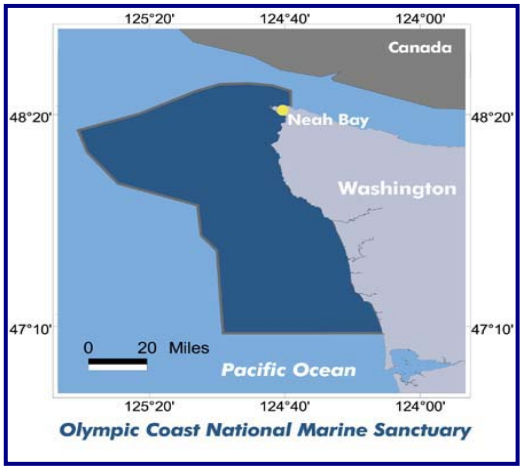
Cruise Report

NOAA Ship McARTHUR II Cruise AR-04-04: Leg 2
(June 1-12, 2004)

A Pilot Survey of Deepwater Coral/Sponge Assemblages and their Susceptibility to Fishing/Harvest Impacts at the Olympic Coast National Marine Sanctuary (OCNMS)



June 2005

NOAA Technical Memorandum NOS NCCOS 15

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Cruise Report
NOAA Ship McARTHUR II Cruise AR-04-04: Leg 2 (June 1-12, 2004)

A Pilot Survey of Deepwater Coral/Sponge Assemblages and their Susceptibility to Fishing/Harvest Impacts at the Olympic Coast National Marine Sanctuary (OCNMS)

Jeffrey Hyland[1], Cynthia Cooksey[1], Ed Bowlby[2], Mary Sue Brancato[2], and Steve Intelmann[2]

[1] NOAA/NOS, National Centers for Coastal Ocean Science (NCCOS), Center for Coastal Environmental Health and Biomolecular Research (CCEHBR), 219 Fort Johnson Road, Charleston, SC, 29412-9110
[2] NOAA/NOS National Marine Sanctuary Program (NMSP), Olympic Coast National Marine Sanctuary (OCNMS), 115 East Railroad Ave., Suite 301, Port Angeles, WA, 98362

[Also see list of other collaborating scientists in Section 4 of this report]

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SUMMARY

The offshore shelf and canyon habitats of the OCNMS (Fig. 1) are areas of high primary productivity and biodiversity that support extensive groundfish fisheries. Recent acoustic surveys conducted in these waters have indicated the presence of hard-bottom substrates believed to harbor unique deep-sea coral and sponge assemblages. Such fauna are often associated with shallow tropical waters, however an increasing number of studies around the world have recorded them in deeper, cold-water habitats in both northern and southern latitudes. These habitats are of tremendous value as sites of recruitment for commercially important fishes. Yet, ironically, studies have shown how the gear used in offshore demersal fishing, as well as other commercial operations on the seafloor, can cause severe physical disturbances to resident benthic fauna. Due to their exposed structure, slow growth and recruitment rates, and long life spans, deep-sea corals and sponges may be especially vulnerable to such disturbances, requiring very long periods to recover. Potential effects of fishing and other commercial operations in such critical habitats, and the need to define appropriate strategies for the protection of these resources, have been identified as a high-priority management issue for the sanctuary.

To begin addressing this issue, an initial pilot survey was conducted June 1-12, 2004 at six sites in offshore waters of the OCNMS (Fig. 2, average depths of 147-265 m) to explore for the presence of deep-sea coral/sponge assemblages and to look for evidence of potential anthropogenic impacts in these critical habitats. The survey was conducted on the NOAA Ship McARTHUR-II using the Navy's Phantom DHD2+2 remotely operated vehicle (ROV), which was equipped with a video camera, lasers, and a manipulator arm for the collection of voucher specimens. At each site, a 0.1-m^2 grab sampler also was used to collect samples of sediments for the analysis of macroinfauna (> 1.0 mm), total organic carbon (TOC), grain size, and chemical contaminants. Vertical profiles of salinity, dissolved oxygen (DO), temperature, and pressure were recorded at each site with a small SeaCat conductivity-temperature-depth (CTD) profiler. Niskin bottles attached to the CTD also obtained near-bottom water samples in support of a companion study of microbial indicators of coral health and general ecological condition across these sites. All samples except the sediment-contaminant samples are being analyzed with present project funds.

Original cruise plans included a total of 12 candidate stations to investigate (Fig. 3). However, inclement weather and equipment failures restricted the sampling to half of these sites. In spite of the limited sampling, the work completed was sufficient to address key project objectives and included several significant scientific observations. Foremost, the cruise was successful in demonstrating the presence of target deepwater coral species in these waters. Patches of the rare stony coral *Lophelia pertusa*, more characteristic of deepwater coral/sponge assemblages in the North Atlantic, were observed for the first time in OCNMS at a site in 271 meters of water. A large proportion of these corals consisted of dead and broken skeletal remains, and a broken gorgonian (soft coral) also was observed nearby. The source of these disturbances is not known. However, observations from several sites included evidence of bottom trawl marks in the sediment and derelict fishing gear (long lines). Preliminary results also support the view that these areas are important reservoirs of marine biodiversity and of value as habitat for demersal fishes. For example, onboard examination of 18 bottom-sediment grabs revealed benthic infaunal species representative of 14 different invertebrate phyla. Twenty-eight species of fishes

from 11 families, including 11 (possibly 12) species of commercially important rockfishes, also were identified from ROV video footage. These initial discoveries have sparked considerable interests in follow-up studies to learn more about the spatial extent of these assemblages and magnitude of potential impacts from commercial-fishing and other anthropogenic activities in the area. It is essential to expand our knowledge of these deep-sea communities and their vulnerability to potential environmental risks in order to determine the most appropriate management strategies.

The survey was conducted under a partnership between NOAA's National Centers for Coastal Ocean Science (NCCOS) and National Marine Sanctuary Program (NMSP) and included scientists from NCCOS, OCNMS, and several other west-coast State, academic, private, and tribal research institutions (see Section 4 for a complete listing of participating scientists).

Additional copies of this cruise report can be obtained by contacting:

1. Dr. Jeffrey Hyland
NOAA/NOS/NCCOS/CCEHBR
219 Fort Johnson Road
Charleston, South Carolina 29412-9110
Telephone: 843/762-8652 (Direct); 843/762-8511 (Switchboard); Fax: 843/762-8700
Email: jeff.hyland@noaa.gov

2. Ed Bowlby
NOAA Olympic Coast National Marine Sanctuary
115 East Railroad Ave., Suite 301
Port Angeles, WA 98362
Telephone: 360/457-6622, Ext 17
Email: ed.bowlby@noaa.gov

1.0 Introduction

The offshore shelf and canyon habitats of the OCNMS (Fig. 1) are areas of high primary productivity and biodiversity that support extensive groundfish fisheries. In addition, recent acoustic and bottom-profile surveys conducted in these areas suggest the presence of hard-bottom substrates believed to harbor unique deep-water coral and sponge assemblages. Such fauna are often associated with shallow tropical waters, however an increasing number of studies around the world have recorded them in deeper, cold-water habitats in both northern and southern latitudes. These habitats are of tremendous value as sites of recruitment for commercially important fishes. A growing management concern is that extensive bottom-trawling and other anthropogenic activities within sanctuary waters may be having significant harmful effects on these unique and valuable resources. Prior studies have shown how the gear used in offshore demersal fishing, as well as other commercial operations on the seafloor (such as cable trenching), can cause severe physical disturbances to resident benthic fauna (e.g., NRC 2002, NOAA/USGS/AFS/ESA 2002). Moreover, due to their exposed structure, slow growth and recruitment rates, and long life spans, deep-sea corals and sponges may be especially vulnerable to such disturbances, requiring very long periods to recover. OCNMS has a critical need to explore and document these resources in order to provide enhanced protection to such critical and sensitive habitats. Accordingly, the present survey set out to document the presence of deep-sea coral/sponge assemblages within sanctuary waters and to look for evidence of their potential risk to fishing and other anthropogenic impacts, and thus possible need of more protective zoning.

Figure 1. Map of Olympic Coast National Marine Sanctuary (OCNMS).

This study was supported by FY04 funds under a partnership established in 1999 between NCCOS and NMSP to promote research aimed at addressing critical sanctuary management needs. Zoning, fishing/harvest effects, and characterization of living marine resources have been

identified as three of the highest-priority management issues for the OCNMS, based on a recent evaluation of information needs for the NMS program (Gittings et al. 2002) and have been ranked as major concerns in recent national forums (NRC 2002, NOAA/USGS/AFS/ESA 2002). The present study was designed to address all three of these management needs. Zoning and fishing/harvest effects, in particular, have been noted as warranting the greatest increase in research activity (Table OC-2, from Gittings et al. 2002). In addition, condition of critical habitat, and comparisons of impacts in areas of high and low fishing intensity, were identified as high-priority endpoints for four of five west-coast sanctuaries. Thus, the present study is addressing sanctuary-wide management needs common to the broader region.

Table 1. Locations of sampling stations for NOAA Ship McARTHUR II Cruise AR-04-04: Leg 2. Stations are classified by low vs. high categories of anticipated fishing activity based on commercial-fishing records. Water depths are averages of values recorded for replicate grab locations at each station.

Station	Expected Level of Fishing Intensity	Latitude	Longitude	Average Depth (m)
OC04001	High	48°14.970'	-125°0.793'	214
OC04003	High	48°9.415'	-124°59.979'	265
OC04004	Low	48°7.635'	-125°3.767'	147
OC04005	Low	48°6.732'	-125°8.626'	209
OC04011	High	47°17.564'	-124°47.524'	241
OC04013	Low	48°6.552'	-125°3.878'	161

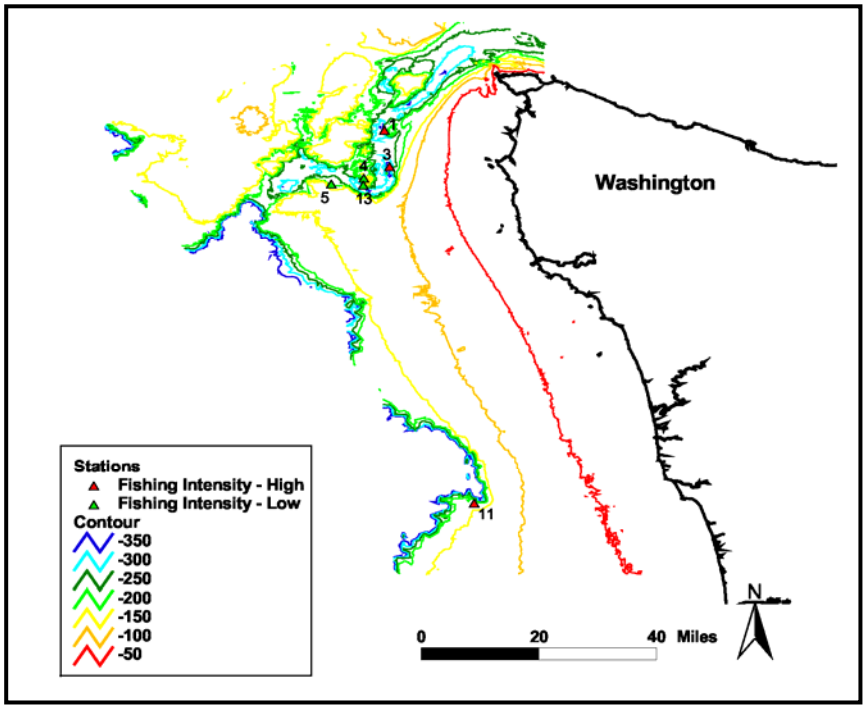

Figure 2. Study area in offshore waters of the OCNMS, showing location of sampling stations for NOAA Ship McARTHUR II Cruise AR-04-04: Leg 2. Red triangles = Stations in areas of high fishing intensity; Green triangles = Stations in areas of low fishing intensity.

2.0 Objectives

Specific objectives of the study are:

- To help address resource management questions of the OCNMS by conducting a study to document the presence of critical hard-bottom benthic habitats believed to exist in deepwater areas of the sanctuary (based on acoustic habitat surveys and bottom profiles). These habitats are thought to contain diverse and unique assemblages of corals, sponges, and other associated fauna that may be particularly vulnerable to human disturbances;

- To groundtruth the previous acoustic survey records by confirming the presence of these habitats;
- To characterize the diversity, abundances, and health of living marine resources associated with both hard-bottom and soft-bottom substrates in these areas;
- To evaluate fishing/harvest pressures on these critical habitats and their associated fauna in areas of low and high fishing intensity;
- To generate GIS-compatible data on critical habitat, associated species of concern, and basic habitat types in these areas to support future biogeographic mapping efforts; and
- To provide support to sanctuary-wide interests on the west coast to address such topics as condition of critical habitats, and fishing/harvest impacts in these areas, which have been identified as unique regional needs for the majority of west-coast sanctuaries.

3.0 Methods

To begin addressing the above objectives, an initial pilot survey was conducted on June 1-12, 2004 at six offshore sites within the OCNMS (average station depths of 147-265 m) in areas believed to contain critical hard-bottom substrate inhabited by the targeted coral and sponge species (Fig. 2, Table 1). Stations in Table 1 include areas of both high and low fishing intensity to support the evaluation of fishing impacts on these critical habitats and associated fauna.

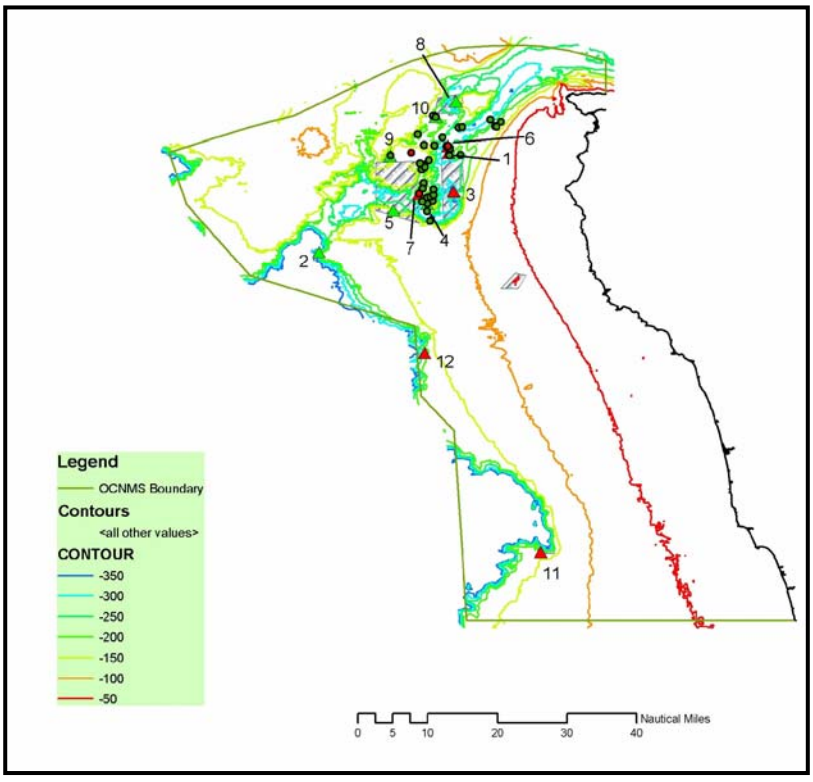

Figure 3. Study area showing location of all 12 original candidate sampling stations. Red triangles = Primary stations in areas of high fishing intensity; Green triangles = primary stations in areas of low fishing intensity; Circles = alternative stations; Diagonals = Side Scan Sonar areas surveyed during the companion Leg 1 cruise to help confirm suitable hard-bottom sites.

Information used to select these stations came from commercial-fishing records and results of previous acoustic and bottom-profile surveys conducted by the OCNMS and other agencies. Original cruise plans included a total of 12 candidate stations to investigate (Fig. 3, Table 2). However, inclement weather and equipment failures limited the sampling to the six stations listed in Table 1.

The survey was conducted on NOAA Ship McARTHUR II Cruise AR-04-04: Leg 2. The ship (Fig. 4) is 224-feet long with cruising speed of 11 knots, an endurance of 8000 nm and 45 days at sea, and accommodations for a scientific party of up to 15. The ship supported all sampling activities including the use of a Remotely Operated Vehicle (ROV), bottom grabs, and CTD profiles.

Table 2. Locations of original 12 candidate sampling sites. Stations are classified by low vs. high categories of anticipated fishing activity. Other rationale for the selection of these sites is included in the comment column.

Station	Expected Level of Fishing Intensity	Latitude	Longitude	Comments*
OC04001	High	48°14.970'	-125°0.793'	GT
OC04002	Low	48°0.714'	-125°19.321'	ND
OC04003	High	48°9.415'	-124°59.979'	ND/SSS
OC04004	Low	48°7.635'	-125°3.767'	GT
OC04005	Low	48°6.732'	-125°8.626'	ND/SSS
OC04006	High	48°15.901'	-125°0.809'	GT
OC04007	High	48°9.077'	-125°4.997'	GT
OC04008	Low	48°22.283'	-124°59.673'	ND/SSS
OC04009	Low	48°14.536'	-125°9.080'	GT
OC04010	Low	48°19.982'	-125°2.624'	GT
OC04011	High	47°17.564'	-124°47.524'	ND/SSS
OC04012	High	47°46.126'	-125°4.191'	ND

Comments*

GT = Groundtruth. In addition to being a good candidate coral/sponge site based on evidence of hard-bottom substrate from previous acoustic and bottom-profile surveys, the site also fulfilled the need to groundtruth results of these latter habitat mapping surveys.

ND = No prior acoustic-survey data. Other information, however, suggested these would be potential sites.

ND/SSS = No prior historical data, but new side-scan-sonar data were to be provided for these sites from surveys conducted on the companion Leg 1 of Cruise AR-04-04.

Sampling of hard-bottom epifaunal assemblages (inclusive of targeted coral and sponge species) was conducted with underwater photography using the Navy's Phantom DHD2+2 ROV (Fig. 5) equipped with a video camera, lasers, and a manipulator arm for the collection of voucher specimens. At each site, the ROV was deployed along a random transect, with the video camera being used both to fly the vehicle and to obtain photographic footage of bottom substrates and associated fauna. Using the tilt mechanism, footage was obtained of vertical surfaces along high-relief structures as well as flatter low-relief areas. Especially interesting organisms and other objects were recorded and time-coded. Any visual evidence of fishing impacts (e.g., trawl scars, broken coral or sponge parts, derelict gear) in the video images were noted as well. Also, random still photo-frames will be obtained subsequently from the footage and used to help provide quantified estimates of various benthic attributes on an areal basis (e.g., % cover, density/m^2, # species/m^2). The original plan was to supplement this latter effort with random photo-quadrat samples using digital-still photographs.

Figure 4. Photograph of NOAA Ship McARTHUR II used on Cruise AR-04-04: Leg 2.

However, design constraints of the small-sized Phantom ROV precluded the simultaneous use of a video camera, manipulator arm, and separate still camera. Initial processing of photographic samples began onboard the ship (i.e., preliminary species identifications where possible). The ROV's manipulator arm was used where possible to obtain epifaunal voucher specimens and to collect samples of corals in support of a companion study of coral health (see below).

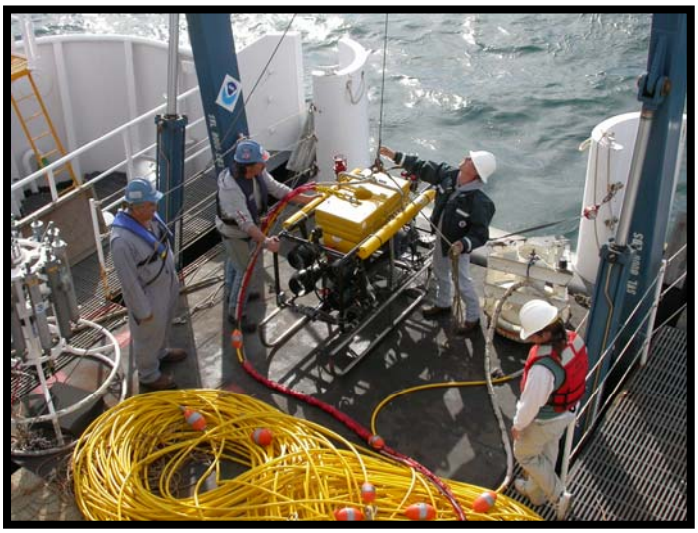

Figure 5. Onboard view of the Navy's Phantom DHD2+2 Remotely Operated Vehicle (ROV). The ROV is equipped with video camera, lasers, and a manipulator arm.

In addition to the ROV operations, a 0.1-m^2 grab sampler also was used to collect samples of sediments for the analysis of macroinfauna (> 1.0 mm), total organic carbon (TOC), grain size, and chemical contaminants. At each of the six stations, three replicate grabs were collected for macroinfaunal analysis and one additional grab was collected and sub-sampled for the remaining abiotic environmental parameters. As part of the QA/QC procedures, samples that had undergone significant slumping or loss of material through the jaws of the grab (e.g., samples with a sediment layer < 5cm) were rejected. Acceptable macroinfaunal samples were live-sieved onboard through a 1.0-mm screen, placed in adequate/securable plastic containers with lids, and preserved in 10% buffered formalin. Samples for the analysis of sediment grain size and TOC were sub-sampled from composited surface sediment (upper 3-5 cm) collected from the additional grab at each station. The surface layer of sediment was removed from the grab with a scoop, placed in a bowl, and mixed. A TOC sub-sample was then removed from the homogenized sample and placed in a 125-mL plastic jar with lid and stored frozen (-20°C). An additional sub-sample for grain-size analysis was removed from the homogenate and placed in a 500-mL plastic jar with lid and stored frozen (-20°C). All samples were appropriately labeled with pertinent information on the project, station/replicate ID, and sample type. All samples except the sediment contaminant samples are being analyzed with present project funds. The contaminant samples will be archived and analyzed subsequently pending availability of funds.

Vertical profiles of salinity, dissolved oxygen (DO), temperature, and pressure were recorded at each site with a small SeaCat CTD (conductivity, temperature, density). Niskin bottles attached to the CTD rosette also obtained near-bottom water samples in support of the companion study of microbial indicators of coral health and general ecological condition across these sites.

As mentioned above, samples of corals were collected where possible with the manipulator arm of the ROV to provide material in support of a companion coral-health study at the NCCOS/CCEHBR lab in Charleston, SC (led by Dr. Cheryl Woodley and her assistant Sarah Polson). Ongoing studies have led to the development of a variety of novel biomolecular and microbial approaches to assessing the health of corals. In efforts to bring this expertise to bear in

the present study, samples for analysis of corals and associated microbial indicators were collected where possible at our sampling sites and provided to Dr. Woodley's laboratory for subsequent analysis. The material included samples of the stony coral *Lophelia pertusa* from one station (Station 3 at 271 m) and samples of sediment and near-bottom water from all six stations. Baseline information on the health of corals associated with these critical habitats would be a valuable contribution to the objectives of this study and goals of the sanctuary.

Data from the present study also will be made available to support other future research efforts at the sanctuary, such as GIS-based biogeographic habitat mapping to be conducted in future years through another NCCOS/OCNMS collaboration. Information on critical habitat, associated living marine resources, and potential fishing impacts in these areas should serve as valuable input data for this subsequent mapping effort.

4.0 Sampling Logistics and Scientific Party

The survey was conducted on NOAA Ship McARTHUR II Cruise AR-04-04: Leg 2, June 1-12, 2004. Mobilization of sampling equipment, including the Navy's Phantom DHD2+2 ROV,

Table 3. Activity log for NOAA Ship McARTHUR II Cruise AR-04-04: Leg 2.

Date	Time	Activity
6/01/04	All day	Begin mobilization of ROV and related equipment in Port Angeles (PA), WA
6/02/04	0800-1930	Continue mobilization of ROV in addition to other non-ROV scientific equipment, supplies & staff. Depart PA 1930 for Station 11 at southern end of study area.
6/03/04	1000	Arrive Station 11.
	1000-1200	Prepare ROV for launch.
	1200-1500	Attempted ROV Dive 1 at Station 11; ops aborted due to equipment failure.
	1530-1900	Bottom grabs & CTD at Station 11.
6/04/04	0850-1105	ROV Dive 2 at Station 11; dive aborted at 1105 due to equipment failure
	1300-1635	Additional bottom grabs & CTD taken at "Station 11A" near Dive 2 rock outcrop observed at Station 11. Steam to Station 5.
	2242-0041	Bottom grabs & CTD at Station 5.
6/05/04	0800-1151	ROV Dive 3 at Station 5.
	1230-1300	Bathymetric/fathometer survey of Station 5 (to search for relief change). Transit to Station 3.
	1420-2000	ROV Dive 4 at Station 3.
6/06/04	0915-1840	ROV Dive 5 at Station 1
	1950-2415	Bottom grabs & CTD at Station 3
6/08/04	0800-1730	Standby for safe weather window for ROV ops. Attempt to repair ROV compass.
	1748-2242	ROV Dive 7 at Station 11
6/09/04	0830-1145	ROV Dive 8 @ Station 13
	1245-1540	Bottom grabs & CTD at Station 13. Steam to Station 9A (close to original candidate Station 9) and standby for rest of night.
6/10/04	0800-1045	Continue standby for safe weather window for ROV ops. Abort wait due to continued poor weather. Steam to new optional Station 14 in Straits of Juan de Fuca (off Cape Flattery) & evaluate conditions. Attempt to sample here aborted as well due to weather. Steam to PA & arrive ~1700.
	~1700-2000	Demobilize all non-ROV scientific equipment, supplies, & staff in PA. Depart for Seattle.
6/11/04	Early a.m.	Ship arrive MOC-Pacific facility in Seattle.
6/12/04	Morning	Demobilize ROV equipment & staff.

occurred in Port Angeles, WA on June 1-2. The ship departed Port Angeles the evening of June 2 and arrived at the first station (11) in the southern end of the study area mid-morning June 3. At-sea operations were conducted June 3-10, during which sampling was completed at the six stations listed in Table 1. Field operations were conducted on an 18-hr/day basis. As feasible, daytime operations (0800 – 2000) were devoted primarily to the ROV work, while nighttime operations (2000 – 0200) were devoted to CTD profiling and sediment grab sampling. The ship returned to Port Angeles the evening of June 10, at which time de-mobilization of all non-ROV scientific crew and equipment occurred. The ship then departed Port Angeles that same evening for Seattle and arrived at the MOC-Pacific home port in Seattle during early morning June 11. Final de-mobilization of the ROV systems occurred on June 12. Further details of these activities are summarized in the Activity Log (Table 3).

This survey was conducted under a partnership between NOAA's National Centers for Coastal Ocean Science (NCCOS) and the Office of National Marine Sanctuaries (ONMS) and included scientists from NCCOS, OCNMS, and several other west-coast State, academic, private, and tribal research institutions. A listing of scientific party members and their affiliations is given in Table 4.

Table 4. List of scientific crew members and affiliations for NOAA Ship McARTHUR II Cruise AR-04-04: Leg 2. Scientists Hyland and Bowlby (flagged with asterisks) served as Co-Chief Scientists and can be contacted for further details of the cruise.

Name	**Affiliation**	**Contact**
Bowlby, Ed*	NOAA/OCNMS	ed.bowlby@noaa.gov
Brancato, Mary Sue	NOAA/OCNMS, Port Angeles, WA	mary.sue.brancato@noaa.gov
Bryant, Brandon	Makah Fisheries Dept., Neah Bay, WA	BrandonLeeBryant@hotmail.com
Cooksey, Cindy	NOAA/NCCOS/CCEHBR, Charleston, SC	cynthia.cooksey@noaa.gov
Crawford, Todd	U.S. Navy, Naval Facilities Engineering Service Center (NFESC), Port Hueneme, CA	michael.t.crawford@navy.mil
Goddard, Jeff	U.C. Santa Barbara, Santa Barbara, CA	goddard@lifesci.ucsb.edu
Hagen, Jennifer	Northwest Indian Fisheries Commission, Forks, WA	jhagen@nwifc.org
Hyland, Jeff*	NOAA/NCCOS/CCEHBR, Charleston, SC	jeff.hyland@noaa.gov
Kohn, Alan	U. of Washington, Seattle, WA	kohn@u.washington.edu
Martin, Darrell	Consultant to Navy/NFESC	omeletboy@earthlink.net
Morgan, Lance	Marine Conservation Biology Institute, Port Angeles, WA	lance@mcbi.org
Pirtle, Jodi	WSU, Vancouver	pirtle@vancouver.wsu.edu
Polson, Sara	NOAA/NCCOS/CCEHBR, Charleston, SC	polson@musc.edu
Schwarck, Nate	Western Washington University, Anacortes, WA	schwarn@cc.wwu.edu

5.0 Preliminary Results

Original cruise plans included a total of 12 candidate stations to investigate (Fig. 3, Table 2). However, inclement weather and equipment failures restricted the sampling to half of these sites (Fig. 2, Table 1). In spite of the limited sampling, the work completed was sufficient to address key project objectives and included several significant scientific observations. Foremost, the cruise was successful in demonstrating the presence of target deepwater coral/sponge assemblages in these waters. Patches of the stony coral *Lophelia pertusa* (Fig. 6) were observed

Figure 6. A dense field of the stony coral *Lophelia pertusa*, characteristic of deepwater coral assemblages in the North Atlantic, was observed at OCNMS for the first time during this survey at a site in 271 meters of water (left photo). Right photo: Close up of specimen collected with ROV manipulator arm.

on a rocky ledge at one site (Station 3) in 271 meters of water. Near-bottom water temperature and salinity at this site were 6.5 ^{0}C and 33.94 psu, respectively (Table 5). Samples of the coral were collected with the ROV manipulator arm and brought back to use as taxonomic voucher specimens and in support of the companion coral-health study. Initial identification of the coral as *Lophelia* was made in the field by Dr. Alan Kohn, one of the onboard taxonomy specialists, and later confirmed by Dr. Stephen Cairns of the Smithsonian Institution. A related observation also of importance was that a large proportion of these corals consisted of dead and broken skeletal remains. A broken gorgonian (soft coral) also was observed on the seafloor nearby (Fig. 7). The exact source of these disturbances is not known. However, observations from several of the sites (Stations 1, 3, and 11) included accounts of bottom trawl marks in the sediment and derelict fishing gear (long lines; Fig. 8).

Preliminary results of the survey also support the view that these areas are important reservoirs of marine biodiversity. For example, initial onboard visual examination of just 18 bottom

Table 5. General oceanographic conditions among sampling stations based on results of CTD profiles and visual inspection of bottom grabs. Temperature, salinity, and dissolved oxygen (DO) are values for near-bottom water from the CTD. Water depths for each station include two sets of values: (1) values recorded directly from the CTD at the site of the CTD profile, and (2) average of values recorded for replicate grab locations at each station (as in Table 1).

Station	Depth (m)[1]	Depth (m)[2]	Salinity (psu)	Temp. (°C)	DO (mg/L)	Sediment Type
OC04001	194.7	214	33.9286	6.5	2.63155	Gray mud with gravel & shell
OC04003	256.7	265	33.9432	6.5	2.46381	Gray mud with rock
OC04004*	-	147	-	-	-	Gray mud with gravel & shell
OC04005	187.0	209	33.8924	6.7	2.9062	Gray sticky mud
OC04011	217.7	241	33.9677	6.8	2.7343	Gray mud
OC04013	189.7	161	33.8449	7.1	3.3070	Gray mud with gravel & shell

*Note: Near-bottom data from the CTD at Station OC04004 were not available for inclusion in this report due to a problem with the record for that particular depth interval. However, data recorded at a depth of 32 m below the surface at that station included salinity of 32.4 psu, temperature of 9.2 °C, and DO of 8.3 mg/L.

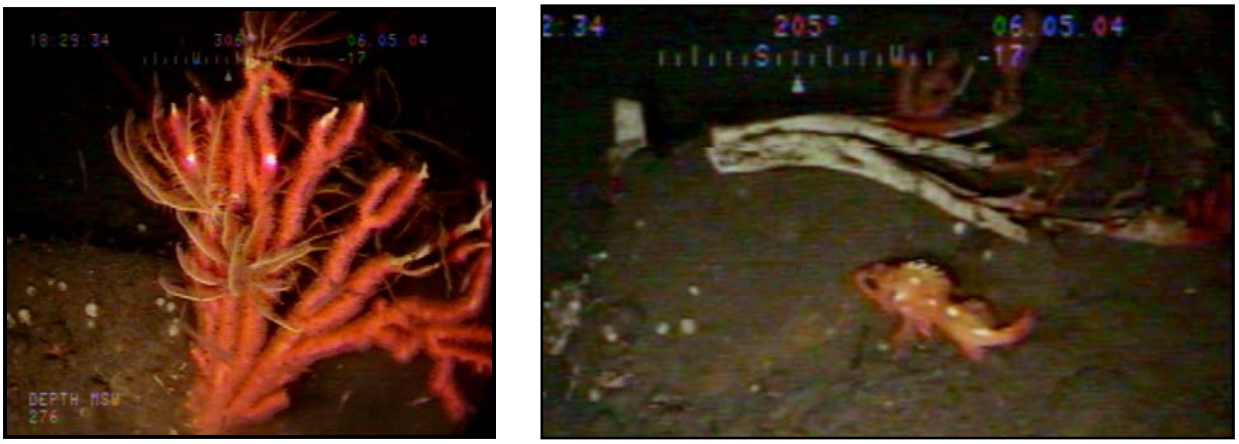

Figure 7. Left Photo: Live gorgonian (soft coral) with attached crinoids observed at OCNMS at 276 m, June 2004. Right Photo: Broken specimen found at 268 m, with rosethorn rockfish (*Sebastes helvomaculatus*) in foreground.

sediment grabs (0.1 m^2 each) revealed benthic infaunal species representative of 14 different invertebrate phyla. These included foraminiferan Protozoa, Porifera, Cnidaria (hydrozoans and anthozoans), Nemertea, Annelida (polychaetes), Mollusca (gastropods, bivalves, scaphopods, chitons), Arthropoda (crustaceans), Sipunculida (peanut worms), Echiura, Ectoprocta (bryozoans), Brachiopoda (lamp shells), Echinodermata (ophiuroids, holothuroids, echinoids), Hemichordata (acorn worm *Soccoglossus*), and Chordata (Urochordata tunicates). One rock (15 cm by 15 cm), caught accidentally in the jaws of a grab, had species from nine different phyla living on it (A. Kohn). Many species of epifaunal invertebrates also were observed from the ROV video footage of rock outcrop and adjacent seafloor throughout the study area. These included hydrozoans, sponges, anemones, gorgonians, sea pens, tubicolous polychaetes, nudibranchs, decapod crustaceans, bryozoans, brachiopods, crinoids (*Flourometra*), sea urchins, starfish, and ophiuroids.

Rocky reefs such as the ones surveyed here can be of tremendous value as habitat for demersal fishes that congregate in these areas for food and shelter. Numerous species of fishes (28) were observed in the present ROV video footage, including 11 (possibly 12) species of the commercially important rockfish guild, family Scorpaenidae (Table 6). Rosethorn rockfish (*Sebastes helvomaculatus*), sharpchin rockfish (*S. zacentrus*) and thornyheads (*Sebastolobus altivelis* and possibly *S. alascanus*) were the most abundant of the rockfishes. Other families identified thus far include Pleuronectidae (flatfish), Bothidae (sanddabs), Zoarcidae (eelpouts), Agonidae (poachers), Bathymasteridae (ronquils), Stichaeidae (pricklebacks), Rajidae (skates), Hexagrammidae (lingcod), Myxinidae (hagfish), and Chimaeridae (ratfish).

Figure 8. Long-line fishing gear with lure on seafloor at OCNMS. Laser points near rockfish at top of view are 10 cm apart.

Table 6. Demersal fish species identified from ROV video footage on NOAA Ship McARTHUR II Cruise AR-04-04: Leg 2. List prepared onboard by Brandon Bryant.

Family	**Scientific Name**	**Common Name**
Scorpaenidae	*Sebastes helvomaculatus*	Rosethorn rockfish
	Sebastes zacentrus	Sharpchin rockfish
	Sebastes elongatus	Greenstripe rockfish
	Sebastes flavidus	Yellowtail rockfish
	Sebastes aurora	Aurora rockfish
	Sebastes ruberrimus	Yelloweye rockfish
	Sebastes babcocki	Redbanded rockfish
	Sebastes aleutianus	Rougheye rockfish
	Sebastes nigrocinctus	Tiger rockfish
	Sebastes borealis	Shortraker rockfish
	Sebastolobus altivelis	Longspine thornyhead
	Sebastolobus alascanus (?)	Shortspine thornyhead
Pleuronectidae	*Microstomus pacificus*	Dover sole
	Eopsetta jordani	Petrale sole
	Hippoglossoides elassodon	Flathead sole
	Hippoglossus stenolepis	Pacific halibut
	Atheresthes stomias	Arrowtooth flounder
Bothidae	*Citharichthys sordidus*	Pacific sanddab
Zoarcidae	Spp	Eelpouts
Agonidae	Spp	Poachers
Bathymasteridae	Spp	Ronquils
Stichaeidae	Spp	Pricklebacks
Rajidae	*Raja binoculata*	Big skate
	Raja rhina	Longnose skate
	Bathyraja kincaidii	Sandpaper skate
Hexagrammidae	*Ophiodon elongatus*	Lingcod
Myxinidae	*Eptatretus stoutii*	Pacific hagfish
Chimaeridae	*Hydrolagus colliei*	Spotted ratfish

The survey also produced at least one species of marine invertebrates new to science. A previously undescribed species of nudibranch (sea slug) was collected in a grab sample from Station 4. The slug (Fig. 9) was 22 mm long and found sitting on its egg mass. Dr. Jeff Goddard, one of the onboard taxonomic specialists, is credited for recognizing it as being a potentially new species of dorid nudibranch. Dr. Sandra Millen of the University of British Columbia later confirmed it to be a new species of the dorid genus *Baptodoris*.

General oceanographic conditions among the various stations, based on results of the CTD profiles and visual inspection of bottom grabs, are summarized in Table 5. Station depths, averaged across replicate grab locations at each station, ranged from 147 m (Station 4) to 265 m (Station 3). Bottom sediments typically consisted of gray muds with varying degrees of gravel, rock, and shell hash. Near-bottom salinity, temperature, and dissolved oxygen (DO) ranged from 33.84–33.97 psu, 6.5–7.1 ^{0}C, and 2.46–3.31 mg/L, respectively.

The above preliminary observations will be supplemented with results from follow-up analyses of the video footage (for epifaunal variables) and the grab samples (for infaunal and abiotic

sediment variables). As mentioned above, in spite of the downtime caused by poor weather and equipment failures, the survey was highly successful in gathering sufficient information and samples to begin addressing program objectives focused on critical sanctuary management needs. Still, additional future studies will be required to further document the spatial extent of these critical habitats and their potential susceptibility to human activities.

Figure 9. A new species of *Baptodoris* (Gastropoda, Nudibranchia) collected in a grab sample from Station 4. The slug was 22 mm long and found sitting on its egg mass (visible at left side of animal). Photo by Dr. Jeff Goddard.

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United States Department of Commerce

Carlos M. Gutierrez
Secretary

National Oceanic and Atmospheric Administration

Vice Admiral Conrad C. Lautenbacher, Jr. USN (Ret.)
Under Secretary of Commerce for Oceans and Atmospheres

National Ocean Service

Richard W. Spinrad
Assistant Administrator for Ocean Service and Coastal Zone Management