

**NOAA'S DEEP-SEA CORAL
FY2011 SCIENCE PLAN
FOR THE
U.S. WEST COAST**

OVERVIEW

The marine region off the coast of Washington, Oregon and California accounts for about 7% (778,628 km²) of the total area of the United States (US) Exclusive Economic Zone (EEZ) and contains extensive deep-sea coral and sponge communities. NOAA has stewardship responsibilities within the EEZ to manage and protect all living resources. NOAA also manages five National Marine Sanctuaries (NMS) on the West Coast: the Channel Islands (CINMS), Monterey Bay (MBNMS), Gulf of the Farallones (GFNMS), Cordell Bank (CBNMS), and Olympic Coast (OCNMS). All contain deep-sea corals.

NOAA's Coral Reef Conservation Program (CRCP) is charged with coordinating the implementation of deep-sea coral activities, which is primarily authorized by the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (U.S.C. 1801 *et seq.*). The MSA was reauthorized in 2006 and it included a new requirement to establish a "Deep-Sea Coral Research and Technology Program" (DSCRTP; MSA Section 408) and authorized Fishery Management Plan discretionary provisions (Sec. 303(b)(2))(Annex 1). The CRCP also integrates a variety of other NOAA mandates for science and management action related to deep-sea coral including other provisions of the MSA and the National Marine Sanctuaries Act (NMSA).

In Fiscal Year (FY) 2010, NOAA expanded deep-sea coral and sponge field research activities to include the US West Coast. The new three-year field research activities are led by a NOAA cross-line office team consisting of the National Marine Fisheries Service (NMFS); the National Ocean Service (NOS); the Office of Oceanic and Atmospheric Research (OAR); and coordinated with multiple NOAA programs and academia.

In year one, FY2010 activities included: 1) a study of biology and ecology of Christmas tree black corals (*Antipathes dendrochristos*) on a deep offshore bank in the southern California Bight; 2) a project to map the extent of deep water sponge reefs near Gray's Harbor, Washington; and, 3) surveys of deep-sea corals and sponges around the OCNMS, CBNMS, GFNMS, and CINMS. A summary of the accomplishments are appended to this plan (Appendix A).

In year two, FY2011 some field activities will focus on contributing data to the Pacific Fishery Management Council (PFMC) five-year review process of groundfish Essential Fish Habitat (EFH) areas while others will contribute to our basic understanding of deep-sea coral ecosystems. The projects for FY2011 are as follows: 1) multibeam mapping of deep-sea coral

habitats in and adjacent to OCNMS and a Remotely Operated Vehicle (ROV) survey of deep-sea corals at priority sites in and adjacent to OCNMS that are subject to pending EFH considerations; 2) multibeam mapping of deep-sea coral habitats in GFNMS (Rittenburg Bank and Farallon Escarpment); 3) an Autonomous Underwater Vehicle (AUV) survey of deep-sea coral habitats in Bodega Canyon near CBNMS; 4) an international collaboration with Canada's Department of Fisheries and Oceans (DFO) to survey deep-sea coral habitats with an AUV and ROV on Bowie and Cobb Seamounts; and 5) initiation of a competitive peer review process in partnership with West Coast and Polar Regions Undersea Research Center (WCPR) to fund targeted one-year research projects in FY2012.

FY11 CRUISE PLANS

Field activities for FY2011 will include four research cruises. The first cruise will take place aboard the Oregon State University (OSU) *Pacific Storm* in July and August and will consist of two legs devoted to multibeam mapping of deep-sea coral habitats in and adjacent to OCNMS and a ROV survey of targeted deep-sea coral sites in OCNMS. The *Pacific Storm* cruise will be led by a combination of researchers from OSU, OCNMS, the National Centers for Coastal and Ocean Sciences (NCCOS), Southwest Fisheries Science Center (SWFSC) and Washington State University (WSU). During the second cruise, GFNMS and the United States Geological Survey (USGS) will collaborate on sonar mapping of Rittenburg Bank and the Farallon Escarpment aboard the NOAA ship *Fulmar*. The third cruise is a joint effort between the Northwest Fisheries Science Center (NWFSC) and CBNMS to do a broad-scale characterization of deep-sea coral and sponge habitats in Bodega Canyon during early fall using still photo observations from an AUV. Lastly, the fourth cruise in the summer is a collaborative effort led by Canada's DFO in partnership with Alaska Fisheries Science Center (AFSC) and NWFSC to assess the abundance, distribution, and habitat associations of deep-sea coral and sponges at two seamounts, Bowie and Cobb.

CRUISE 1: OCNMS Multibeam and ROV Surveys

Introduction

Deep-sea coral research in OCNMS is focused on a West Coast groundfish EFH area named Olympic 2 Conservation Area (Figure 1). The establishment of this 160 square nautical mile Conservation Area in 2006 was based partially on deep-sea coral observations. A proposed boundary expansion of the Conservation Area encompasses approximately 256 square nautical miles adjacent to the Juan de Fuca Canyon (depth 100-350 meters) and includes additional deep-sea coral and sponge habitats that were revealed in earlier surveys. Olympic 2 Conservation Area and areas adjacent to the Juan de Fuca Canyon were selected for ROV surveys and mapping because they comprise one of three areas that have been proposed for EFH modifications (including a change in gear restrictions within the Conservation Area itself) during PFMC's

interim review of West Coast groundfish EFH. The expansion area has not been previously acoustically mapped nor surveyed visually in a comprehensive manner to quantitatively assess the abundance and distribution of deep-sea coral and sponge habitats. Any new information on the locations, densities, and condition of deep-sea corals and their potential role as EFH within the existing and proposed boundaries of the Olympic 2 Conservation Areas will assist in filling scientific data gaps and inform pending management considerations via provisions of MSA and/or NMSA.

OCNMS FY11 CRCP Multibeam & ROV Survey Map

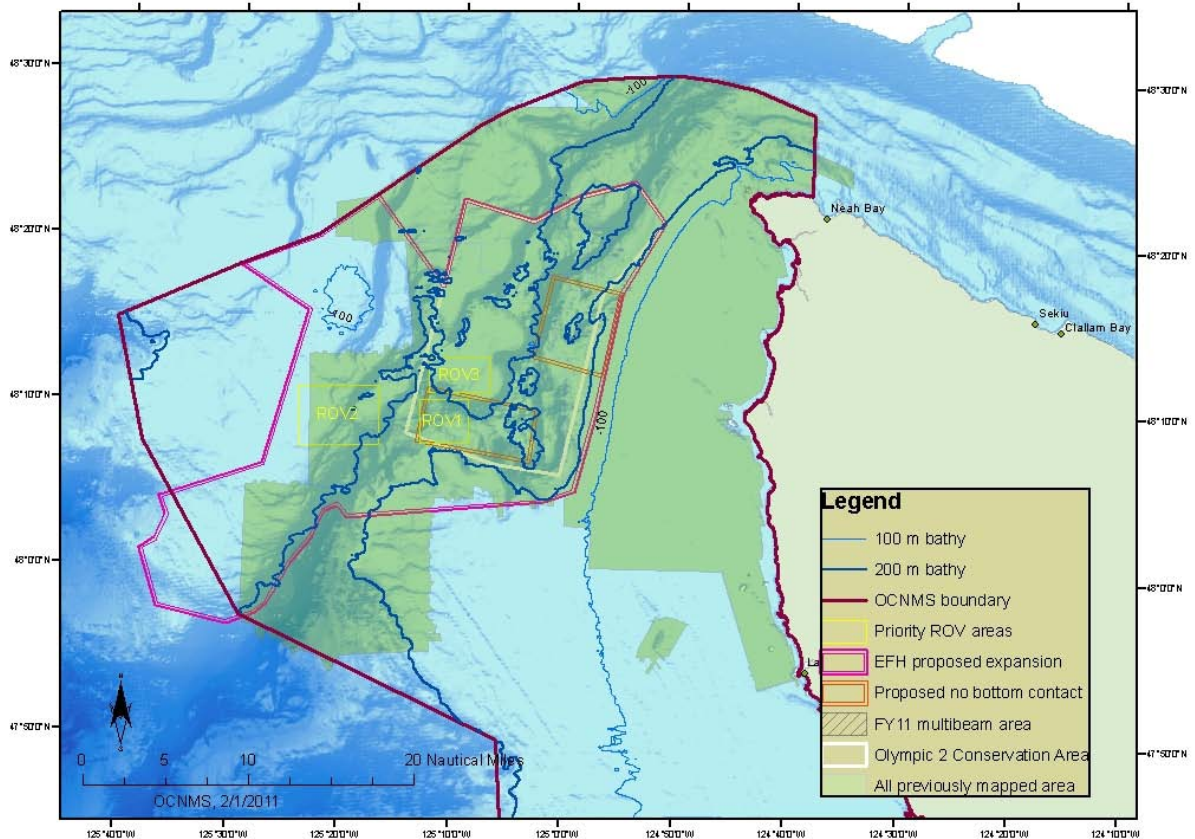


Figure 1: A map of Olympic 2 Conservation Area and proposed expansion area within the boundaries of Olympic Coast National Marine Sanctuary with target areas for ROV surveys.

The objectives of the project are two-fold and defined by the primary survey technologies used: multibeam and ROV. For the multibeam portion of the cruise (Leg 1) the objectives are as follows: 1) conduct multibeam mapping of areas west of the Juan de Fuca Canyon; 2) produce high resolution maps of bathymetry and backscatter; 3) characterize key features of surveyed substrates such as complexity, hardness, rugosity, and slope; and, 4) identify high-confidence targets for visual surveys of deep-sea coral and sponges in areas adjacent to the Juan de Fuca Canyon. For the ROV portion of the cruise (Leg 2) the objectives are as follows: 1) assess the abundance and distribution of deep-sea coral and sponge habitats within an area of Olympic 2

Conservation Area proposed for boundary expansion or zoned to exclude all bottom contact fishing gear; 2) based on multibeam data visually confirm the presence of deep-sea coral and sponge areas adjacent to Juan de Fuca Canyon; 3) collect information to help understand the value of deep-sea coral as habitat for other associated species, including commercially important fishes and invertebrates, or in providing other important ecosystem functions (e.g., potential reservoirs of biodiversity); and, 4) assess the condition of deep-sea coral assemblages in relation to potential anthropogenic or environmental disturbances.

Earlier research surveys and bycatch in bottom trawl fisheries in areas near the Juan de Fuca Canyon indicate the presence of some deep-sea corals and sponges. Mapping the seafloor of this area with multibeam sonar (Figure 2) during Leg 1 is a first step towards confirming likelihood of deep-sea coral habitat (e.g., hard substrate). Map products from acoustic surveys of the benthos will assist with identification of areas to be visually surveyed (e.g. ROV) to ground-truth the distribution and abundance of deep-sea coral. The proposed ROV dive targets of Leg 2 are indicated as ROV1, ROV2, and ROV3 in order of priority (Figure 1). The ROV targets were selected based on existing acoustic maps (side-scan and/or multibeam) that indicate some degree of hard substrate and a high likelihood of having deep-sea coral and sponge communities as previously determined from 2004 and 2006 surveys (Hyland et al. 2005; Brancato et al. 2007). These areas were part of the FY2010 Deep-Sea Coral Science Plan for the West Coast, but few targets were surveyed in 2010, because of inclement weather. Two additional targets were subsequently partially surveyed in November 2010 as part of shakedown test for the SWFSC ROV on the NOAA ship *Bell Shimada*. The proposed 2011 ROV fieldwork will attempt to complete the sampling identified as a priority by the planning team in 2010 with the possible addition of new target areas, based on results of the multibeam acoustic mapping of areas near the Juan de Fuca Canyon.

FY11 OCNMS Multibeam Area

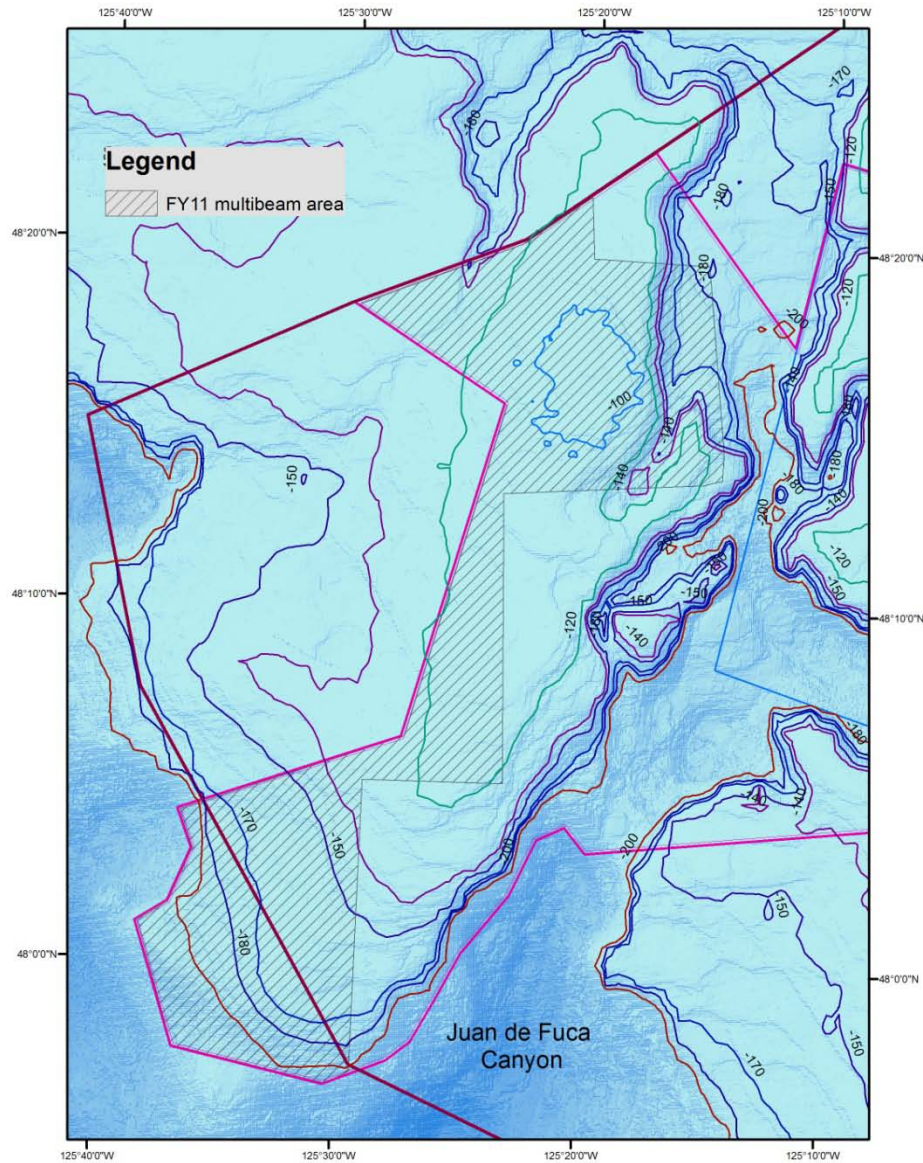


Figure 2. Area west of Juan de Fuca Canyon proposed for multibeam mapping.

Operations

Mobilization and demobilization will occur in Newport, Oregon, the homeport for the *Pacific Storm*. Leg 1 of the cruise includes a multibeam acoustic survey of portions of areas near the Juan de Fuca Canyon. The multibeam survey will begin in July 2011 and will be conducted by OSU researcher Chris Goldfinger and his team, and OCNMS researcher Nancy Wright. The multibeam system will be a Reson 8101 (leased), to be pole mounted to the *Pacific Storm*. The

shiptime requested is 13 days, based on 24-hour operations. The request includes 10 days to survey areas adjacent to the Juan de Fuca Canyon, plus two transit days and one mobilization day. Mobilization, demobilization, and transit time will be shared with several other multibeam projects also utilizing the *Pacific Storm* in the same timeframe in nearby areas of Washington and northern Oregon. Thus providing some cost savings through sharing of equipment, transit times and mobilization costs.

Project roles for Leg 1 are as follows: Chris Goldfinger, OSU, will serve as Chief Scientist and Cruise Leader for the sonar mapping operations and will be the liaison for the *Pacific Storm* operations. Chris Goldfinger and his team in collaboration with Nancy Wright of OCNMS will process the acoustic data and classify habitat types in order to identify likely targets for visual surveys of deep-sea coral and sponge communities during Leg 2.

Leg 2 of the cruise will commence in August 2011, shortly after Leg 1, using the SWFSC's ROV. The ROV survey will be a collaboration of multiple parties, including SWFSC researcher John Butler and his team, OCNMS research coordinator Ed Bowlby and his team, NCCOS researchers Peter Etnoyer and Jeff Hyland, and WSU researchers Brian Tissot and Sean Rooney. ROV operations will consist of quantitative video transects with digital still images of target taxonomy (deep-sea corals, sponges and associated fishes). Environmental data (salinity, temperature, pH, oxygen saturation and depth) will be collected continuously during the surveys and in the water column. Limited voucher specimens of deep-sea corals and sponges will be collected as requested by researchers. The ship time requested is 18 days, based on 12-hour operations. The request includes 12 ROV survey days to targeted areas within OCNMS (Olympic 2 Conservation Area and areas adjacent to the Juan de Fuca Canyon), plus three transit days and three mobilization and demobilization days.

Project roles for Leg 2 are as follows: Ed Bowlby, OCNMS and John Butler SWFSC will serve as the co-Chief Scientists; Butler will serve as Cruise Leader for the ROV operations and Bowlby will serve as liaison for the *Pacific Storm* operations. OCNMS, SWFSC, NCCOS and WSU will process the visual data. The group will work together to meet objectives and compose reports.

Data and Post-processing

PFMC's five-year review process for the expansion of the EFH has recently been initiated with a proposed deadline of November 30, 2011 to receive any new deep-sea coral information for modifying existing West Coast groundfish EFH. Therefore, multibeam and ROV data collected from both legs of this survey will have an expedited processing period of approximately three to four months in order to provide data and reports to inform the PFMC discussions by the proposed deadline.

Multibeam data (topography and backscatter) collected in Leg 1 at depths between 100-350 meters will be processed by Chris Goldfinger and his team with assistance from OCNMS researcher Nancy Wright. Data will be collected using Hypack Survey Software with bathymetry and backscatter processed in CARIS. Final Geographic Information System products will be developed in ESRI ArcMap.

Topography and backscatter data from Leg 1 will be processed in 10 meter resolution and interpreted to maps of seafloor character with classes for hardness, slope, depth, and rugosity. Areas of hard substrate that have potential for deep-sea coral development will be identified and reported to the ROV team for Leg 2 of the OCNMS survey for possible investigation. Digital copies of the final maps will be produced and made available through the OCNMS web site and the Pacific Coast Ocean Observing System Data Web Portal upon completion of the survey and development of Federal Geographic Data Committee metadata.

During Leg 2, the ROV will be used to conduct quantitative video surveys over predetermined track lines at priority sites, generally operating at depths between 150-350 meters. The ROV survey will follow scientific protocols previously established by OCNMS, NCCOS (Hyland et al. 2005; Brancato et al. 2007) and WSU (Tissot 2008). Limited sampling of portions of deep-sea coral colonies will occur to confirm taxonomic identification, genetics, and for use in aging studies. Post-processing of video records will characterize distribution and abundance of deep-sea coral across substratum types, depths and to determine species associations. Since there will be no nighttime ROV surveys during this portion of the cruise, the nighttime focus will be on beginning post-processing of video data collected during the day, including species identification, analysis of track length and field of view in order to meet the November EFH process deadline. At the conclusion of Leg 2, there will be an expedited post-processing of remaining video data divided among OCNMS, SWFSC, NCCOS, and WSU.

Results from the ROV survey will feed directly into the November 2011 deadline for the PFMC groundfish EFH five-year review process. A site characterization will be produced with the following: 1) quantitative observations of deep-sea corals and sponges as frequency, relative size, and micro habitat characterization and distribution areas depicted with appropriate figures and tables; 2) a species density index that shows differences in composition among the sites surveyed; 3) observations of anthropogenic disturbance (e.g. presence of fishing gear); and, 4) graphs of temperature, oxygen and salinity from the CTD data. The site characterization report will also be submitted to the CRCP.

CRUISE 2: Rittenburg Bank and Farallon Escarpment Multibeam Surveys

Introduction

A priority for deep-sea coral research in north-central California for FY2011 is multibeam mapping of two features within the GFNMS: 1) a 25 square kilometer bedrock outcrop on the continental shelf called Rittenburg Bank (RB in Figure 1, depth 50-150 meters), and 2) a large steep feature (300 square kilometers) on the continental slope referred to as the Farallon Escarpment (Figure 3, depth 150-1000 meters). Both features have depth profiles and geological history consistent with known nearby deep-sea coral aggregations. This project is a collaboration of GFNMS, USGS, and NCCOS.

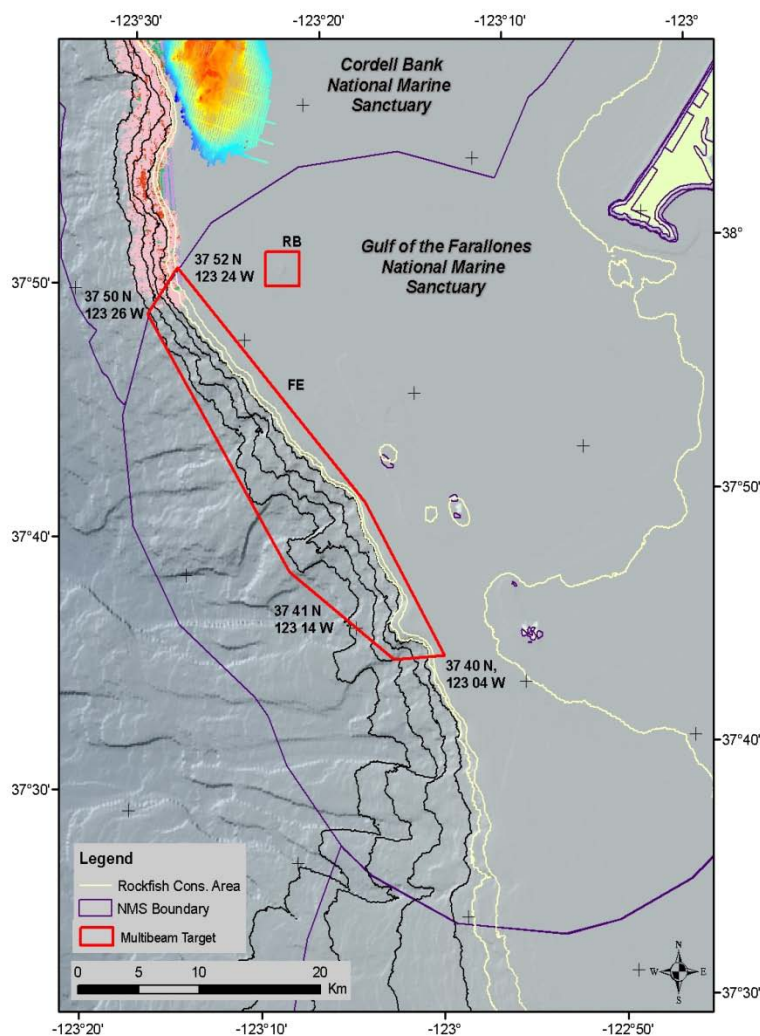


Figure 3. Target features for multibeam mapping in the Gulf of the Farallones National Marine Sanctuary.

The objectives of this project are as follows: 1) conduct multibeam mapping of Rittenburg Bank (50-150 meters) and the Farallon Escarpment (150-1000 meters); 2) produce high-resolution maps of depth, hardness, slope, and rugosity; and, 3) identify high-confidence targets for visual surveys of deep-sea coral and sponges.

Rittenburg Bank was selected as a priority for mapping because it is currently not identified as EFH but is likely to host deep-sea coral and sponges. Towed camera sled observations since 2004 identified substrate and habitat similar to Cordell Bank, 15 kilometers to the north where many species of deep-sea corals and sponges have been documented. Deep-sea corals are expected to occur on Rittenburg Bank, which may have been impacted by bottom contact gear. Since 1981 bottom contact commercial fishing for Dungeness crab, halibut, slope and shelf rockfish, and flatfish has occurred in the area. This fishing activity may warrant consideration as EFH, but more information is needed. The Farallon Escarpment is proposed as a primary target because the depth profile (150-1000 meters) is consistent with the depth range of known deep-sea coral and sponges in the region, and deep-sea corals have been reported as bycatch in trawl surveys from the Escarpment. The Escarpment is also not currently identified as EFH. Mapping these features will be a first step towards reconnaissance of this area. Once map products from this project can be analyzed visual surveys can be planned for the future if warranted.

Operations

The primary tool for mapping is the USGS Reson 7111 aboard NOAA ship *Fulmar*. The ship time requested is 19 days, based on 12-hour operations. The request includes two days to survey Rittenburg Bank and 12 days to survey Farallon Escarpment, plus two transit days from *Fulmar's* homeport, and three mobilization and demobilization days. For mapping operations, the Reson 7111 would be pole-mounted on the *Fulmar*, running overlapping parallel acoustic line transects at a speed of 6 knots.

Project roles are as follows: Jan Roletto, GFNMS and Guy Cochrane, USGS, will serve as co-Chief Scientists. Cochrane will also serve as the Cruise Leader for sonar mapping operations and will be the liaison for *Fulmar* operations; Peter Etnoyer, NCCOS, will assist with post-processing and habitat classification in order to identify targets for visual surveys of deep-sea corals.

Data and Post-processing

The data to be collected is Reson 7111 multibeam echosounder data (in decibels) interpreted into intermediate resolution (10-20 meters) grids of depth (topography) and acoustic reflectance (backscatter) for the instruments effective range, from about 50-800 meters depth. Maps products will be 10-20 meters resolution multibeam topography and backscatter characterizing the hardness, slope, depth, and rugosity. Data will be calibrated using a sound velocity profile collected at sea by CTD, then cleaned and filtered using CARIS software. Clean data will be

interpreted into habitat classification maps in an unsupervised (automated) mode using ESRI geographic information software. Dive targets will be identified from habitat classification maps through discussion and consultation among project partners, to benefit ground-truthing and deep-sea coral exploration efforts. Fly-through visualizations will be produced for outreach and education purposes using multibeam data in the high-quality rendering environment provided by Fledermaus 3D software. Fly-through videos will be output as .mov and .avi files for viewing and sharing on Mac and Windows computers.

Cruise 3: Bodega Canyon AUV Characterization

Introduction

A broad-scale characterization of deep-sea coral and sponge habitats will be conducted in Bodega Canyon during early fall 2011 using still photo observations from an AUV. This project will be a joint effort between NWFSC and CBNMS. The overall goal of this study is to provide information on this unexplored canyon system to compare with other well-studied canyons in the region (Figure 4). The area is currently open to trawling; however, fishing effort data suggest that it is an area of lower trawl intensity and may provide a good contrast to those areas with high trawling intensity. Bodega Canyon is outside the existing boundary of CBNMS, but is included in the area proposed for Sanctuary expansion. Information on the habitats and associated communities could assist in the evaluation of these areas for protection as EFH Conservation Areas or by an expansion of the NMS.

Currently, there is high-resolution multibeam data of this region from the NOAA ship *Okeanos Explorer* survey in 2009. Target locations have been identified from this data and will include areas with the highest likelihood to harbor deep-sea corals (Figure 5). Data collected will also include a range of habitat types to acquire contrast and provide ground-truthing for the development of habitat maps. The objectives for this work is as follows: 1) assess the abundance, distribution, and habitat associations of deep-sea corals and sponges, as well as associated fish and invertebrates, over a broad region of the Canyon; 2) understand environmental factors (e.g., depth, substratum, bottom topography, and water properties) that influence deep-sea coral and sponge distribution; and, 3) gather information to help understand the value of deep-sea corals and sponges as habitat for fish and other associated species. In addition, data from still images will be used to groundtruth the multibeam data and provide information for proposed future studies focused on detailed ROV work, including collections.

Operations

The AUV operations will be conducted using the NWFSC AUV Seabed *Lucille* and associated cameras. Images of the seafloor will be collected using high-resolution downward looking and forward angled cameras. The AUV will survey at a height of three meters from the bottom. Initial scanning of the images to assess habitat and biota will be conducted prior to the next day's

Cordell Bank NMS 2011 Deep Sea Coral Dive Target - Bodega Canyon

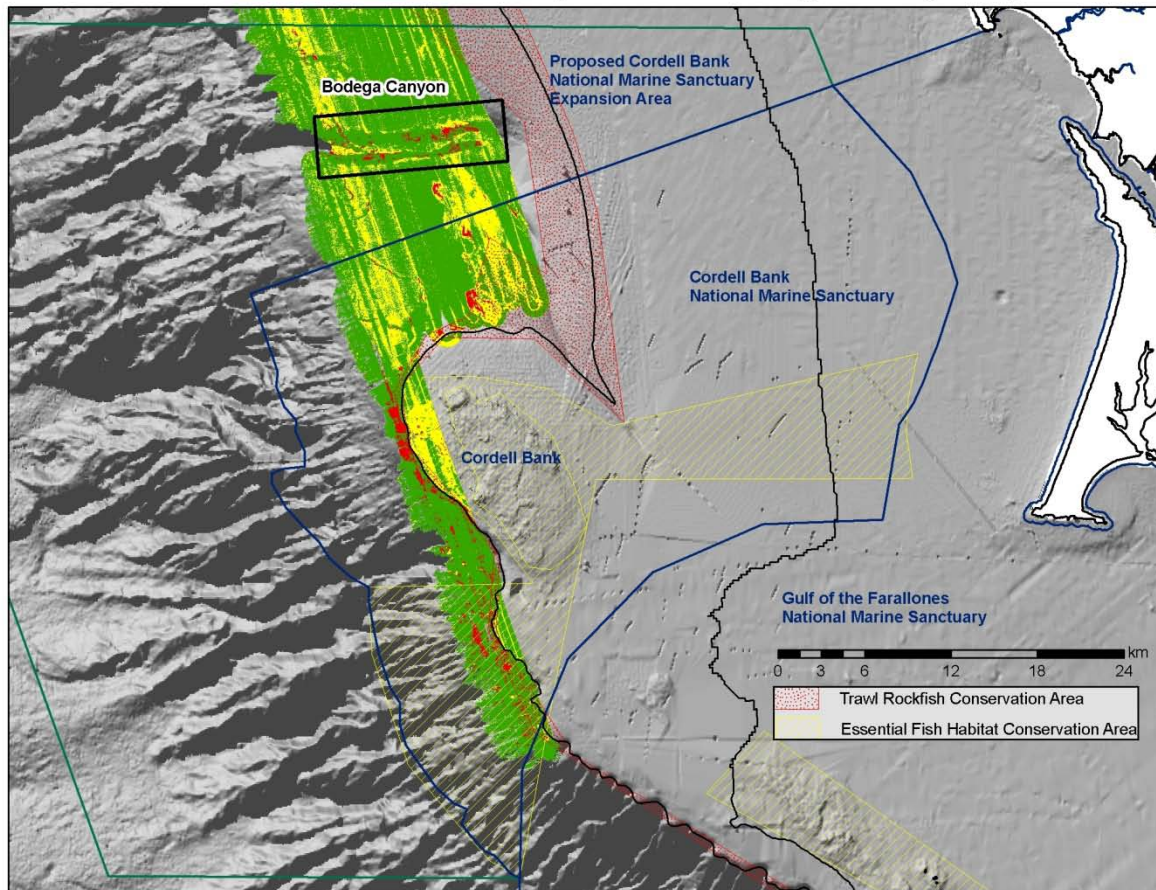


Figure 4. Location of Bodega Canyon north of Cordell Bank National Marine Sanctuary.

operation, thus providing the potential to alter target locations. Images will be downloaded at the end of each mission and color corrected. Digital stills will be reviewed following the cruise and deep-sea corals and sponges will be identified, counted and measured. Using sensors attached to the AUV, data will also be collected on salinity and temperature of the seafloor environment. Profiles of the water column will also be made with a CTD (salinity, temperature, fluorescence, and dissolved oxygen) to characterize the oceanographic conditions of the Canyon system. The project will be conducted on NOAA ship *Fulmar* over six survey days (a total of 12 vessel days for mobilization and demobilization, transit, and weather).

Project roles for Cruise 3 are as follows: Lisa Etherington and Elizabeth Clarke will serve as co-Chief Scientists. Clarke will operate the AUV and provide initial image and data analysis. Etherington and CBNMS staff will provide secondary report writing, maps, and documentation.

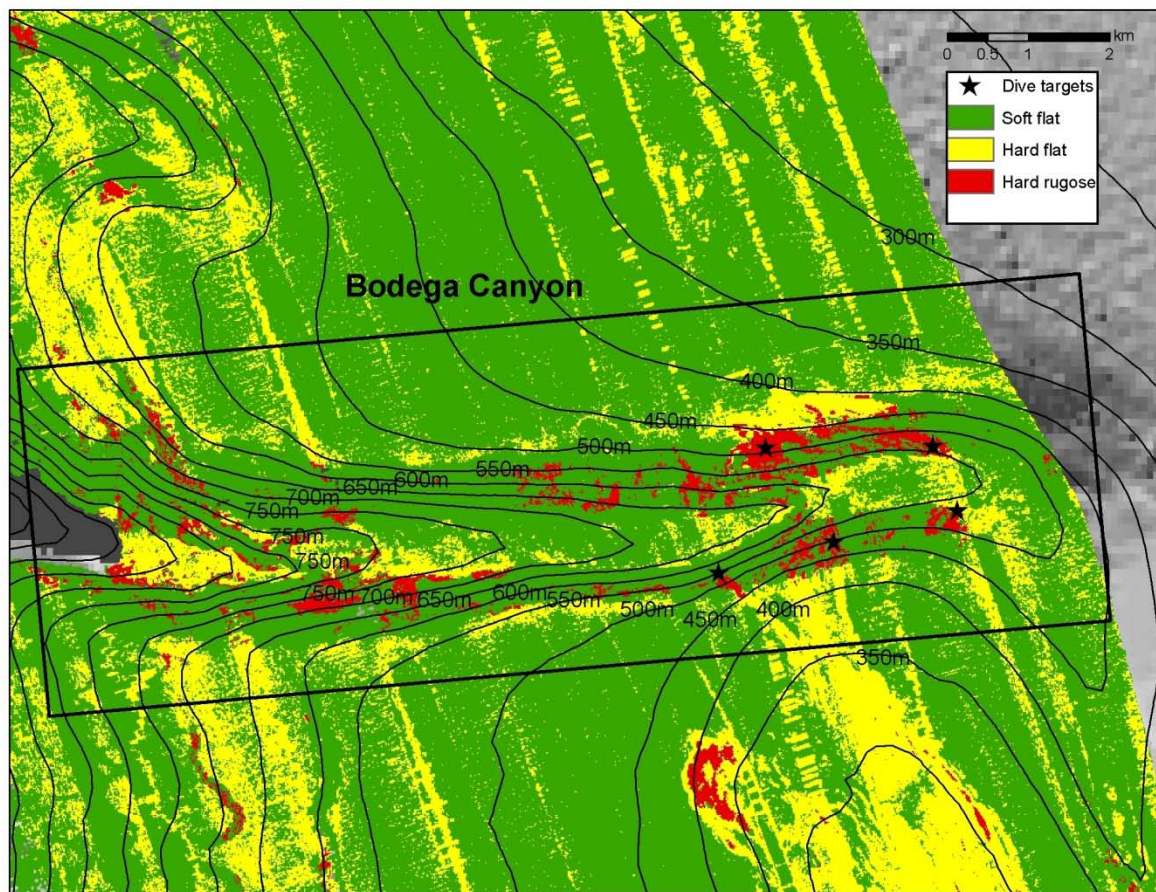


Figure 5. Multibeam mapping data and proposed AUV dive targets in Bodega Canyon.

Data and Post-processing

Still photos collected by the AUV will be processed to provide data at the highest possible taxonomic resolution for deep-sea corals, sponges, and fishes, focusing initially on sponges and deep-sea corals in order to meet the deadline imposed by the EFH five-year review process. Image analysis software will be used to quantify biological observations (identify, count, and measure), as well as identify substrate composition. Still images will be sub-sampled along the AUV transects to describe patterns of animal density by habitat type (i.e. depth and habitat). Data will be stored in a standardized database as well as GIS layers. A data report will be produced that summarizes information on the dive sites, including a descriptive site overview, an image gallery of representative images, and a description of the physical and biological environment. Data will be combined with other research efforts to produce more comprehensive analyses of deep-sea coral and sponge communities and habitat associations on the West Coast of North America.

CRUISE 4: Bowie and Cobb Seamounts, an International Collaboration

Introduction

Studying deep-sea corals and sponges of Bowie and Cobb Seamount is collaboration among the AFSC, NWFSC, and Canada's DFO. While it is a high priority of the West Coast Deep-Sea Coral Program to focus on data needs for the EFH Review for West Coast groundfish there is also a continuing need to address international mandates to protect deep-sea corals. As outlined in the Report to Congress on the Implementation of Deep Sea Coral Research and Technology Program in addition to domestic activities, NOAA should continue to work with international partners to understand and protect vulnerable ecosystems such as deep-sea coral and sponge ecosystems. This collaborative effort will study deep-sea coral and sponge communities on Bowie and Cobb Seamounts during July and August 2011.

Two dominant seamount chains are present within the Gulf of Alaska Seamount Province: the Kodiak-Bowie seamount chain and the Cobb seamount chain. Bowie Seamount is a large submarine volcano in the northeastern Pacific Ocean, located 180 kilometers (110 miles) west of the Queen Charlotte Islands, British Columbia, Canada. Cobb Seamount is located 500 kilometers (310 miles) west of Grays Harbor, Washington, United States. Both of these seamounts have base depths of 3,000 meters and rise to the shallowest depths of any seamounts in the region, approximately 34 meters from the surface (Chaytor et al 2007). While neither of the seamounts has been extensively studied and both have been described as having abundant rockfish, as well benthic invertebrate fauna, this project provides a unique opportunity to collaborate with international partners facing similar issues for deep-sea coral conservation. Both seamounts have occasionally faced some fishing pressures however their relatively remote locations have protected them from intensive fishing pressures and may provide examples of relatively pristine deep-sea coral communities.

In 1992, NOAA sponsored a study on Cobb Seamount and concluded that concerns for overfishing at the seamount have some merit since Cobb lies outside of the US EEZ and US fishing vessels are not regulated. Bowie Seamount is within the Canadian EEZ and was designated in 2008 as Canada's seventh marine protected area due to its rich and unique nature, as well as its vulnerability to future over exploitation.

The objectives of this joint project are to survey tops and slopes of Bowie and Cobb Seamounts to depths of 1,500 meters using an AUV provided by NOAA and ROV and 17 days of shiptime provided by Canada DFO. The project will quantify the distribution of deep-sea corals and sponges via still photos taken by the AUV and video taken by the ROV. The goal of the project is to assess the abundance, distribution, and habitat associations of deep-sea corals and sponges, as well as associated fish and invertebrates and provide the data to inform the international management of these areas.

Operations

Operations will be conducted on the Canadian Coast Guard Vessel *Tulley*. The AUV operations will be conducted using the NWFSC Seabed *Lucille* AUV and associated cameras. Images of the seafloor will be collected using high-resolution downward looking and forward angled cameras. The AUV will survey at a height of three meters from the bottom. Initial scanning of the images to assess habitat and biota will be conducted prior to the next day's operation, thus providing the potential to alter target locations. Images will be downloaded at the end of each mission and color corrected. Digital stills will be reviewed following the cruise and deep-sea corals and sponges will be identified, counted and measured. Using sensors attached to the AUV, data will also be collected on salinity and temperature of the seafloor environment.

Project Roles are as follows: Jim Boutillier of DFO Canada will be Chief Scientist for the cruise and Elizabeth Clarke will be the cruise leader for AUV operations, as well as the lead for the analysis of AUV data.

Data and Post-processing

Still photos collected by the AUV will be processed to provide data at the highest possible taxonomic resolution for deep-sea corals, sponges, and fishes focusing initially on sponges and deep-sea corals. Image analysis software will be used to quantify biological observations (identify, count, and measure), as well as identify substrate composition. Still images will be sub-sampled along the AUV transects to describe patterns of animal density by habitat type (i.e. depth and substrate). Data will be stored in a standardized database. A data report will be produced that summarizes information on the dive sites, including a descriptive site overview, an image gallery of representative images and a description of the physical and biological environment. Data will be combined with other research efforts to produce more comprehensive analyses of deep-sea coral and sponge communities and habitat associations on the West Coast of North America.

Peer Review Process for West Coast

The planning team is initiating a partnership with WCPR to develop a peer-review process for selecting projects for FY2012. In this proposed process, selection will be based on scientific merit, feasibility, relevance to NOAA's mission, CRCP guidance, and the West Coast deep-sea coral priorities. Other criteria include some of the top priorities identified by the West Coast workshop in January 2010: determining the ecological roles of deep-sea corals and sponges, understanding the basic biology of deep-sea corals and sponges, and understanding anthropogenic and natural impacts on deep-sea coral ecosystems. Proposals will be strongly encouraged to involve NOAA and other academic partners, address how data will be disseminated to user communities (e.g., resource managers), and include activities that have broad scientific and societal impact. FY2011 funds will support the cost to run a peer-review

process (i.e. pre-proposals, full proposals, mail reviews, and panel meeting), and a small amount of funds will be set aside at WPCR for FY2012 awards.

OTHER CONSIDERATIONS

Overall Management and Reporting

A cruise report will be produced for each of the four cruises, and will include survey site descriptions, preliminary site maps with survey transects, lists of data collected, collection sites and a timeline for the completion of data analysis to the CRCP. The reports will be submitted to Elizabeth Clarke, the West Coast Science Planning Team Leader and a subsequent overall final report will be produced on combined results for each of the four cruises, including the aforementioned components, as well as quantitative analyses of density, abundance, species richness, and deep-sea coral interactions with various environmental (e.g., depth, substrata), and biotic factors including other associated species (particularly fishes) as appropriate for each cruise. In addition to the final report, data will be presented in peer-reviewed journal articles.

Chief Scientists for each cruise will coordinate any sample collection of deep-sea coral so that genetics, taxonomy, and aging can be completed in a consistent manner. The scientists will provide related samples and information and coordinate collection and reporting efforts. Each Chief Scientist will be responsible for submitting deep-sea coral and sponge samples to appropriate taxonomic experts and resultant taxonomic identifications will be available to the Principal Investigators and to the NWFSC genetics archive.

The NWFSC has been funded to develop a genetics archive of deep-sea corals and sponges on the West Coast. The NWFSC will provide ethanol-filled collection tubes and/or ziplock bags (if freezing is more expedient) for a subsample of each coral that is collected, for genetic identification purposes. Tissue samples will be returned to the NWFSC where personnel in the Genetics and Evolution group will acquire DNA sequence information from each in order to assign a taxonomic species designations. Subsamples will remain in the tissue archive for future population genetic studies as they become feasible. Deep-sea coral and sponge sample identifications will be reported out to aid in data analysis. Voucher specimens also may be archived at appropriate institutes (e.g., Smithsonian Institution, California Academy of Sciences).

FUTURE PLANS

FY2012 will be guided by the results from FY2011. Year three efforts will continue to refine EFH information needed for management on the West Coast and to develop information to understand the distribution, ecology and biology of deep-sea corals in the region. Some of the topics under consideration by the planning team for FY2012 include but are not limited to: 1) a

survey to determine the distribution and abundance of deep-sea coral and sponges in the Gulf of the Farallones, if appropriate habitat targets will be identified from FY2011 mapping efforts; 2) a study of the distribution of deep-sea corals in areas off northern California and southern Oregon where trawl bycatch data indicate relatively high abundance of deep-sea corals; 3) a study of distribution and abundance of deep-sea corals in the area of Sur Ridge (inside MBNMS) where installation of underwater cables may impact deep-sea corals and sponges; 4) a study of more accessible deep-sea corals in relatively shallow depths (30-80 meters) to provide information on the role of deep-sea corals as EFH on the West Coast; and, 5) a partnership with WCPR to run a targeted competitive peer-review process to meet West Coast deep-sea coral priorities. The goal for the three-year field activities will be to provide a better understanding of the location, distribution, abundance, role as EFH, and status of deep-sea corals and sponges to inform management actions.

BUDGET

EXPENDITURE TYPE	AMOUNT
CRUISE 1 – OCNMS Multibeam and ROV Survey	
Chartered Vessel (<i>Pacific Storm</i>)	\$231,200
OSU Personnel	\$107,200
SWFSC Personnel	\$46,300
OCNMS Personnel	\$50,000
NCCOS Personnel	\$15,000
WSU Personnel	\$10,000
Subtotal	\$459,700
CRUISE 2 – North-central California Multibeam Surveys	
Chartered Vessel (<i>Fulmar</i>)	\$50,400
USGS Personnel	\$70,400
NCCOS Travel	\$3,000
Subtotal	\$123,800
CRUISE 3 – Bodega Canyon AUV Characterization	
Chartered Vessel (<i>Fulmar</i>)	\$27,000
NMFS AUV Operations	\$71,000
CBNMS Personnel	\$10,500
Subtotal	\$108,500
CRUISE 4 – Bowie and Cobb Seamounts an International Collaboration	
NMFS Personnel	\$8,000
NMFS AUV Operations	\$17,000
Subtotal	\$25,000
Peer Review Process for West Coast	
Peer review process	\$17,000
Science awards	\$66,000
Subtotal	\$83,000
TOTAL	\$800,000

BUDGET JUSTIFICATION

CRUISE 1: OCNMS Multibeam and ROV Surveys

Approximately \$459,700 will go to CRUISE 1 for 31 days on the *Pacific Storm*. The cruise is divided into Leg 1, the multibeam survey at \$208,000 and Leg 2, the ROV survey at \$251,700. The total cost for the multibeam survey includes \$53,200 for Goldfinger and team to conduct the multibeam survey, analysis, and product development; \$5,200 materials and travel; and \$26,700 to lease and ship the Reson 8101 multibeam sonar. Contracted vessel time is \$80,000 for 13 days of crew time, fuel, transit costs, and weather days. The overhead costs for Leg 1 are \$42,900. The total costs for the SWFSC ROV survey includes \$33,300 for Butler and team to conduct an ROV survey, analysis, and product development; \$8,000 to ship the ROV and supplies; and \$5,000 in travel for the Butler team. Collection and post-processing of the ROV visual data will be conducted by OCNMS, SWFSC, NCCOS and WSU and includes \$50,000 to cover OCNMS costs for contracted staffing, travel, and equipment; \$15,000 to cover NCCOS costs for contracted staffing, travel, taxonomy collections, and equipment; and \$10,000 to cover WSU costs for contracted staffing and travel. Contracted vessel time is \$103,500 for 18 days of crew time, fuel and transit costs. The overhead costs for Leg 2 are \$26,900.

CRUISE 2: North-central California Multibeam Surveys

Approximately \$123,800 is budgeted for CRUISE 2. This includes \$70,400 for USGS multibeam data collection and interpretation, mobilization and demobilization, and overhead for the project; \$3,000 for one NCCOS staff to travel to meet with personnel and assist with post-processing and habitat classification, and purchase supplies; and \$50,400 for 19 days of contracted vessel time on the *Fulmar* that includes two days for mobilization, one day for demobilization, two days for transit and two days for time to refuel during the work at Rittenburg and Farallon Escarpment and 12 working days.

CRUISE 3: Bodega Canyon AUV Characterization

Approximately \$108,500 is budgeted for CRUISE 3. This includes \$71,000 for NMFS to support AUV operations, of this total \$7,000 will support travel and mobilization and demobilization activities, \$50,000 to support contract staff to post-process data, \$5,000 to support overtime of NMFS staff, and \$9,000 for shipping, equipment, supplies, and calibration; \$10,500 to CBNMS, \$1,750 for CBNMS travel and lodging and \$8,750 for CBNMS contract staff to post process data, and develop products and reports; and \$27,000 for 12 days of contracted vessel time that includes two transits days, two weather days, one mobilization and one demobilization, and six working days.

CRUISE 4: Bowie and Cobb Seamounts an International Collaboration

Approximately \$25,000 is budgeted for CRUISE 4. This includes \$8,000 for overtime of NMFS staff; \$7,000 to support travel to and from Nanaimo, Canada and mobilization and

demobilization activities for four NMFS staff; and \$10,000 for shipping, supplies and equipment (such as drop weights, links, cables, hardware) and equipment repair and calibration.

Targeted Peer Review Process for West Coast

Approximately \$83,000 will be budgeted for the peer-review process and awards. This includes \$17,000 to conduct the pre-proposals, full proposals, mail reviews, and panel meeting, as well as indirect cost for these activities. The remaining \$66,000 will be banked at WPCR and applied to selected science awards in FY2012.

APPENDIX A: FY10 SCIENCE PLAN ACCOMPLISHMENTS

CRUISE 1 Leg 1 - Olympic Coast

Leg 1 (June 7-16, 2010) focused on potential deep-sea coral and sponge habitats of OCNMS that are being considered for additional protection of PFMC's Olympic 2 Conservation Area.

Because of mechanical and weather issues, only three sites were visually surveyed using the *Kraken 2* ROV and the NMFS Seabed *Lucille* AUV aboard the NOAA Ship *McArthur II*. The ROV survey collected nine hours of high-definition video and digital still camera images at one site, confirming the presence of deep-sea coral and sponge communities with numerous rockfish species on mostly boulder patches at depths between 100-140 meters. Two additional sites were surveyed using the AUV coupled with the collection of physical oceanographic data. All the information collected will be used to contribute to PFMC's five-year review of EFH for groundfish.

CRUISE 1 Leg 2 - Cordell Bank and Gulf of the Farallones

Leg 2 (June 20-24, 2010) in CBNMS and GFNMS were preempted by unfavorable weather conditions a majority of the cruise. Direct observations were made using the *Kraken 2* ROV during a single eleven hour dive conducted on the continental slope just west of Cordell Bank at depths between 180-500 meters. High-definition video and still images were collected using the ROV and one octocoral specimen was collected for genetic analysis and species identification. Four species of deep-sea corals were observed for the first time within CBNMS. The video and still images from the ROV provided data for ground truthing habitat maps created from multibeam sonar data collected on a previous cruise. Fifteen CTD casts and discrete-depth water sample collections were completed at five stations along an east-west cross-shelf and slope transect to provide baseline data on ocean acidification and to help understand habitat features influencing deep-sea coral distribution patterns.

CRUISE 1 Leg 3 - Channel Islands

Leg 3 (June 28-July 2, 2010) in CINMS completed five days of surveys for deep-sea corals and sponges at depths of 280-900 meters on Piggy Bank, an underwater mountain off Southern California. Scientists collected approximately 45 hours of continuous high-definition video and several thousand still images using the ROV. Eight AUV night-time surveys were conducted at depths of 284-888 meters with over 16,000 digital images collected by the AUV. Data collected from the cruise on environmental conditions included depth, temperature, substratum types, topography, and carbonate saturation state to help understand habitat factors that influence deep-sea coral settlement and distribution. Nine CTD casts with water samples at various depths were taken at the start and end of each ROV transect and 33 specimens of deep-sea coral, sponges, and associated organisms were collected with the ROV to confirm taxonomic identifications and identify genetic, reproductive, and stable isotopes. Coral and sponge specimens have been distributed to various taxonomic experts at museums and universities. Identification of some of

the sponges is new records for the northeast Pacific and some are new species or even a new genus. This underscores how little is known of several members of the deep-sea coral communities off the West Coast. An interactive image database of the information collected during this cruise leg is posted at <http://swfsc.noaa.gov/DeepseaCoralImageDatabase/>. At this site, you can map the images of the deep-sea corals, sponges and other organisms observed during this cruise, as well as view associated data on identification and depth. This is an interactive database, whereby other researchers can provide expert opinion that will be critical to the ongoing development of this database. Data analyses and site characterization are underway.

CRUISE 2 - Southern California Bight

Cruise 2 on board the *Velero IV* (October 2010) focused on the biology and ecology of Christmas tree black corals (*Antipathes dendrochristos*) on a deep offshore bank in the southern California Bight (Hidden Reef). Surveys of thousands of deep-sea corals, sponges, and associated fishes were conducted on rocky banks at depths 110-475 meters using non-extractive transect methodologies and direct observations using the Nuytco Research LTD's Dual DeepWorker manned submersible. Approximately 17 hours of annotated high-definition video were collected along navigated track lines. Data collected also included depth, temperature, salinity, dissolved oxygen, and substratum type, to help understand habitat factors that influence deep-sea coral settlement and distribution. Information collected will help quantify habitat-specific abundance and size composition of the Christmas tree black coral, evaluate change in the deep-sea coral communities eight years after initial baseline surveys, and determine fish associations with black corals to help understand the role of deep-sea corals as EFH. Additionally, a few deep-sea corals and sponges were collected in order to confirm taxonomic identifications and for genetic and reproductive analyses.

CRUISE 3 - Grays Canyon, Washington

Cruise 3 was divided into two cruises with both cruises focused on completing a survey of the glass sponge reef areas off Grays Harbor, Washington. The first cruise took place in July 2010 and provided detailed multibeam information on the sponge areas. A draft map of the area was developed from the high resolution multibeam information and was used to design follow up surveys with the NMFS Seabed *Lucille* AUV in the fall 2010. On the second cruise in September 2010, on board the *Pacific Storm*, seven AUV dives with the NMFS Seabed *Lucille* were conducted in the glass sponge areas and over 24,000 georeferenced still images were collected. Detailed multibeam information was collected by the AUV at specific sites thought to have particularly dense populations of sponges. All the data collected are being used to determine and understand the distribution patterns of sponges and associated fishes and provide the PFMC with information needed to manage EFH around Grays Canyon.

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