status, and ecological role of deep-water corals off the northeast coast of the United States. White Paper for the New England Fishery Management Council. • Watling, L., P. Auster, I. Babb, C. Skinder, and B. Hecker. 2003. A Geographic Database of Deepwater Alcyonaceans of the Northeastern U.S. Continental Shelf and Slope. Version 1.0 CD-ROM. National Undersea Research Center, University of Connecticut, Groton. 	
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<p>NMSP - Flower Garden National Marine Sanctuary</p> <ul style="list-style-type: none"> • Flower Garden Banks NMS research plan • FGBNMS Deepwater Fish Habitat Cruise Workbooks 	http://walrus.wr.usgs.gov/pacmaps/wg-index.html
<p>NMSP - Gulf of Farallones National Marine Sanctuary</p> <ul style="list-style-type: none"> • The Joint Management Plan 	http://www.sanctuaries.noaa.gov/jointplan/welcome.html
<p>NMSP - Olympic Coast National Marine Sanctuary</p> <ul style="list-style-type: none"> • Bowlby, E., M.S. Brancato and J. Hyland. Exploration for Deep Sea Coral & Sponge Communities in the Olympic Coast National Marine Sanctuary. 2005 funding proposal submitted to NOAA's Office of Ocean Exploration. • Bowlby, C.E. 2004. Preliminary report on deep-sea coral and sponge survey results off the Washington coast. Presentation to the Olympic 	http://olympiccoast.noaa.gov/

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NMSP - Gray's Reef National Marine Sanctuary	http://graysreef.noaa.gov/
NOAA Fisheries- Northeast Fisheries Science Center	www.nefsc.noaa.gov
NOAA Fisheries- Southeast Fisheries Science Center	www.sefsc.noaa.gov
NOAA Fisheries- Northwest Fisheries Science Center	www.nwfsc.noaa.gov
NOAA Fisheries- Southwest Fisheries Science Center	www.swfsc.noaa.gov
NOAA Fisheries- Pacific Islands Fisheries Science Center	www.pifsc.noaa.gov

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Appendix E. Table 1. Federal Government partners listed in Deep Coral Communities Profiles.

	Ocean Exploration	Flower Garden Banks NMS	Cordell Bank NMS	Gulf of Farallones NMS	Gray's Reef NMS	Monterey Bay NMS	Olympic Coast NMS	NURP CMRC	NURP NURC - UNCW	NURP WCPURC	NURP HURL	NURP NURC NA & GL	NOAA Fisheries: NEFSC	NOAA Fisheries: SEFSC	NOAA Fisheries: NWFSC	NOAA Fisheries: SWFSC	NOAA Fisheries: AKFSC	NOAA Fisheries: PIFSC
Federal Govt. External Partners																		
NASA/United Space Alliance	X	X																
U.S. Geological Survey (USGS)	X		X	X					X			X						
U.S. National Park Service				X														
Naval Facilities Engineering Service Center							X											
South Atlantic Fisheries Management Council									X									
Western Pacific Fisheries Management Council											X							
U.S. Navy (USN)	X											X						
Minerals Management Service	X								X									
National Institute for Science and Technology									X									
Pacific Island Benthic Habitat Mapping Program											X							

Appendix E. Table 2. State Government partners listed in Deep Coral Communities Profiles.

	Ocean Exploration	Flower Garden Banks NMS	Cordell Bank NMS	Gulf of Farallones NMS	Gray's Reef NMS	Monterey Bay NMS	Olympic Coast NMS	NURP CMRC	NURP NURC - UNCW	NURP WCPURC	NURP HURL	NURP NURC NA & GL	NOAA Fisheries: NEFSC	NOAA Fisheries: SEFSC	NOAA Fisheries: NWFSC	NOAA Fisheries: SWFSC	NOAA Fisheries: AKFSC	NOAA Fisheries: PIFSC
State Govt. Partners																		
South Carolina Department of Natural Resources					X													
Alaska Department of Fish & Game										X		X						
State of Hawai'i Dept. of Land and Natural Res											X							

Appendix E. Table 3. Private organization and contractor partners listed in Deep Coral Communities Profiles.

Private organization and contractor partners	Ocean Exploration	Flower Garden Banks NMS	Cordell Bank NMS	Gulf of Farallones NMS	Gray's Reef NMS	Monterey Bay NMS	Olympic Coast NMS	NURP CMRC	NURP NURC - UNCW	NURP WCPRURC	NURP HURL	NURP NURC NA & GL	NOAA Fisheries: NEFSC	NOAA Fisheries: SEFSC	NOAA Fisheries: NWFSC	NOAA Fisheries: SWFSC	NOAA Fisheries: AKFSC	NOAA Fisheries: PIFSC
Private Organizations																		
Monterey Bay Aquarium						X												
British Broadcasting Corporation						X												
Contractors																		
Delta Oceanographics			X				X	X										
Canadian Scientific Submersible Facility							X											

Appendix E. Table 4. Institution and University partners listed in Deep Coral Communities Profiles.

Institution and University External Partners	Ocean Exploration	Flower Garden Banks NMS	Cordell Bank NMS	Gulf of Farallones NMS	Gray's Reef NMS	Monterey Bay NMS	Olympic Coast NMS	NURP CMRC	NURP NURC - UNCW	NURP WCPURC	NURP HURL	NURP NURC NA & GL	NOAA Fisheries: NEFSC	NOAA Fisheries: SEFSC	NOAA Fisheries: NWFSC	NOAA Fisheries: SWFSC	NOAA Fisheries: AKFSC	NOAA Fisheries: PIFSC
Institutions																		
Smithsonian Institute		X				X			X									
Moss Landing Marine Lab.			X			X				X								
Woods Hole Oceanographic Institute						X				X		X						
Monterey Bay Research Institute						X												
Chesapeake Biological Lab (Univ. of Maryland)						X												
Harbor Branch Oceanographic Institution								X	X									
Hawaii Mapping Research Group											X							
Universities																		
University of Texas A & M		X																
University of New Hampshire		X							X									
University of California, Davis			X															
University of California				X														
San Francisco State University				X														
Savannah State University					X													
California Academy of Science		X				X												
Florida State University									X									
University of Southern Mississippi									X									
Louisiana State University									X									
Penn State University									X									
University of Hawaii	X										X							
University of Maine												X						
University of Louisiana, Lafayette												X						
Florida Atlantic University												X						
University of South Florida												X						
University of Washington	X																	

Appendix F. Template and Instructions:

This appendix depicts the template used by the Deep Coral Communities Team to collect information on NOAA deep coral communities activities, as well as instructions provided to personnel responsible for completing the forms. For a digital copy of the template, contact:

Timothy Birdsong
NOAA Office of Ocean Exploration
Phone: 301-713-9444 x120
E-mail: timothy.birdsong@noaa.gov

Appendix F. Figure 1. The Deep Coral Communities Profile Template.

NOAA Deep Coral Communities Research Profiles Template

CONTACT INFORMATION

Name:

Affiliation:

Mailing Address:

Phone:

E-mail address:

RESEARCH INFORMATION

Region(s) of Interest:

Major Research Interests:

Recent Deep-Sea Coral Research Projects (FY 2003-2004):

Upcoming Deep-Sea Coral Research Projects (FY 2005-2006):

Long-term Research Plans:

Major Equipment and Facilities:

NOAA Partners:

External Partners:

References:

APPENDIX F. Figure 2. Instructions for completing a Deep Coral Communities Profile.

NOAA Deep Coral Communities Research Profiles

Definition of Terms and Instructions

This document provides definitions of the terms used in the NOAA Deep Coral Communities Activities Document. The objective is to describe NOAA deep coral communities research efforts in a concise, consistent manner. The information compiled will be organized in a document to present to NOAA Senior program managers and others interested in deep coral communities research and management.

Contact Information: Provide contact information for the primary point of contact within the program who is most knowledgeable about deep coral communities research activities and priorities.

Region(s) of Interest: Identify primary regions where the deep coral communities research is conducted (i.e., South Atlantic Bight), as well as any pertinent place names such as "Bear Seamount".

Major Research Interests: Draft 1-2 paragraphs that provide an overview of the program office's deep coral communities research activities and the purpose. Specify the focus of the research, i.e., biology, ecology, habitat characterization, geology, oceanography, anthropogenic impact assessment, climate change, etc.

Recent Deep Coral Communities Research Projects (FY 2003-2004): Provide a short paragraph on each, briefly describing the objectives, as well as any products or deliverables that were generated (reports, Web sites, maps, databases, GIS, etc.).

Upcoming Deep Coral Communities Research Projects (FY 2005-2006): Provide a short paragraph on each, briefly describing the objectives, as well as any products or deliverables that the program plans on generating (reports, Web sites, maps, databases, GIS, etc.).

Long-term Research Plans: Provide a short description of any long-term plans for continuing deep coral communities research. Specify any critical information needs (i.e., mapping specific features, defining the ecology of specific areas, etc.)

Major Equipment and Facilities: Provide a bulleted list of any equipment that the program office uses, or plans to use. Include vessels, ROVs, HOVs, UUVs, underwater camera systems, laboratories, etc. Focus on equipment that the program typically has access to, not desired equipment.

NOAA Partners: Provide a bulleted list of no more than 10 NOAA program offices that are critical partners for conducting the deep coral communities research, as well as developing products and deliverables.

External Partners: Provide a bulleted list of no more than 10 external institutions that are critical partners for conducting the deep coral communities research, as well as developing products and deliverables.

References: Provide a list of any relevant plans that drive the deep coral communities research efforts (titles of the plans suffice), as well as any relevant Web sites where additional information on the efforts can be found – provide a specific link.
