

**A PRELIMINARY REPORT TO THE PACIFIC FISHERY MANAGEMENT COUNCIL
ESSENTIAL FISH HABITAT REVIEW COMMITTEE**

December 1, 2011

**A CHARACTERIZATION OF DEEP-SEA CORAL AND SPONGE COMMUNITIES
ON THE CONTINENTAL SHELF OF NORTHERN WASHINGTON,
OLYMPIC COAST NATIONAL MARINE SANCTUARY,
USING A REMOTELY OPERATED VEHICLE IN 2006**

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INTRODUCTION AND SCIENTIFIC OBJECTIVES

Deep-sea corals (DSC), particularly structure forming corals, are biogenic habitats and are recognized as slow-growing, long-lived and fragile, making them and their associated organisms vulnerable to human-induced impacts, particularly from physical disturbances (NRC 2002; Hourigan et al. 2007; NOAA 2010). The extent of habitat degradation resulting from these threats is largely unknown although there is increasing information on significant impacts in some areas. Activities that can directly impact deep coral communities include fishing using bottom-tending fishing gear, deep coral harvesting, oil and gas and mineral exploration and production, and submarine cable/pipeline deployment. Invasive species, climate change and ocean acidification represent additional serious threats.

Submersible and ROV surveys for deep-sea habitats in Olympic Coast National Marine Sanctuary (OCNMS) started in the year 2000 to investigate potential impacts to the benthic habitat caused by trenching operations to lay fiber optic cable in OCNMS (Brancato and Bowlby

2005). The stony coral *Lophelia pertusa* was discovered in the sanctuary in 2004 (Hyland et al. 2005). This report on a 2006 DSC survey expands on the previous publication (Brancato et al. 2007) to include quantification of habitat types and the distribution/abundance of deep-sea corals and sponges (DSCS).

The Olympic 2 Conservation Area was created in 2006 as part of West Coast groundfish Essential Fish Habitat (EFH) areas (http://www.pcouncil.org/wp-content/uploads/EFH_maps.pdf), partially based on DSC data. Olympic 2 covers approximately 159 square nautical miles, or about 7 percent of OCNMS. The 2004 discovery of the stony coral *Lophelia pertusa* in the sanctuary (Hyland et al. 2005) was a contributing factor in the Pacific Fishery Management Council's (PFMC) decision on some boundaries of the Conservation Area.

These EFH closed areas were identified by PFMC and are intended to minimize to the extent practicable the adverse effects of fishing on groundfish EFH. New information on the locations, densities, and condition of DSCs and their role as EFH within these proposed conservation areas would not only help to fill scientific data gaps, but would provide new information pertinent to pending management considerations (via provisions of Magnuson-Stevens Act and/or the National Marine Sanctuaries Act). EFH Conservation Areas are closed to specific types of fishing. For Olympic 2 bottom trawling is prohibited for all non-treaty fisheries.

The specific objectives of the 2006 survey, as noted in Brancato et al. (2007), were the following. This supplemental report focuses on objectives 1, 2, 3, and 6.

Objective 1: Locate coral and sponge assemblages in the sanctuary.

Objective 2: Define (map) the area of coverage of any “major” assemblages.

Objective 3: Identify to the lowest taxonomic level possible, the species providing biogenic structure.

Objective 4: Characterize the diversity, abundance and richness of species associated with coral-sponge habitat areas. Related research questions follow:

- Is the species diversity/abundance/richness of non-coral and sponge species different in coral/sponge areas than in adjacent areas without coral or sponges?

Objective 5: Document evidence of potential environmental disturbances that may present risks to deep coral and sponge health. Related research questions follow:

- Evaluate fishing/harvest pressures on coral-sponge assemblages and their associated fauna and how these vary due to fishing intensity.
- Is the condition of coral/sponges different in trawlable versus untrawlable habitats?
- Within trawlable habitats, is the condition of corals/sponges different between two levels of fishing intensity?
- Is the condition of coral/sponges different in closed areas than non-closed areas?

Objective 6: Document the substrate/habitat (and any other environmental features) the coral and sponge assemblages inhabit.

Objective 7: Collect and assess fish-habitat association information.

Objective 8: Monitor recovery of trawlable habitats within the Olympic 2 EFH Conservation Area to characterize changes in epifauna over time.

STUDY SITE

The study area is located in OCNMS, which is off the western coast of Washington state (Figure 1). The sanctuary boundary follows the international border with Canada in the north, an offshore boundary approximating the 200m bathymetric contour, and the southern boundary northwest of Grays Harbor. OCNMS therefore covers most of the continental shelf in northern Washington. The offshore boundaries, which extend seaward 40 to 70 km (24 to 45 miles), also cross the heads of three major submarine canyons, in places reaching a maximum depth of over 1,400 meters (4,500 feet). OCNMS spans 8,259 square kilometers (3,189 square miles) of marine waters off Washington.

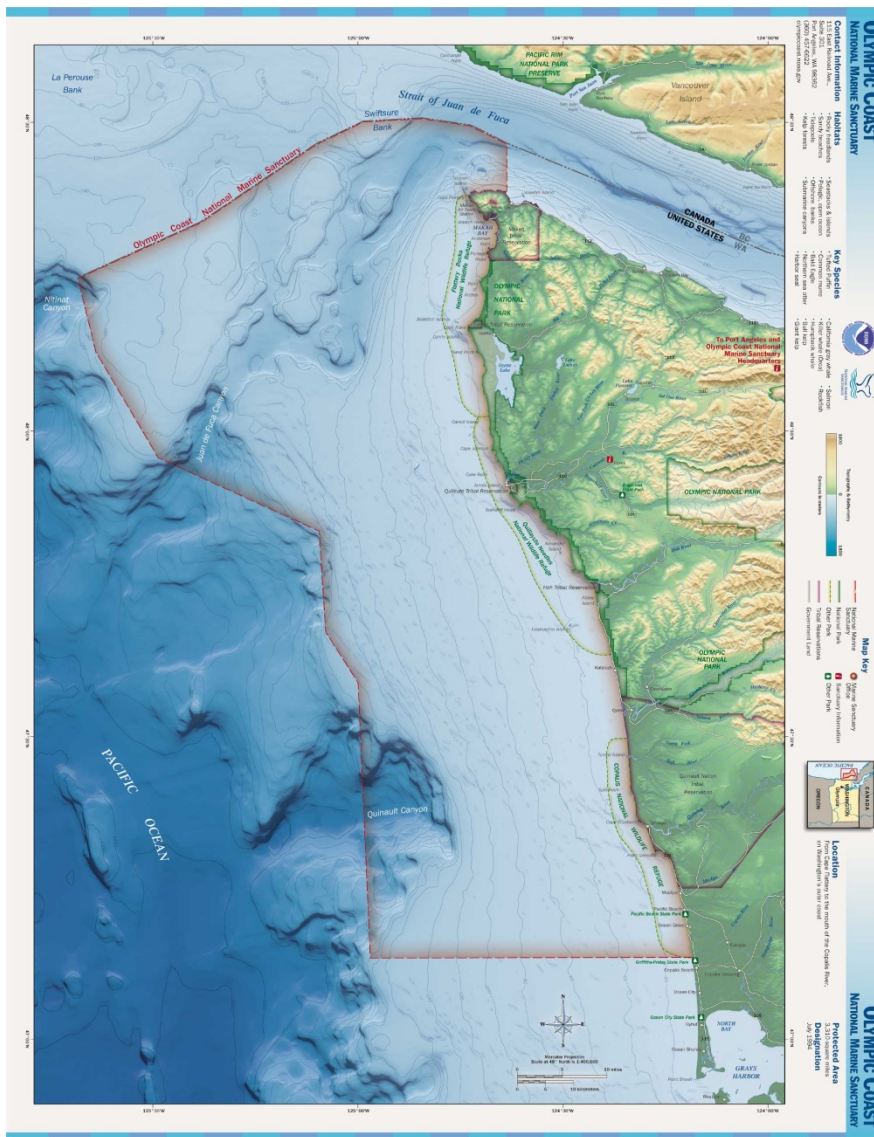


Figure 1. Map of the Olympic Coast National Marine Sanctuary showing shelf and canyon bathymetric relief off the Washington coast of the United States.

Because gorgonian and stony corals generally recruit to hard substrates, side scan sonar data were reviewed by OCNMS scientists to delineate potential hard-bottom substrates to serve as ROV dive targets (Intelmann et al. 2007). Potential hard-bottom features were initially identified from side scan sonar mosaics for which habitat classification had not yet been conducted. These hard-bottom approximations based on side scan data represented the population of known potential coral-sponge habitat in the sanctuary.

In addition to the side scan sonar imagery, multibeam bathymetry and backscatter was also queried for the purpose of limiting dive depths and evaluating bathymetric relief. However only small portions of the sanctuary have been mapped using high resolution multibeam since multibeam surveys off the Washington coast had been restricted, until recently, due to Navy classified areas (Intelmann et al. 2007).

We used these acoustic maps of hard bottom areas to select 48 candidate ROV dive sites as areas of potential coral and sponge habitat for the 2006 DSC survey (Figure 2).

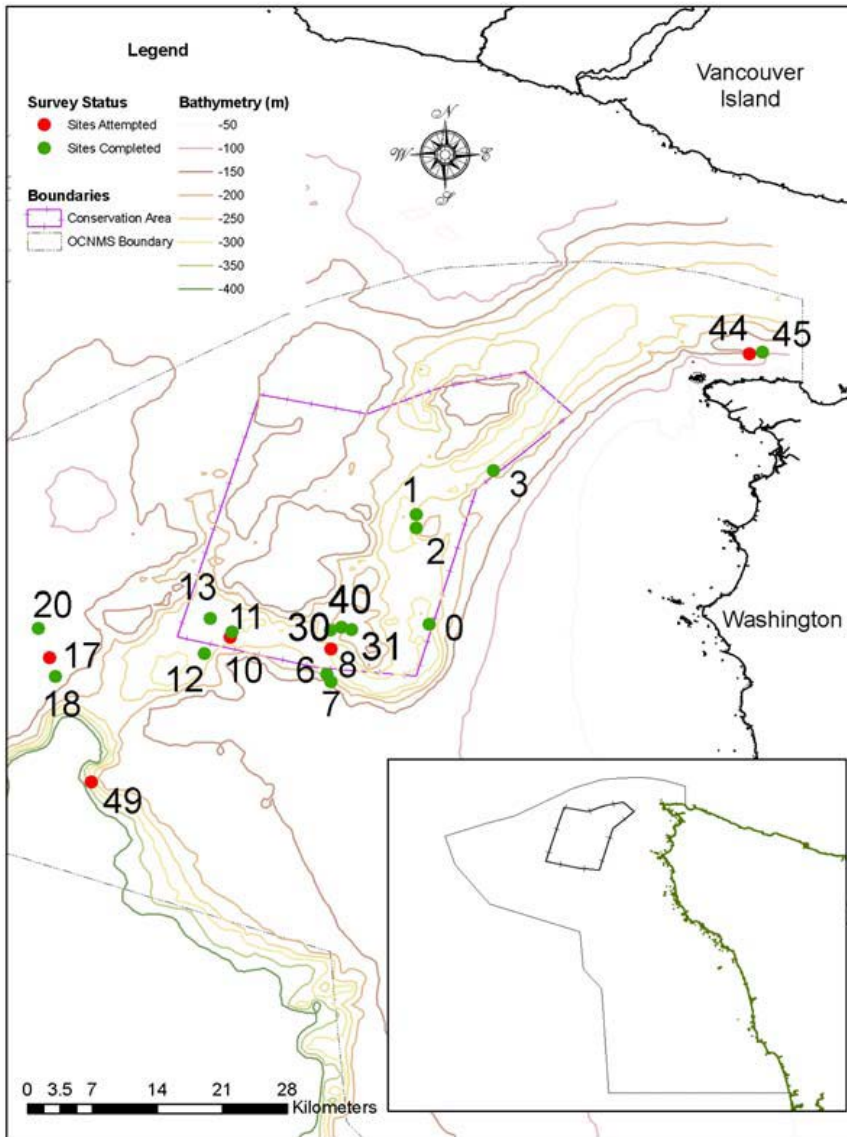


Figure 2. 2006 ROV dive sites in OCNMS and within the EFH Conservation Area Olympic 2.

The Juan de Fuca trough and canyon revealed many of the hard bottom features we looked for. They wind their way southwestward from the Strait of Juan de Fuca (Figure 1). The upper part of this feature – the Juan de Fuca Trough – is a complex, glacially carved, underwater fjord-like system. Farther offshore the trough becomes the Juan de Fuca Canyon that cuts across the outer continental shelf and slope, terminating in deep water at the base of the continental slope. Most of our dive targets were located along the Juan de Fuca Trough, consisting largely of glacial deposits; some sites included glacial erratic boulders left either by the retreat of the Cordilleran ice sheet from Canada and the Olympic Peninsula, or carried to their location by icebergs from the sheet and deposited on the primarily sand or silt shelf substrate.

Analysis of seafloor substrate data used for groundfish EFH designation in 2006, limited as it was, indicated that approximately six percent of OCNMS was hard substrate with potential to host biologically structured habitat. Of this estimated hard substrate, 29 percent was within the Olympic 2 EFH conservation area (Figure 3, from NOAA 2011). More recent surveys by OCNMS researchers with ROV and acoustic surveys have documented corals and other biologically-structured habitat in additional areas, which indicates that this preliminary analysis may underestimate the historic or current distribution of biogenic habitat.

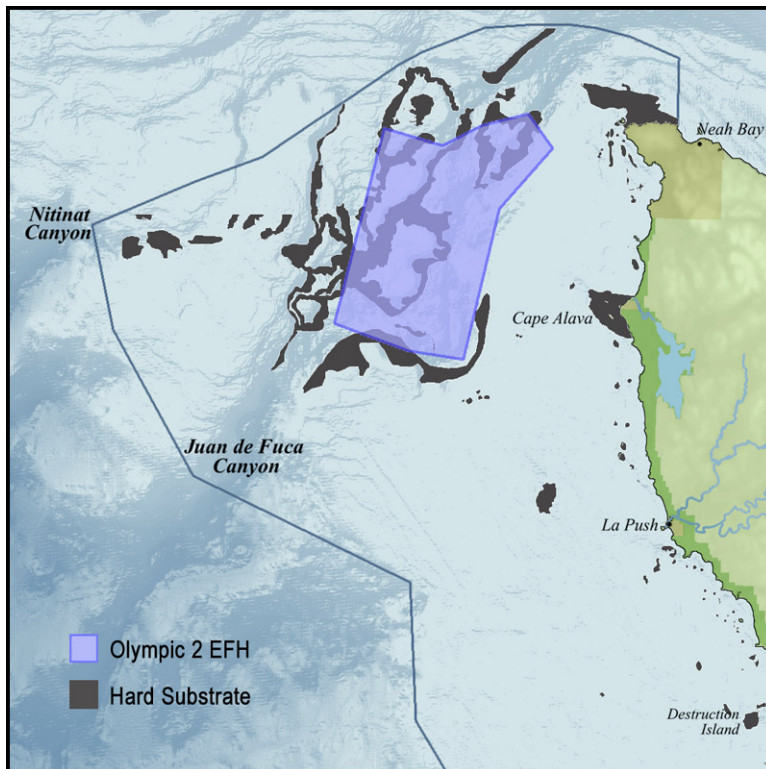


Figure 3. Potential historic distribution of biologically structured habitat associated with hard substrate overlaid on Olympic 2 EFH Conservation Area (data from Curt Whitmire, NOAA, as recorded in NOAA 2011).

FIELD SURVEY METHODS



NOAA Ship *McArthur II*



ROPOS ROV

ROV surveys were conducted 24 hours/day with alternating 12 hour shifts of science and ROV teams. The Canadian Scientific Submersible Facility supplied the ROPOS ROV, which operated off the NOAA Ship *McArthur II*.

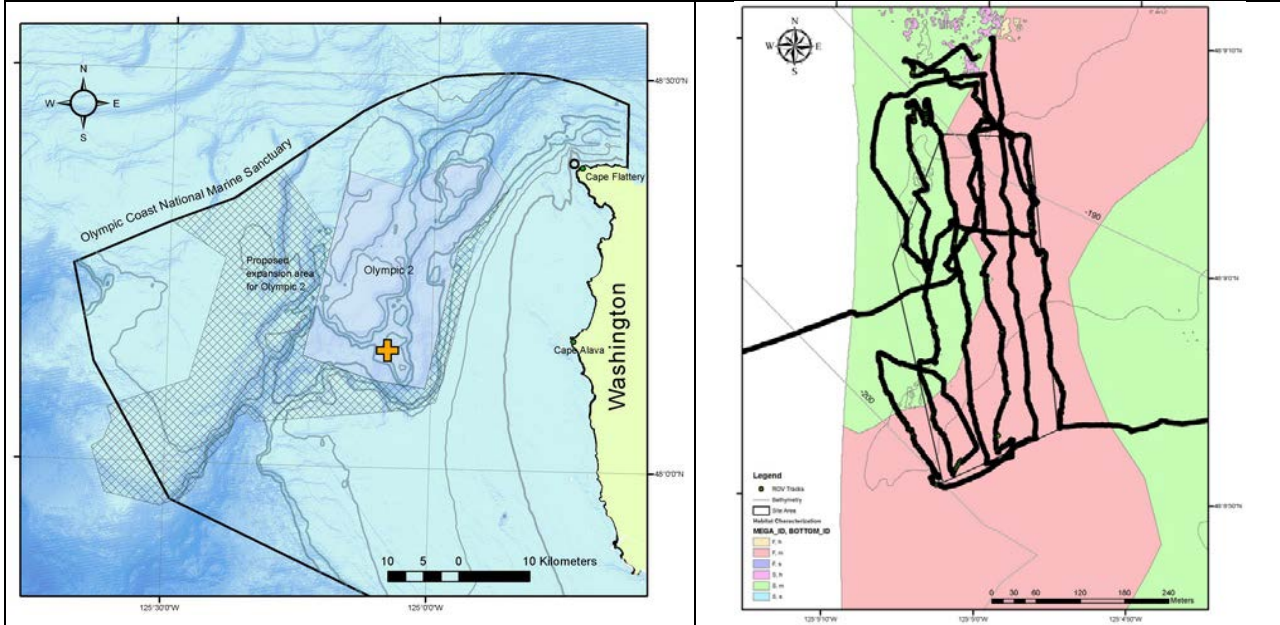
The ROV survey followed scientific protocols previously established by OCNMS and NCCOS (Hyland et al. 2005) and that was explained in detail in Brancato et al. 2007. Pre-selected transect lines, generally spaced 40m apart, were developed for each of the sites in order for the ROPOS ROV to run quantitative video surveys, operating at depths between 44-372 meters. Protocol included limited sampling of portions of coral colonies that would confirm taxonomic identification, genetics, and for use in aging studies; limited sponge sampling occurred as well. Post-processing of video records would characterize distribution and abundance of coral and sponge species across substratum types and to determine species associations. Although quantitative video analysis for fish has not been completed to date, fish species were identified during invertebrate analysis, when feasible. Quantification of some sites for habitat types and for deep-sea coral and sponge densities is in progress as well.

SUMMARY OF DIVES

DIVE NUMBER: 952

SURVEY AREA: 30

GENERAL LOCATION AND DIVE TRACK



SITE OVERVIEW

Project	2006 Deep Sea Coral Research Cruise, Olympic Coast National Marine Sanctuary
Chief Scientist	Ed Bowlby ¹
Co-Principal Investigators	Mary Sue Brancato and Jeff Hyland
Contact Info ¹	ed.bowlby@noaa.gov Olympic Coast National Marine Sanctuary 115 E Railroad Ave. Suite 301, Port Angeles, WA, 98362
Purpose	Locate and characterize the distribution and abundance of deep-sea coral and sponge habitats in OCNMS.
Vehicle	NOAA Ship <i>McArthur II</i> , ROPOS ROV
Science Observers	M.S. Brancato, P. Etnoyer, C. Whitmire J. Hyland and E. Bowlby
Forward View Tape Count	2
Digital Still Images	87
Oxygen mg/L (avg)	3.0
Salinity ppt (avg)	30.1
Temperature °C (avg)	6.8
# of Samples Collected	2

SITE DATA

Start Date	2006-05-26	Start Latitude	N 48° 8' 53.2752"
End Date	2006-05-26	Start Longitude	W125° 4' 54.5448"
Minimum Bottom Depth (m)	-152.7	End Latitude	N48° 9' 0.1548"
Maximum Bottom Depth (m)	-191.3	End Longitude	W125° 5' 1.4676"
Start Bottom (GMT)	03:21:35	Bottom Current (kts)	< 1 (estimated)
End Bottom (GMT)	07:46:15	Bottom Current Direction	N

IMAGE GALLERY

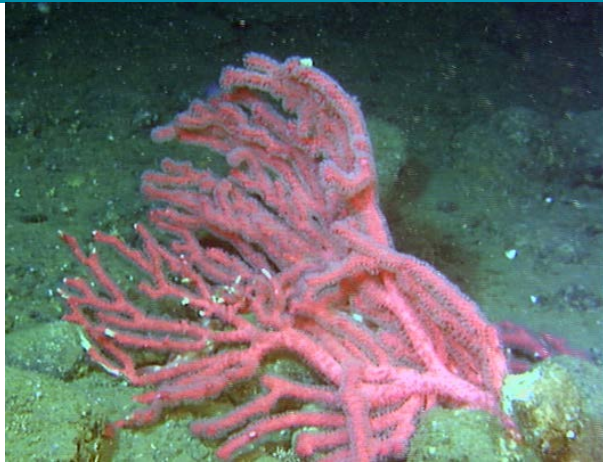


IMAGE A: A bubblegum coral colony *Paragorgia arborea pacifica* on boulder sand habitat

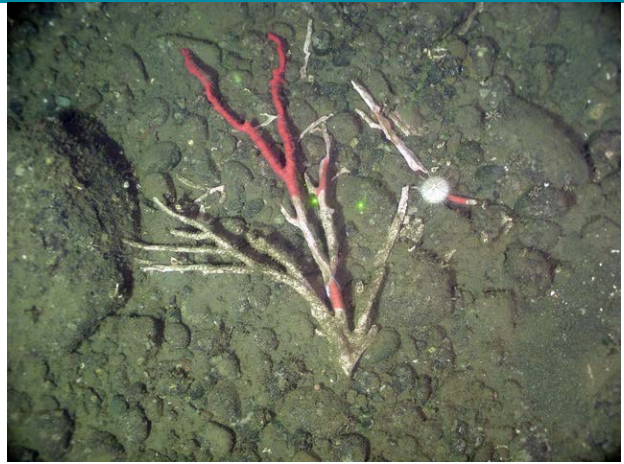


IMAGE B: Mostly dead branches from a bubblegum coral colony *Paragorgia arborea pacifica* on cobble habitat



IMAGE C: Large sponge on cobble boulder habitat



IMAGE D: *Plumarella longispina* with a nudibranch attached on sand pebble habitat

DIVE NUMBER: 952

SURVEY AREA: 30

PHYSICAL ENVIRONMENT

Habitats

The substrate at survey site 30 varied with pebble, cobble and boulders. Quantification of habitat types for this site is in progress.

DIVE NUMBER: 952

SURVEY AREA: 30

BIOLOGICAL ENVIRONMENT

Corals

Paragorgia arborea pacifica was the predominant coral at this site, but various *Swiftia* species, *Plumarella longispina* and a hydrocoral were also documented. Dead or damaged *Paragorgia* was also found at this site. Quantification of coral distribution/abundance for this site is in progress.

DIVE NUMBER: 952

SURVEY AREA: 30

BIOLOGICAL ENVIRONMENT

Sponges

Quantification of sponge distribution/abundance for this site is in progress.

DIVE NUMBER: 952

SURVEY AREA: 30

BIOLOGICAL ENVIRONMENT

Fishes

Quantification of fish distribution/abundance for this site is in progress.

ADDITIONAL COMMENTS

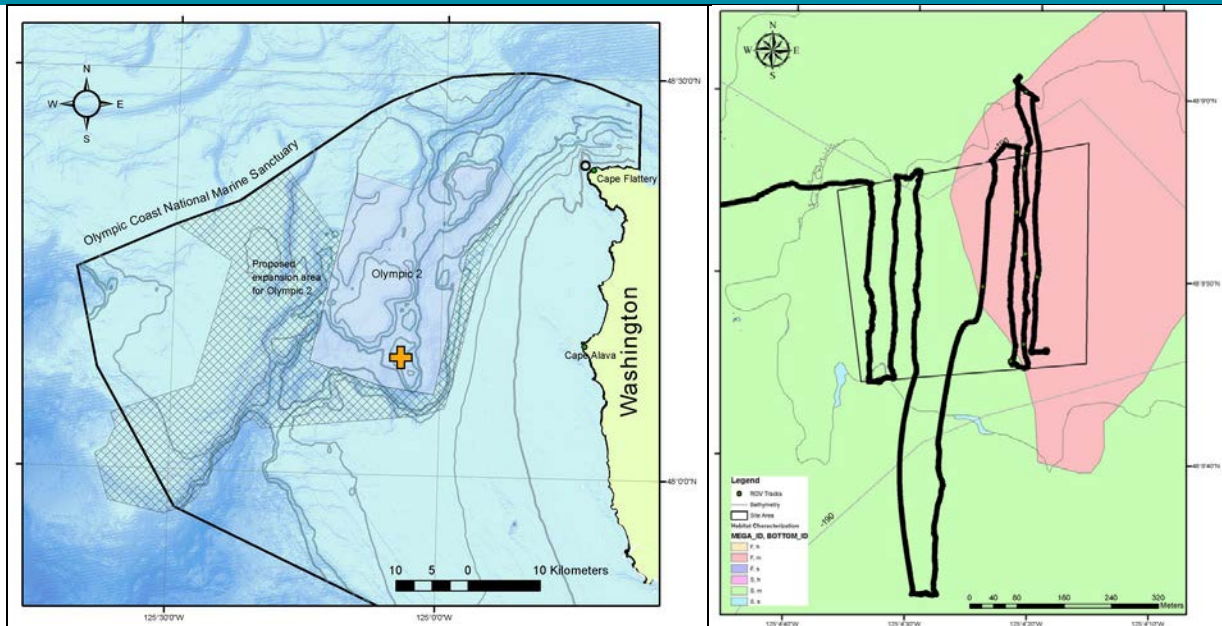
This is another site near which the NOAA Fisheries bycatch database indicated sponges or corals were part of the bycatch. Survey site 30 is inside Olympic 2 Conservation Area. This site was surveyed for about four hours, encountering currents 1 knot or less, starting and ending from the north, but switching from the southeast in the middle. The depth at this site ranged from 153 to

191 meters. Relatively low average salinity (30.1 ppt) was calculated at this site but the coral species did not appear to differ from those observed at other sites.

DIVE NUMBER: 952

SURVEY AREA: 31

GENERAL LOCATION AND DIVE TRACK



SITE OVERVIEW

Project	2006 Deep Sea Coral Research Cruise, Olympic Coast National Marine Sanctuary
Chief Scientist	Ed Bowlby ¹
Co-Principal Investigators	Mary Sue Brancato and Jeff Hyland
Contact Info ¹	ed.bowlby@noaa.gov Olympic Coast National Marine Sanctuary 115 E Railroad Ave. Suite 301, Port Angeles, WA, 98362
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Vehicle	NOAA Ship <i>McArthur II</i> , ROPOS ROV
Science Observers	M.S. Brancato, P. Etnoyer, C. Whitmire J. Hyland and E. Bowlby

Forward View Tape Count	7
Digital Still Images	195
Oxygen mg/L (avg)	3.39
Salinity ppt (avg)	33.92
Temperature °C (avg)	6.72
# of Samples Collected	3

SITE DATA

Start Date	2006-05-25	Start Latitude	N48° 8' 46.1328"
End Date	2006-05-26	Start Longitude	W125° 4' 18.7968"
Minimum Bottom Depth (m)	-187.2	End Latitude	N48° 8' 55.0608"
Maximum Bottom Depth (m)	-210.7	End Longitude	W125° 4' 33.8736"
Start Bottom (GMT)	21:30:06	Bottom Current (kts)	0.5 (estimated)
End Bottom (GMT)	03:00:36	Bottom Current Direction	W

IMAGE GALLERY



IMAGE A: Bubblegum coral colony *Paragorgia arborea pacifica* with a hermit crab halfway up branch on left on pebble sand habitat

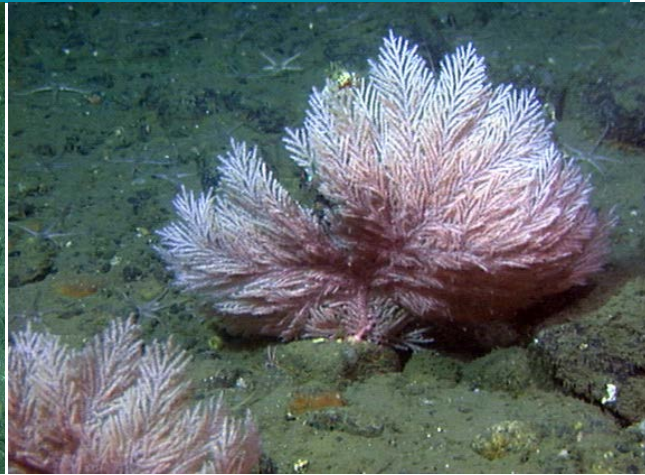


IMAGE B: Gorgonian colonies *Plumarella longispina* on gravel sand habitat



IMAGE C: Fishing line entangled in a bubblegum coral colony *Paragorgia arborea pacifica* on gravel sand habitat

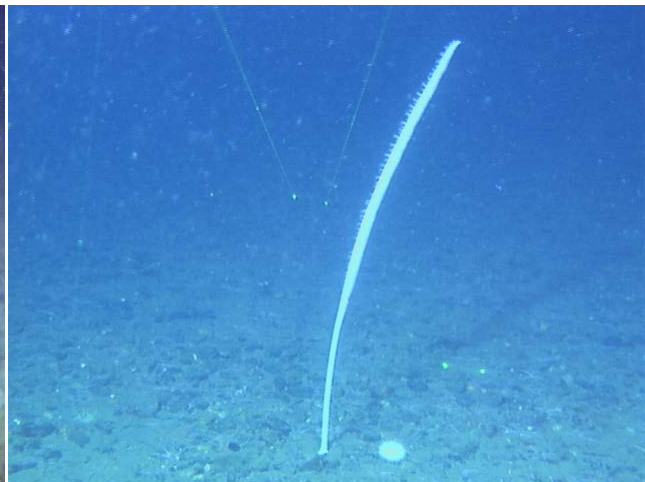


IMAGE D: A sea whip coral on gravel pebble habitat

DIVE NUMBER: 952

SURVEY AREA: 31

PHYSICAL ENVIRONMENT

Habitats

The substrate at survey site 31 was somewhat similar to 30 but with more mud in addition to the pebble, cobble and boulders. Quantification of habitat types for this site is in progress.

DIVE NUMBER: 952

SURVEY AREA: 31

BIOLOGICAL ENVIRONMENT

Corals

Several gorgonians, including *Paragorgia arborea pacifica* were documented, as well as sea pens and hydrocorals. Quantification of coral distribution/abundance for this site is in progress.

DIVE NUMBER: 952

SURVEY AREA: 31

BIOLOGICAL ENVIRONMENT

Sponges

Quantification of sponge distribution/abundance for this site is in progress.

DIVE NUMBER: 952

SURVEY AREA: 31

BIOLOGICAL ENVIRONMENT

Fishes

Quantification of fish distribution/abundance for this site is in progress.

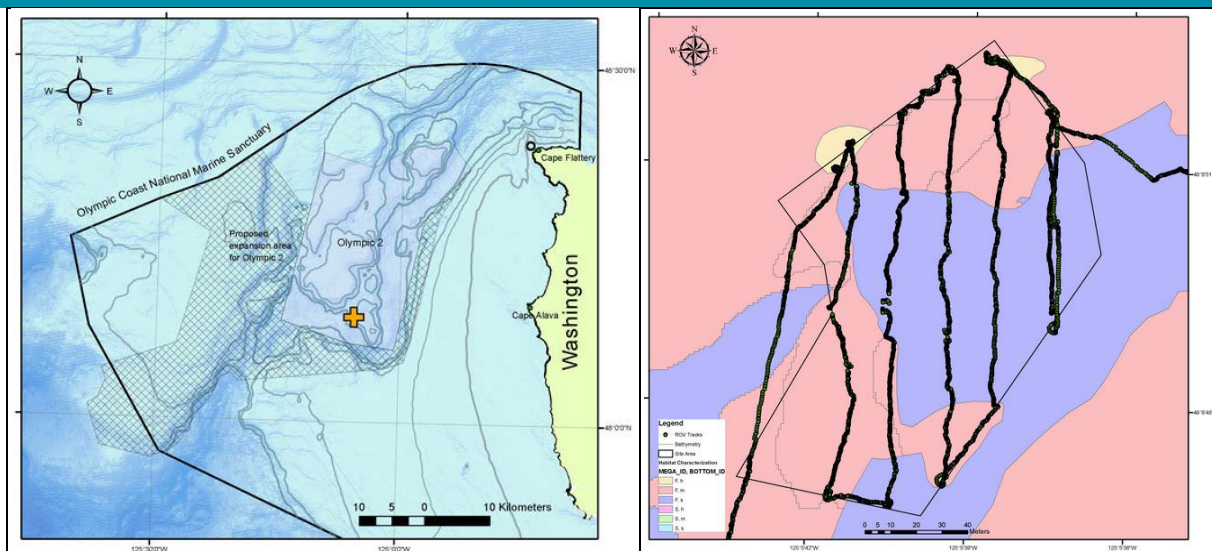
ADDITIONAL COMMENTS

The site was surveyed for about 4 hours, encountering negligible currents (0.5 knots) mainly from the west. Depth ranged from 187 to 211 meters. Survey site 31 is inside Olympic 2 Conservation Area. Lost fishing gear entangled on corals was observed at this site.



**DIVE
NUMBER: SURVEY AREA: 40
952**

GENERAL LOCATION AND DIVE TRACK



SITE OVERVIEW

Project	2006 Deep Sea Coral Research Cruise, Olympic Coast National Marine Sanctuary		
Chief Scientist	Ed Bowlby ¹		
Co-Principal Investigators	Mary Sue Brancato and Jeff Hyland		
Contact Info ¹	ed.bowlby@noaa.gov Olympic Coast National Marine Sanctuary 115 E Railroad Ave. Suite 301, Port Angeles, WA, 98362		
Purpose	Locate and characterize the distribution and abundance of deep-sea coral and sponge habitats in OCNMS.		
Vehicle	NOAA Ship <i>McArthur II</i> , ROPOS ROV		
Science Observers	M.S. Brancato, P. Etnoyer, C. Whitmire J. Hyland and E. Bowlby		
Forward View Tape Count	1		
Digital Still Images	14		
Oxygen mg/L (avg)	2.9		
Salinity ppt (avg)	26.6		
Temperature °C (avg)	6.8		
# of Samples Collected	0		

SITE DATA

Start Date	2006-05-26	Start Latitude	N 48° 8' 51.6552"
End Date	2006-05-26	Start Longitude	W 125° 5' 37.4424"

Minimum Bottom Depth (m)	-188.5	End Latitude	N 48° 8' 51.2772"
Maximum Bottom Depth (m)	-208.4	End Longitude	W 125° 5' 41.2152"
Start Bottom (GMT)	08:17:57	Bottom Current (kts)	0.2 (estimated)
End Bottom (GMT)	09:29:28	Bottom Current Direction	NE

IMAGE GALLERY



IMAGE A: Gorgonian colony *Swiftia beringi* on boulder mud habitat

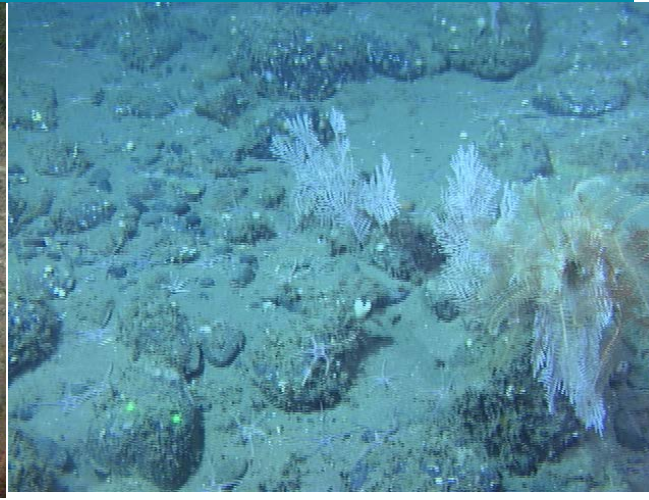


IMAGE B: *Plumarella longispina* on boulder mud habitat



IMAGE C: Gorgonian colonies of *Swiftia beringi* on boulder mud habitat

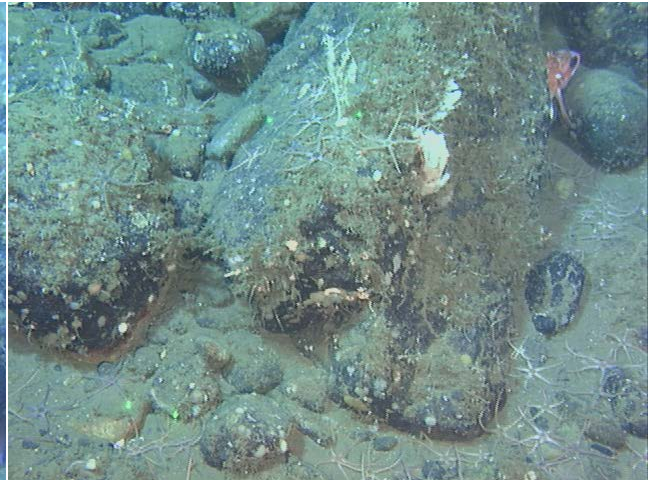


IMAGE D: *Swiftia beringi* colony on boulder mud habitat

DIVE NUMBER: 952

SURVEY AREA: 40

PHYSICAL ENVIRONMENT

Habitats

This is a muddy mixed substrate site of pebble and gravel with occasional boulders. Quantification of habitat types for this site is in progress.

DIVE NUMBER: 952

SURVEY AREA: 40

BIOLOGICAL ENVIRONMENT

Corals

Paragorgia arborea pacifica and various *Swiftia* species were documented at this muddy mixed substrate site of pebble and gravel with occasional boulders. Quantification of coral distribution/abundance for this site is in progress.

DIVE NUMBER: 952

SURVEY AREA: 40

BIOLOGICAL ENVIRONMENT

Sponges

Quantification of sponge distribution/abundance for this site is in progress.

DIVE NUMBER: 952

SURVEY AREA: 40

BIOLOGICAL ENVIRONMENT

Fishes

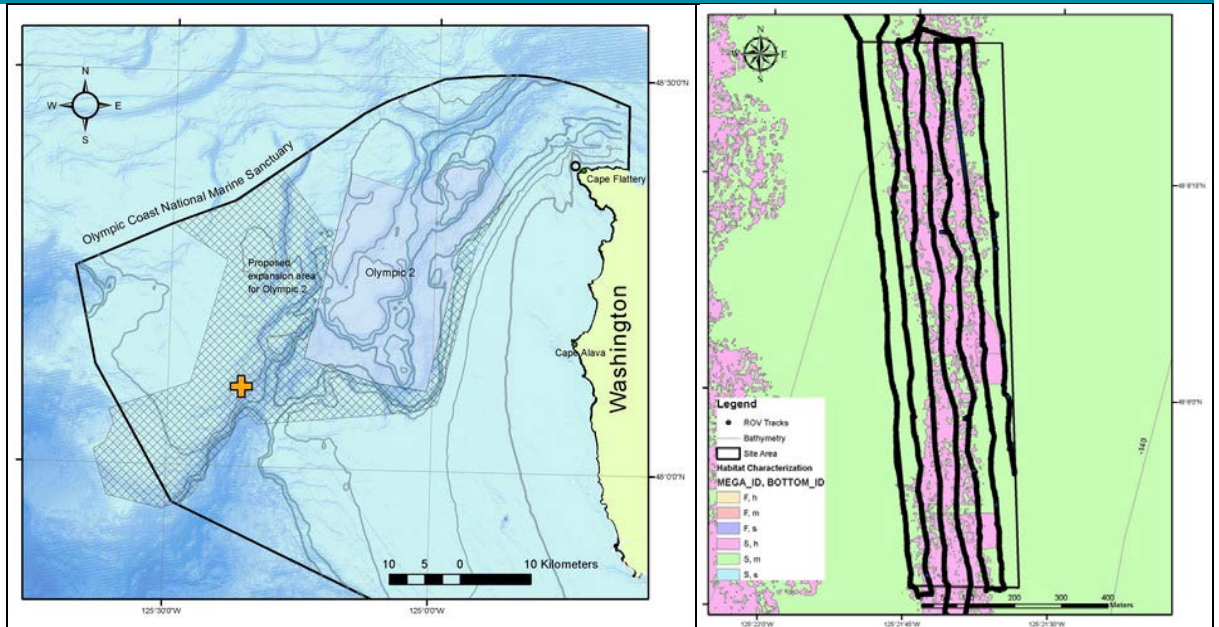
Quantification of fish distribution/abundance for this site is in progress.

ADDITIONAL COMMENTS

Survey site 40 is inside Olympic 2 Conservation Area. This tiny site was surveyed for only about an hour in currents of only about 0.2 knots from the northeast. This site had the slightest change in depth over the survey area, ranging from 189 to 208 meters. Average salinity was low (26.7 ppt) but this may be an artifact of the short dive time.

**DIVE
NUMBER: SURVEY AREA: 18
953**

GENERAL LOCATION AND DIVE TRACK



SITE OVERVIEW

Project	2006 Deep Sea Coral Research Cruise, Olympic Coast National Marine Sanctuary
Chief Scientist	Ed Bowlby ¹
Co-Principal Investigators	Mary Sue Brancato and Jeff Hyland
Contact Info ¹	ed.bowlby@noaa.gov Olympic Coast National Marine Sanctuary 115 E Railroad Ave. Suite 301, Port Angeles, WA, 98362
Purpose	Locate and characterize the distribution and abundance of deep-sea coral and sponge habitats in OCNMS.
Vehicle	NOAA Ship <i>McArthur II</i> , ROPOS ROV
Science Observers	M.S. Brancato, P. Etnoyer, C. Whitmire J. Hyland and E. Bowlby
Forward View Tape Count	2
Digital Still Images	157
Oxygen mg/L (avg)	4.4
Salinity ppt (avg)	33.6
Temperature °C (avg)	7.7
# of Samples Collected	1

SITE DATA

Start Date	2006-05-26	Start Latitude	N 48° 5' 54.6792"
End Date	2006-05-27	Start Longitude	W 125° 21' 33.6276"
Minimum Bottom Depth (m)	-87.9	End Latitude	N 48° 6' 24.2748"
Maximum Bottom Depth (m)	-276.4	End Longitude	W 125° 21' 51.0156"
Start Bottom (GMT)	17:56:44	Bottom Current (kts)	<1 (estimated)
End Bottom (GMT)	00:55:46	Bottom Current Direction	not determined

IMAGE GALLERY



IMAGE A: *white encrusting sponge* on boulder habitat

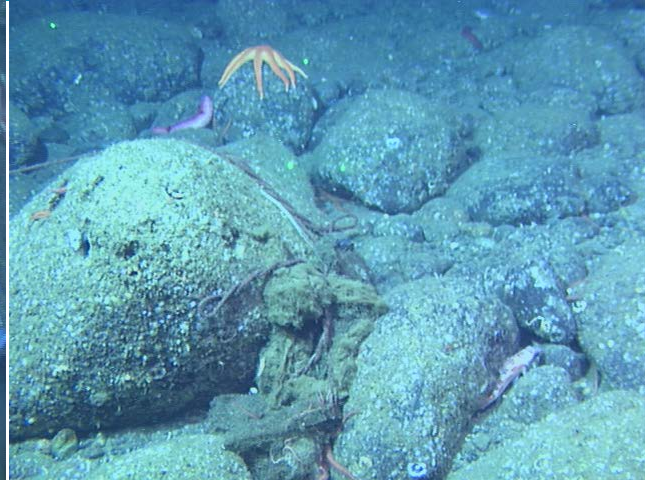


IMAGE B: anthropogenic observations on boulder habitat



IMAGE C: Tiger rockfish (*Sebastes nigrocinctus*) on boulder habitat

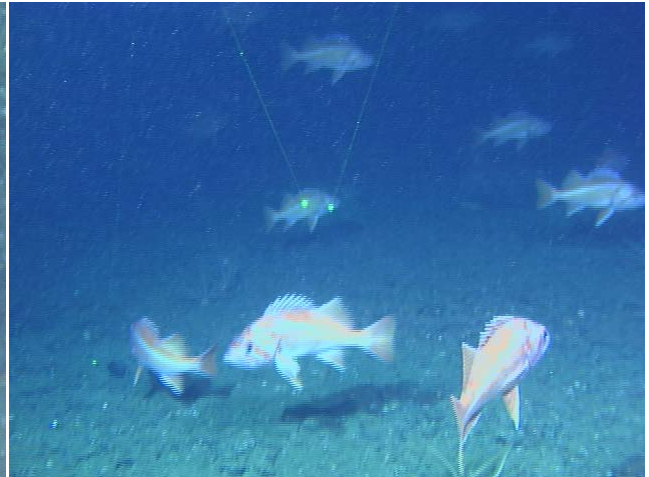


IMAGE D: school of Canary rockfish (*Sebastes pinniger*) on sand pebble habitat

DIVE NUMBER: 953

SURVEY AREA: 18

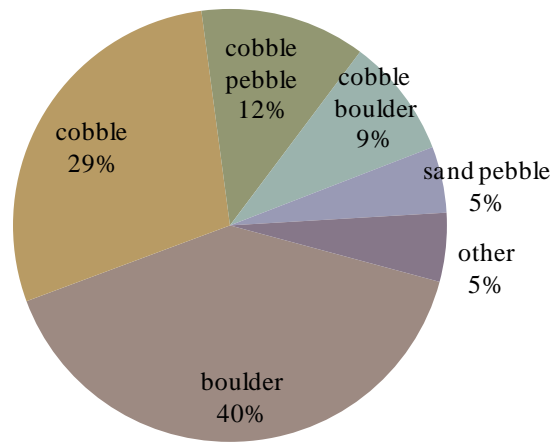
PHYSICAL ENVIRONMENT

Habitats

The total area surveyed at this site was 16,983 m². Site 18 consisted of a boulder field (40%) and mixed cobble and boulder areas (9%) surrounded by cobble (29%) and cobble pebble (12%).

Habitats Surveyed

area = 16,983 m²



DIVE NUMBER: 953

SURVEY AREA: 18

BIOLOGICAL ENVIRONMENT

Corals

At least one coral species was observed but not identified.

Color Code	Coral Groups	Counts
	<i>unidentified</i>	1

BIOLOGICAL ENVIRONMENT

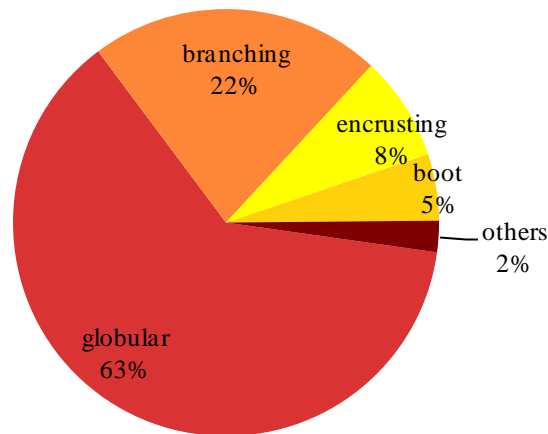
Sponges

The globular sponge morph was the most abundant at 63%, followed by branching sponge morph (22%). There were also encrusting and boot sponge morphs observed as well as a few other morphs. Many sponge fragments were also observed.

Other invertebrates observed included crinoids (*Florometra serratissima*), urchins (*Strongylocentrotus pallidus*), sea cucumbers (*Parastichopus leukothele* and *P. californicus*), ophiuroid brittle stars, and various sea stars.

Density of Sponges

60 sponges / 1,000m²



Color Code	Class	Structural Morphs	Count
	Demosponge	globular	637
	Demosponge	branching	224
	Hexactinellids	encrusting	80
	Hexactinellids	boot	51
	Demosponge	vase	9
	Hexactinellids	farrea	5
	Demosponge	single tube	5
	Demosponge	multi-tube	1

BIOLOGICAL ENVIRONMENT

Fishes

There were many rockfish species observed at site 18 including rosethorn (*Sebastes helvomaculatus*), canary (*Sebastes pinniger*), redstriped (*Sebastes proriger*), tiger (*Sebastes nigrocinctus*), yelloweye (*Sebastes ruberrimus*), and greenstriped (*Sebastes elongatus*). Thorneyheads (*Sebastolobus* sp.) were noted at the site and some of the other fish species included Pacific halibut (*Hippoglossus strenolepis*), lingcod (*Ophiodon elongatus*), spotted ratfish (*Hydrolagus coliei*) and multiple flatfish species.

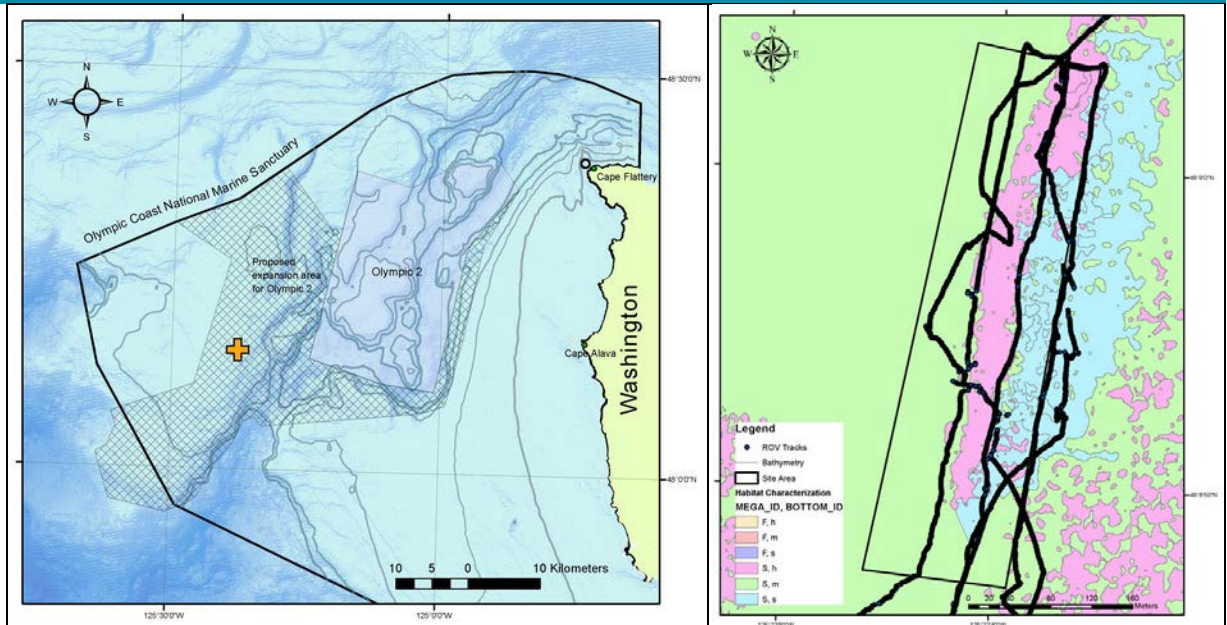
Scientific Name	Common Name
<i>Sebastes helvomaculatus</i>	rosethorn rockfish
<i>Sebastes pinniger</i>	canary rockfish
<i>Sebastes proriger</i>	redstriped rockfish
<i>Sebastes nigrocinctus</i>	tiger rockfish
<i>Sebastes ruberrimus</i>	yelloweye rockfish
<i>Sebastes elongatus</i>	greenstriped rockfish
<i>Sebastolobus</i> sp.	thorneyhead
<i>Hippoglossus strenolepis</i>	Pacific halibut
Pleuronectidae	righteye flounders
<i>Ophiodon elongatus</i>	lingcod
<i>Hydrolagus coliei</i>	spotted ratfish
Agonidae	poachers
<i>Eptatretus</i> sp.	hagfish

ADDITIONAL COMMENTS

We surveyed the site for about 7.5 hours during which time current speeds started at a high of about 1.25 knots, slowing to less than a knot after the first 1.5 hours and remaining low for the rest of the survey. Lost fishing gear, netting and trawl tracks were evident at this site. Survey site 18 is outside Olympic 2 Conservation Area.

**DIVE
NUMBER: SURVEY AREA: 20
953**

GENERAL LOCATION AND DIVE TRACK



SITE OVERVIEW

Forward View Tape Count	1
Digital Still Images	12
Oxygen mg/L (avg)	no data
Salinity ppt (avg)	no data
Temperature °C (avg)	no data
# of Samples Collected	0

SITE DATA

Start Date	2006-05-27	Start Latitude	N 48° 8' 46.5720"
End Date	2006-05-27	Start Longitude	W 125° 22' 39.1728"
Minimum Bottom Depth (m)	unavailable	End Latitude	N 48° 8' 47.1084"
Maximum Bottom Depth (m)	unavailable	End Longitude	W 125° 22' 43.5432"
Start Bottom (GMT)	03:34:28	Bottom Current (kts)	not detected
End Bottom (GMT)	05:30:53	Bottom Current Direction	n/a

IMAGE GALLERY



IMAGE A: lunar sponge (*Latrunculia* sp.; globular morph) on boulder habitat



IMAGE B: big skate on pebble gravel habitat

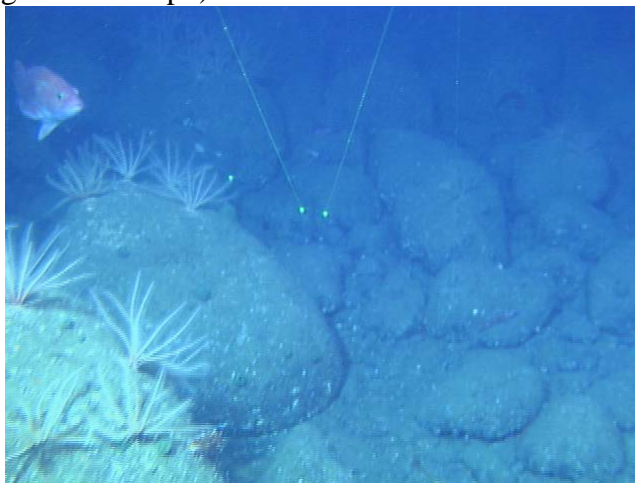


IMAGE C: yelloweye rockfish (*Sebastes ruberrimus*) over boulder habitat

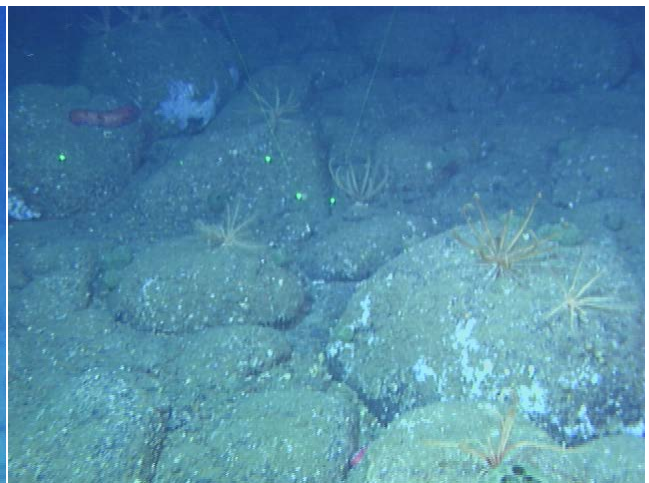


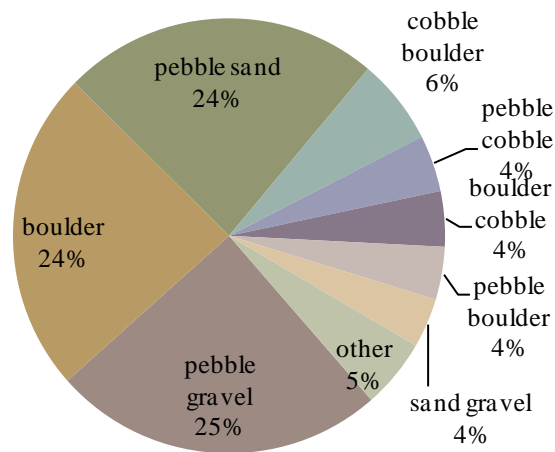
IMAGE D: encrusting white sponge on boulder habitat

Habitats

The total area surveyed at site 20 was 4,663/m². The site was dominated by substrates of gravel, sand and pebble (49%). There were also boulder patches observed (24%). Some areas of sand waves were also noted.

Habitats Surveyed

area = 4663 / m²



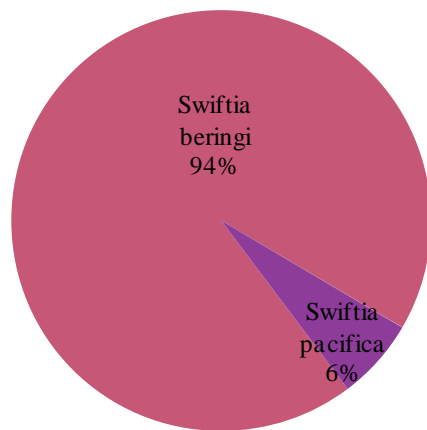
BIOLOGICAL ENVIRONMENT

Corals

This site was dominated by areas of boulder patches with two *Swiftia* species prominent, both *S. beringi* and *S. pacifica*.

Density of Corals

3.4 corals / 1,000m²



Color Code	Coral Groups	Counts
	<i>Swiftia beringi</i>	15
	<i>Swiftia pacifica</i>	1

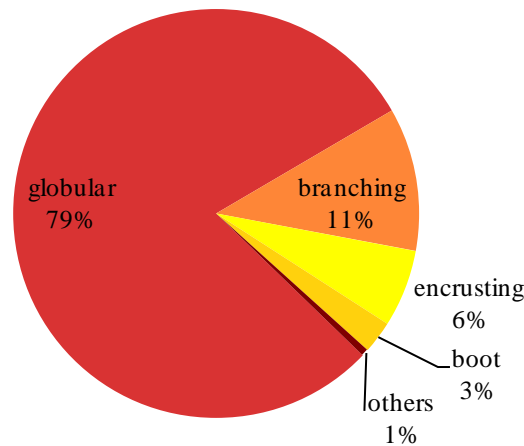
Sponges

The globular ball sponge morph was the most abundant sponge at 79% of the total density. The globular morphs observed were primarily green lunar sponges (*Latrunculia* sp.) found on boulders. Other sponge morphs consisted of branching, encrusting and boot.

Other invertebrates observed at this site were crinoids (*Florometra serratissima*), sea cucumbers, both *Parastichopus leukothele* and *P. californicus*, and various anemones and sea star species.

Density of Sponges

426 sponges / 1,000m²



Color Code	Class	Structural Morphs	Count
	Demosponge	globular	1,576
	Demosponge	branching	228
	Hexactinellids	encrusting	122
	Hexactinellids	boot	51
	Hexactinellids	farrea	5
	Demosponge	single tube	5
	Demosponge	multi-tube	1



BIOLOGICAL ENVIRONMENT

Fishes

There were multiple rockfish species observed at site 20 including rosethorn (*Sebastes helvomaculatus*), canary (*Sebastes pinniger*), yellowtail (*Sebastes flavidus*), tiger (*Sebastes nigrocinctus*), and yelloweye (*Sebastes ruberrimus*). Other fish species were lingcod (*Ophiodon elongatus*), spotted ratfish (*Hydrolagus coliei*) and multiple flatfish species.

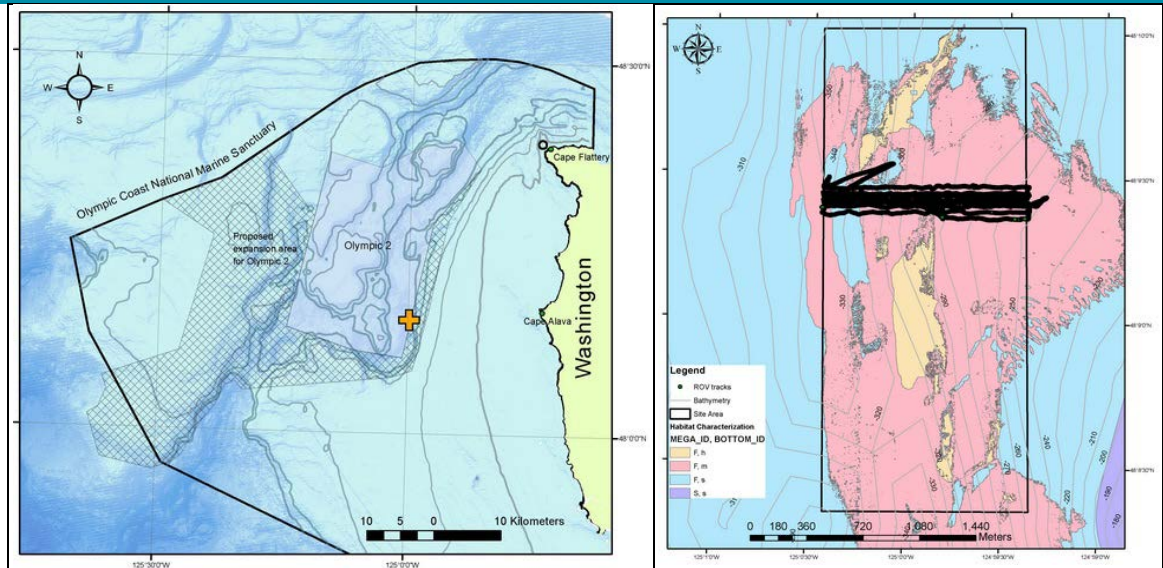
Scientific Name	Common Name
<i>Sebastes helvomaculatus</i>	rosethorn rockfish
<i>Sebastes pinniger</i>	canary rockfish
<i>Sebastes flavidus</i>	yellowtail rockfish
<i>Sebastes nigrocinctus</i>	tiger rockfish
<i>Sebastes ruberrimus</i>	yelloweye rockfish
Pleuronectidae	righteye flounders
<i>Ophiodon elongatus</i>	lingcod
<i>Hydrolagus coliei</i>	spotted ratfish
<i>Raja rhina</i>	longnose skate
<i>Eptatretus</i> sp.	hagfish

ADDITIONAL COMMENTS

Survey site 20 is outside Olympic 2 Conservation Area. This was also a site near where the NOAA Fisheries bycatch data indicated sponges or corals had been brought up as bycatch. We surveyed the site for about 2 hours during which currents were negligible.

**DIVE
NUMBER: SURVEY AREA: 0
956**

GENERAL LOCATION AND DIVE TRACK



SITE OVERVIEW

Project	2006 Deep Sea Coral Research Cruise, Olympic Coast National Marine Sanctuary
Chief Scientist	Ed Bowlby ¹
Co-Principal Investigators	Mary Sue Brancato and Jeff Hyland
Contact Info ¹	ed.bowlby@noaa.gov Olympic Coast National Marine Sanctuary 115 E Railroad Ave. Suite 301, Port Angeles, WA, 98362
Purpose	Locate and characterize the distribution and abundance of deep-sea coral and sponge habitats in OCNMS.
Vehicle	NOAA Ship <i>McArthur II</i> , ROPOS ROV
Science Observers	M.S. Brancato, P. Etnoyer, C. Whitmire J. Hyland and E. Bowlby
Forward View Tape Count	3
Digital Still Images	334
Oxygen mg/L (avg)	3.0
Salinity ppt (avg)	32.0
Temperature °C (avg)	6.9
# of Samples Collected	5

SITE DATA

Start Date 2006-05-30 Start Latitude N48° 9' 21.4164"

End Date	2006-05-31	Start Longitude	W124° 59' 48.1848"
Minimum Bottom Depth (m)	-253.8	End Latitude	N48° 9' 26.9892"
Maximum Bottom Depth (m)	-371.8	End Longitude	W125° 0' 26.4060"
Start Bottom (GMT)	20:35:02	Bottom Current (kts)	< 2 (estimated)
End Bottom (GMT)	10:14:54	Bottom Current Direction	S

IMAGE GALLERY



IMAGE A: Bubblegum coral colony *Paragorgia arborea pacifica* with extended polyps on cobble boulder habitat



IMAGE B: Bubblegum coral colony *Paragorgia arborea pacifica* with crinoids on cobble sand habitat. The front lower branches of this colony appear to be broken off.



IMAGE C: *Desmophyllum* sp. on boulder with rockfish association on cobble boulder habitat.

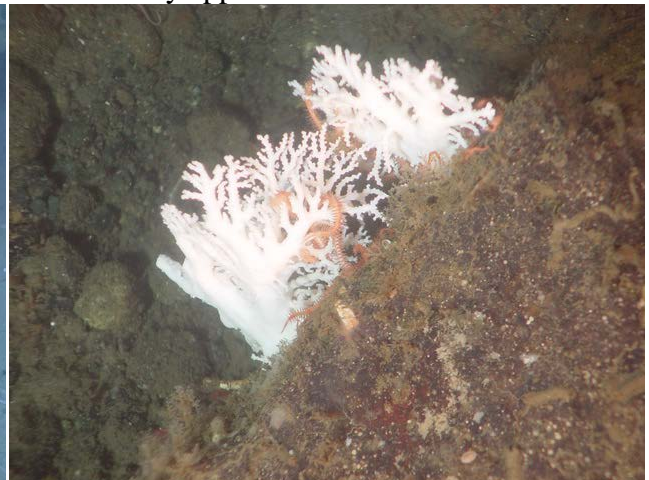


IMAGE D: Dueling *Stylaster* sp. attached to boulder with brittle stars entangled on cobble boulder habitat.

DIVE NUMBER: 956

SURVEY AREA: 0

PHYSICAL ENVIRONMENT

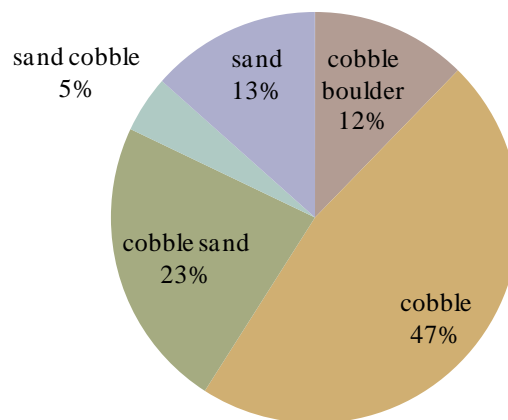
Habitats

The total area surveyed at site 0 was 16,128/m². This site was dominated by areas of cobble (47%) and mixed cobble with sand (23%) and cobble boulder (12%). There were a few sand patches observed (13%).

Survey site 0 is inside Olympic 2 Conservation Area. NOAA Fisheries bycatch data reviewed prior to the survey revealed sponges or corals near this site had been retrieved as bycatch.

Habitats Surveyed

area = 16,128 m²



DIVE NUMBER: 956

SURVEY AREA: 0

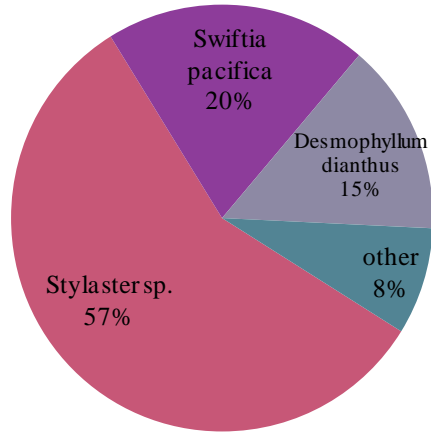
BIOLOGICAL ENVIRONMENT

Corals

The first documentation of *Lophelia pertusa* in OCNMS was made at survey site 0 in 2004 on a pilot study (Hyland et al. 2005). These colonies could not be located again in 2006, in spite of an extensive survey attempt. Rubble that appeared to be scleractinian skeletal material was recorded. Live corals observed included the hydrocoral *Stylaster* sp. (57%) and the gorgonian *Paragorgia arborea pacifica*, the giant cup coral *Desmophyllum dianthus* and various *Swiftia* species.

Density of Corals

14 corals / 1,000 m²



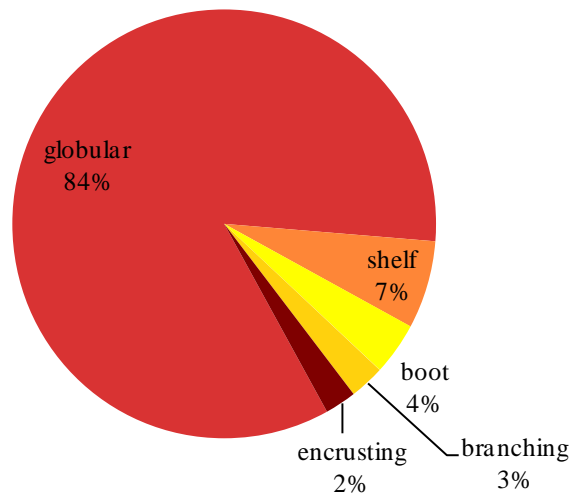
Color Code	Coral Groups	Counts
	<i>Stylaster</i> sp.	134
	<i>Swiftia pacifica</i>	47
	<i>Desmophyllum dianthus</i>	34
	<i>Swiftia beringi</i>	8
	<i>Paragorgia arborea pacifica</i>	6
	<i>Swiftia simplex</i>	4
	<i>Pennatula</i> sp.	1

Sponges

The globular sponge morph was the most abundant at 84% of the total density. Other sponge morphs included branching, encrusting and boot sponges.

Density of Sponges

23 sponges / 1,000 m²



Color Bar	Class	Structural Morphs	Count
	Demosponge	globular	1,576
	Demosponge	branching	228
	Hexactinellids	encrusting	122
	Hexactinellids	boot	51
	Hexactinellids	farrea	5
	Demosponge	single tube	5
	Demosponge	multi-tube	1

BIOLOGICAL ENVIRONMENT

Fishes

There were multiple rockfish species observed at this site including rosethorn (*Sebastes helvomaculatus*), redbanded (*Sebastes babcocki*), and aurora (*Sebastes aurora*) as well thornyheads (*Sebastolobus* sp.). Other fish species included Pacific halibut (*Hippoglossus strenolepis*), spotted ratfish (*Hydrolagus colliei*), big skate (*Raja binoculata*), longnose skate (*Raja rhina*) and multiple flatfish species.

Scientific Name	Common Name
<i>Sebastes helvomaculatus</i>	rosethorn rockfish
<i>Sebastes babcocki</i>	redbanded rockfish
<i>Sebastes aurora</i>	aurora rockfish
<i>Sebastolobus</i> sp.	thornyhead
<i>Hippoglossus strenolepis</i>	Pacific halibut
Pleuronectidae	righteye flounders
<i>Hydrolagus colliei</i>	spotted ratfish
<i>Raja binoculata</i>	big skate
<i>Raja rhina</i>	longnose skate
<i>Anoplopomatidae fimbria</i>	sablefish
Agonidae	poachers
<i>Eptatretus</i> sp.	hagfish

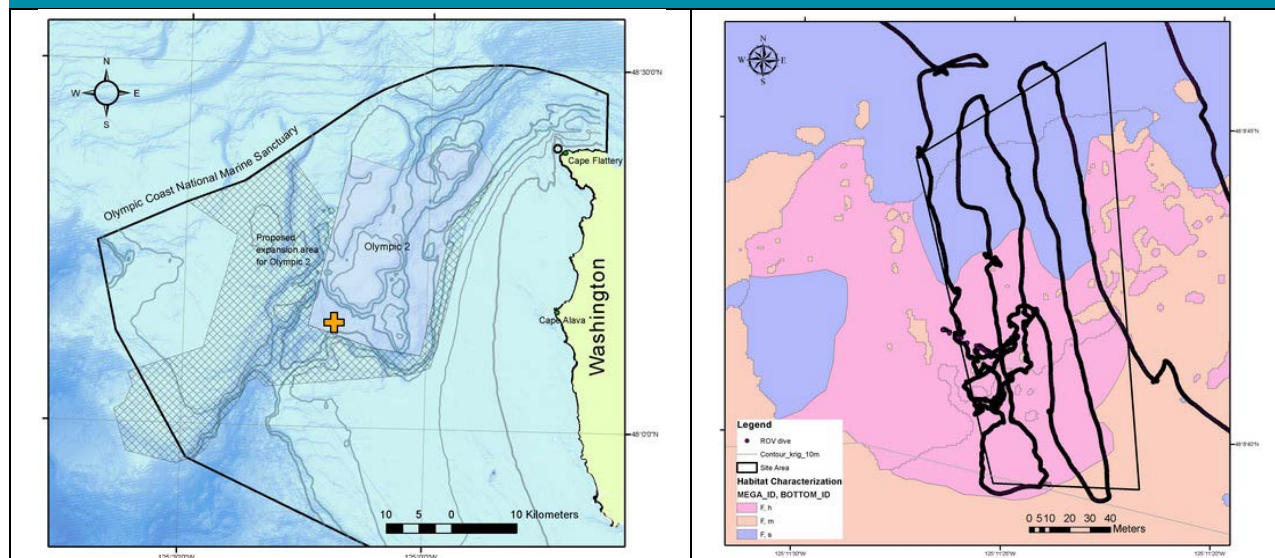
ADDITIONAL COMMENTS

Current speed was quite variable over the course of the approximate 16-hour dive at this site, ranging from 3/4 knot to 2 knots and changing directions several times, coming from the south, the west and then the south again. Depth at this site ranged from 254 to 372 meters.

DIVE NUMBER: 957

SURVEY AREA: 11

GENERAL LOCATION AND DIVE TRACK



SITE OVERVIEW

Project	2006 Deep Sea Coral Research Cruise, Olympic Coast National Marine Sanctuary		
Chief Scientist	Ed Bowlby ¹		
Co-Principal Investigators	Mary Sue Brancato and Jeff Hyland		
Contact Info ¹	ed.bowlby@noaa.gov Olympic Coast National Marine Sanctuary 115 E Railroad Ave. Suite 301, Port Angeles, WA, 98362		
Purpose	Locate and characterize the distribution and abundance of deep-sea coral and sponge habitats in OCNMS.		
Vehicle	NOAA Ship <i>McArthur II</i> , ROPOS ROV		
Science Observers	M.S. Brancato, P. Etnoyer, C. Whitmire J. Hyland and E. Bowlby		
Forward View Tape Count	1		
Digital Still Images	96		
Oxygen mg/L (avg)	2.9		
Salinity ppt (avg)	33.6		
Temperature °C (avg)	6.5		
# of Samples Collected	2		

SITE DATA

Start Date	2006-05-31	Start Latitude	N 48° 8' 44.5272"
End Date	2006-05-31	Start Longitude	W 125° 11' 27.0456"
Minimum Bottom Depth (m)	-276.4	End Latitude	N 48° 8' 41.1360"

Maximum Bottom Depth (m)	-291.9	End Longitude	W 125° 11' 21.5664"
Start Bottom (GMT)	20:10:48	Bottom Current (kts)	1.25 (estimated)
End Bottom (GMT)	23:32:13	Bottom Current Direction	NE



IMAGE GALLERY



IMAGE A: A damaged bubblegum coral colony *Paragorgia arborea pacifica* on sand boulder habitat



IMAGE B: Hagfish wrapped around *Stylaster* sp. on sand boulder habitat



IMAGE C: *Plumarella longispina* and *Stylaster* sp. on sand boulder habitat

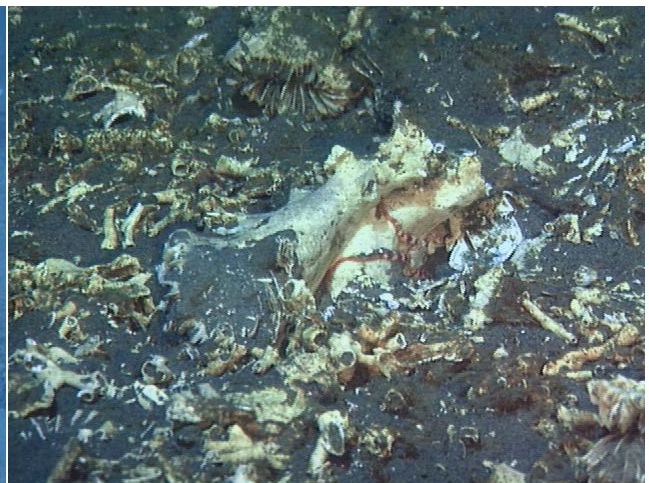


IMAGE D: Skeletal rubble of scleractinian *Lophelia pertusa* and giant cup coral *Desmophyllum* sp. on sand cobble habitat

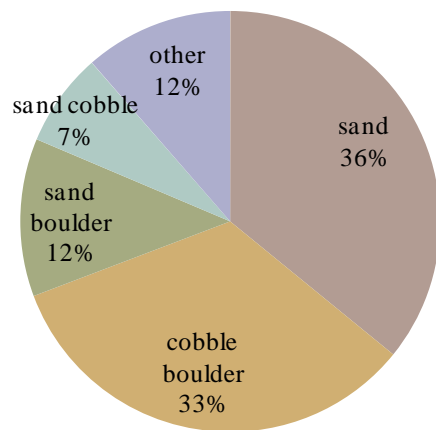
PHYSICAL ENVIRONMENT

Habitats

The total area surveyed at this site was 2,055/m². The site was dominated by sand (36%) and mixed sand with boulder (12%) and sand cobble (7%). There were occasional cobble mixed with boulder patches (33%).

Habitats Surveyed

area = 2,055 m²



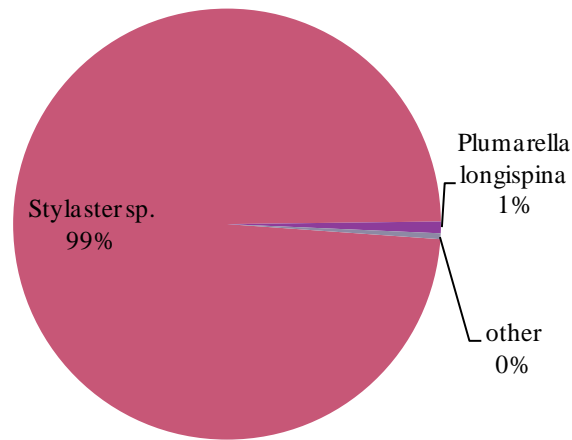
BIOLOGICAL ENVIRONMENT

Corals

This site included a considerable area of dead *Lophelia* sp. and *Desmophyllum* sp. and a broken *Paragorgia arborea pacifica* colony. *Stylaster* was clearly the dominant coral species (99%). Low numbers of *Plumarella longispina*, *Primnoa pacifica*, *Stylaster* sp. and *Swiftia* sp. were recorded.

Density of Coral

671 corals / 1,000 m²



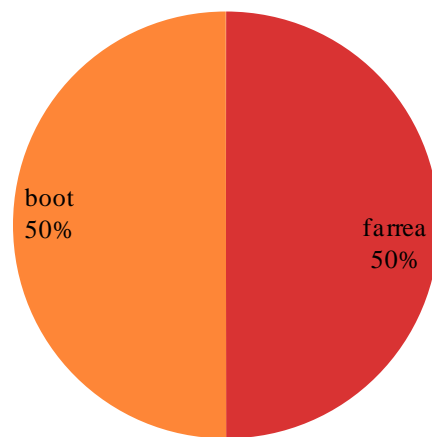
Color Code	Coral Groups	Counts
	<i>Stylaster</i> sp.	1361
	<i>Plumarella longispina</i>	12
	<i>Swiftia beringi</i>	2
	<i>Swiftia simplex</i>	1
	<i>Swiftia pacifica</i>	1
	<i>Primnoa pacifica</i>	1
	<i>Paragorgia arborea pacifica</i>	1

Sponges

There were only two sponges observed at site 11.

Density of Sponges

1 sponge / 1,000 m²



Color Code	Class	Structural Morphs	Count
	Hexactinellids	farrea	1
	Hexactinellids	boot	1

BIOLOGICAL ENVIRONMENT

Fishes

Rockfish species observed at this site were rosethorn (*Sebastes helvomaculatus*), as well as thorneyhead (*Sebastes thornyhead* sp.). Other fish species included lingcod (*Ophiodon elongatus*), Pacific halibut (*Hippoglossus stenolepis*), and multiple flatfish species (Pleuronectidae).

Scientific Name	Common Name
<i>Sebastes helvomaculatus</i>	rosethorn rockfish
<i>Sebastes thornyhead</i> sp.	thorneyhead
<i>Ophiodon elongatus</i>	lingcod
<i>Hippoglossus stenolepis</i>	Pacific halibut
Pleuronectidae	righteye flounders
<i>Raja rhina</i>	longnose skate
Agonidae	poachers
Anoplopomatidae	sablefish
<i>Eptatretus</i> sp.	hagfish

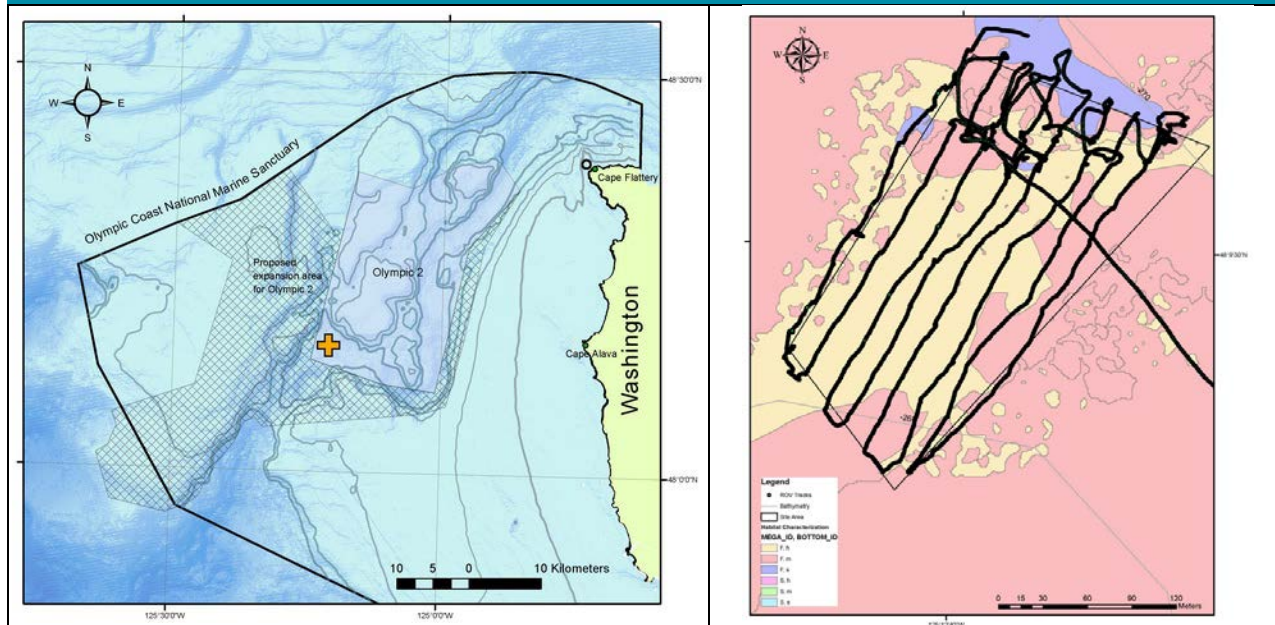
ADDITIONAL COMMENTS

Currents were moderate throughout the 3.5 hours surveying this site, at about 1.25 knots from the northeast. The depth at this site ranged from 276 to 292 meters. Survey site 11 is inside Olympic 2 Conservation Area.

DIVE NUMBER: 957

SURVEY AREA: 13

GENERAL LOCATION AND DIVE TRACK



SITE OVERVIEW

Project	2006 Deep Sea Coral Research Cruise, Olympic Coast National Marine Sanctuary
Chief Scientist	Ed Bowlby ¹
Co-Principal Investigators	Mary Sue Brancato and Jeff Hyland
Contact Info ¹	ed.bowlby@noaa.gov Olympic Coast National Marine Sanctuary 115 E Railroad Ave. Suite 301, Port Angeles, WA, 98362
Purpose	Locate and characterize the distribution and abundance of deep-sea coral and sponge habitats in OCNMS.
Vehicle	NOAA Ship <i>McArthur II</i> , ROPOS ROV
Science Observers	M.S. Brancato, P. Etnoyer, C. Whitmire J. Hyland and E. Bowlby
Forward View Tape Count	2
Digital Still Images	210
Oxygen mg/L (avg)	2.6
Salinity ppt (avg)	33.7
Temperature °C (avg)	6.7
# of Samples collected	7

SITE DATA

Start Date	2006-05-31	Start Latitude	N48° 9' 34.5564"
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End Date	2006-06-01	Start Longitude	W125° 12' 39.4164"
Minimum Bottom Depth (m)	-222.5	End Latitude	N48° 9' 32.5908"
Maximum Bottom Depth (m)	-279.2	End Longitude	W125° 12' 39.6648"
Start Bottom (GMT)	14:10:17	Bottom Current (kts)	<0.5 (estimated)
End Bottom (GMT)	19:08:20	Bottom Current Direction	undetermined

IMAGE GALLERY



IMAGE A: A bubblegum coral colony *Paragorgia arborea pacifica* covered with brittlestars and a crinoid on boulder habitat



IMAGE B: A crustacean-eating sponge (*Asbestopluma* sp.) on mud habitat



IMAGE C: Crinoids on top of a *Farrea* sp. sponge on cobble mud habitat



IMAGE D: Branching morph sponge on mud pebble habitat

DIVE NUMBER: 957

SURVEY AREA: 13

PHYSICAL ENVIRONMENT

Habitats

This site included cobble and boulders on a silty seafloor and a small rock outcrop. Trawl tracks were evident at this site that is located outside Olympic 2 Conservation Area. Quantification of habitat types for this site is in progress.

DIVE NUMBER: 957

SURVEY AREA: 13

BIOLOGICAL ENVIRONMENT

Corals

At least four gorgonian corals, the cup coral *Desmophyllum dianthus* and the hydrocoral *Stylaster* sp. were present. Quantification of coral distribution/abundance for this site is in progress.

DIVE NUMBER: 957

SURVEY AREA: 13

BIOLOGICAL ENVIRONMENT

Sponges

A small patches of the reef building sponge *Farrea occa* were present. Quantification of sponge distribution/abundance for this site is in progress.

DIVE NUMBER: 957

SURVEY AREA: 13

BIOLOGICAL ENVIRONMENT

Fishes

Quantification of fish distribution/abundance for this site is in progress.

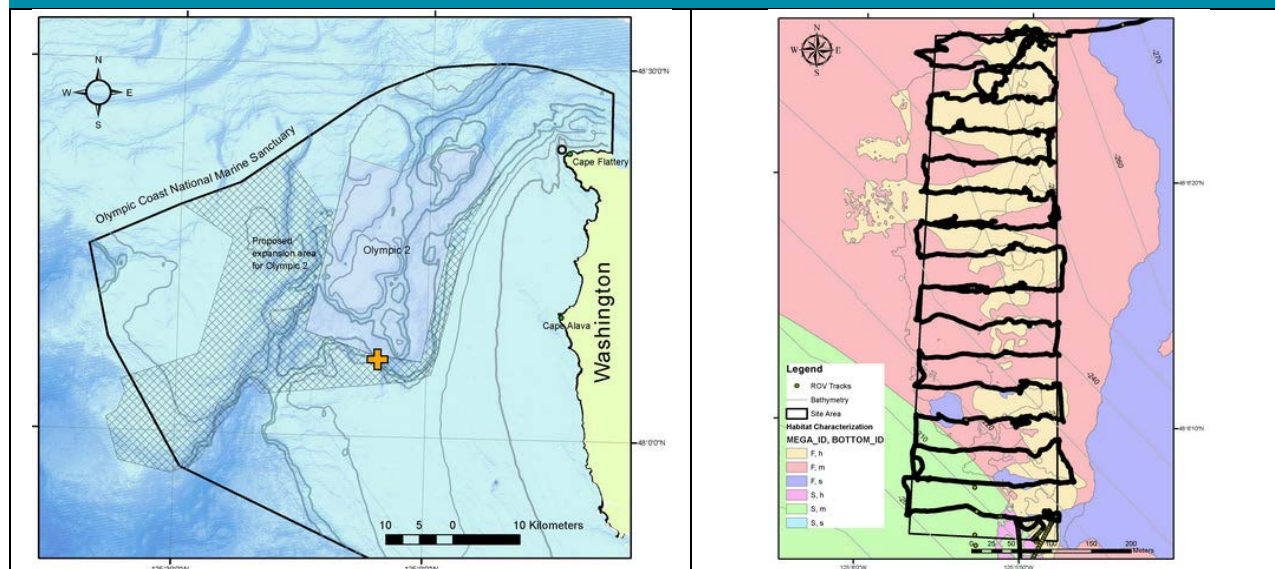
ADDITIONAL COMMENTS

Site 13 was surveyed for about 5 hours during which the currents remained less than 0.5 knots with no direction defined.

DIVE NUMBER: 959

SURVEY AREA: 6

GENERAL LOCATION AND DIVE TRACK



SITE OVERVIEW

Project	2006 Deep Sea Coral Research Cruise, Olympic Coast National Marine Sanctuary		
Chief Scientist	Ed Bowlby ¹		
Co-Principal Investigators	Mary Sue Brancato and Jeff Hyland		
Contact Info ¹	ed.bowlby@noaa.gov Olympic Coast National Marine Sanctuary 115 E Railroad Ave. Suite 301, Port Angeles, WA, 98362		
Purpose	Locate and characterize the distribution and abundance of deep-sea coral and sponge habitats in OCNMS.		
Vehicle	NOAA Ship <i>McArthur II</i> , ROPOS ROV		
Science Observers	M.S. Brancato, P. Etnoyer, C. Whitmire J. Hyland and E. Bowlby		
Forward View Tape Count	5		
Digital Still Images	684		
Oxygen mg/L (avg)	2.9		
Salinity ppt (avg)	33.8		
Temperature °C (avg)	6.9		
# of Samples Collected	2		

SITE DATA

Start Date	2006-06-01	Start Latitude	N48° 6' 25.8696"
End Date	2006-06-02	Start Longitude	W125° 5' 48.3324"
Minimum Bottom Depth (m)	-44.2	End Latitude	N48° 6' 6.4404"

Maximum Bottom Depth (m)	-288.9	End Longitude	W125° 5' 48.4044"
Start Bottom (GMT)	23:07:19	Bottom Current (kts)	<0.5 (estimated)
End Bottom (GMT)	12:54:33	Bottom Current Direction	SW

IMAGE GALLERY



IMAGE A: Rosethorn (left) and redbanded rockfish (right) at the base of a wall with scleractinian *Lophelia pertusa* and *Desmophyllum dianthus*



IMAGE B: Two species of *Swiftia*, *S. pacifica* (red) and *S. beringi* (white) on mud wall habitat

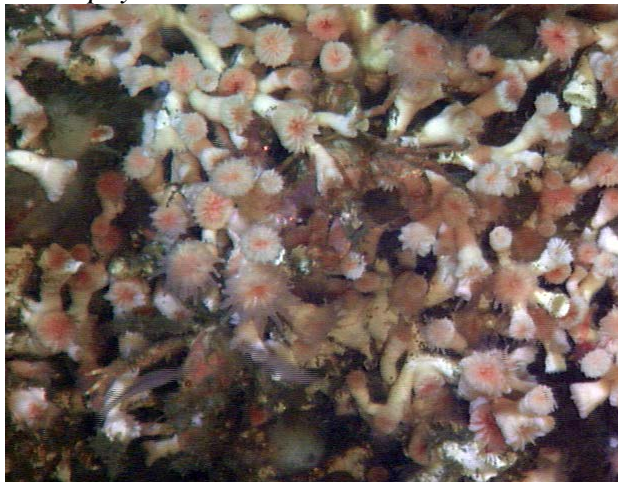


IMAGE C: A colony of scleractinian *Lophelia pertusa* that appears healthy with polyps extended on cobble wall habitat



IMAGE D: *Paragorgia arborea pacifica* on cobble boulder habitat

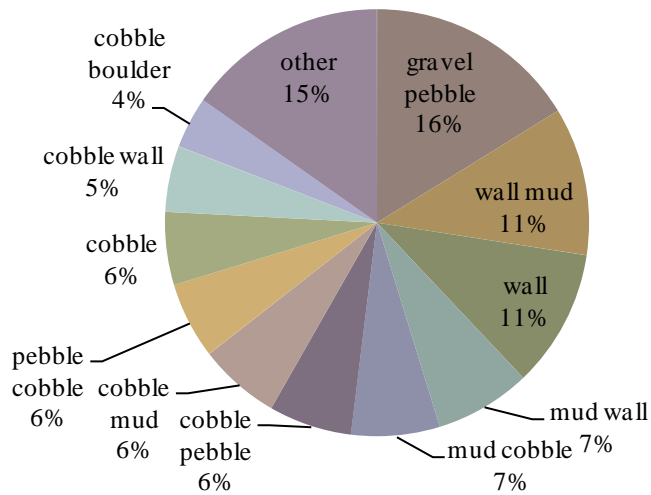
Habitats

The total area surveyed at site 6 was 6,243 m². The site was dominated by mixed cobble areas (40%), and areas of gravel pebble (16%). Additionally, there was a long wall at this site, portions of which were observed to be rock and other sections of mud.

The long rock wall was steep on its eastern side and included occasional boulders.

Habitats Surveyed

area = 6243 m²



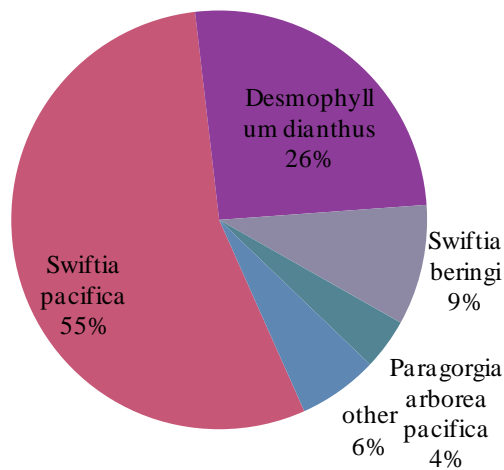
BIOLOGICAL ENVIRONMENT

Corals

Multiple coral species were observed at this site including four *Swiftia* sp., with the two dominant species being *S. pacifica* and *S. beringi*. Other corals included *Paragorgia arborea pacifica*, *Plumarella longispina* and *Primnoa pacifica*. This site included a long rock wall where live colonies of *Lophelia pertusa* and the giant cup coral *Desmophyllum dianthus* were found on the vertical wall surfaces.

Density of Corals

101 corals / 1,000m²



Color Code	Coral Groups	Counts
	<i>Swiftia pacifica</i>	346
	<i>Desmophyllum dianthus</i>	162
	<i>Swiftia beringi</i>	59
	<i>Paragorgia arborea pacifica</i>	25
	<i>Lophelia pertusa</i>	23
	<i>Plumarella longispina</i>	7
	<i>Swiftia spauldingi</i>	3
	<i>Primnoa pacifica</i>	3
	<i>Swiftia simplex</i>	1
	<i>Stylaster</i> sp.	1
	<i>Pennatula</i> sp.	1

BIOLOGICAL ENVIRONMENT

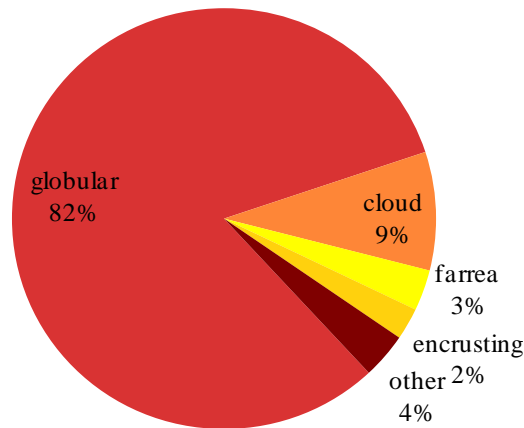
Sponges

Small globular sponge morphs were the most abundant sponge at 82% of the total observed. Other sponge morphs included cloud sponges (9%), and some *Farrea* sp. and encrusting sponges. Small numbers of other sponge morphs were noted.

Other invertebrates observed included ophiroid brittle stars, crinoids (*Florometra serratissima*), urchins (*Strongylocentrotus pallidus* and *S. fragilis*), pom pom anemones (*Liponema brevicornis*) and metridium anemones, sea cucumbers (*Parastichopus leukothele* and *P. californicus*) and various sea star species.

Density of Sponges

45 sponges / 1,000 m²



Color Code	Class	Structural Morphs	Count
	Demosponge	globular	234
	Hexactinellids	cloud	26
	Hexactinellids	farrea	9
	Hexactinellids	encrusting	7
	Demosponge	vase	3
	Demosponge	multi-tube	2
	Demosponge	shelf	2
	Hexactinellids	boot	2
	Demosponge	single tube	1

BIOLOGICAL ENVIRONMENT

Fishes

The rockfish species observed at site 6 were rosethorn (*Sebastes helvomaculatus*), darkblotched (*Sebastes crameri*), redbanded (*Sebastes babcocki*), sharpchin (*Sebastes zacentrus*), bocaccio (*Sebastes paucispinis*), and greenstriped (*Sebastes elongatus*). Thorneyheads (*Sebastolobus* sp.) were also observed and other groundfish species included lingcod (*Ophiodon elongatus*), Pacific halibut (*Hippoglossus stenolepis*), and multiple flatfish species (Pleuronectidae). Ratfish (*Hydrolagus colliei*) and hagfish (*Eptatretus* sp.) were also noted.

There were observations of shark egg cases attached to *Primnoa pacifica* colonies.

Lost fishing gear were recorded at this site.

Scientific Name	Common Name
<i>Sebastes helvomaculatus</i>	rosethorn rockfish
<i>Sebastes crameri</i>	darkblotched rockfish
<i>Sebastes babcocki</i>	redbanded rockfish
<i>Sebastes zacentrus</i>	sharpchin rockfish
<i>Sebastes paucispinis</i>	bocaccio rockfish
<i>Sebastes elongatus</i>	greenstriped rockfish
<i>Sebastolobus</i> sp.	thorneyhead
<i>Ophiodon elongatus</i>	lingcod
<i>Hippoglossus stenolepis</i>	Pacific halibut
Pleuronectidae	righteye flounders
<i>Eptatretus</i> sp.	hagfish
<i>Hydrolagus colliei</i>	spotted ratfish

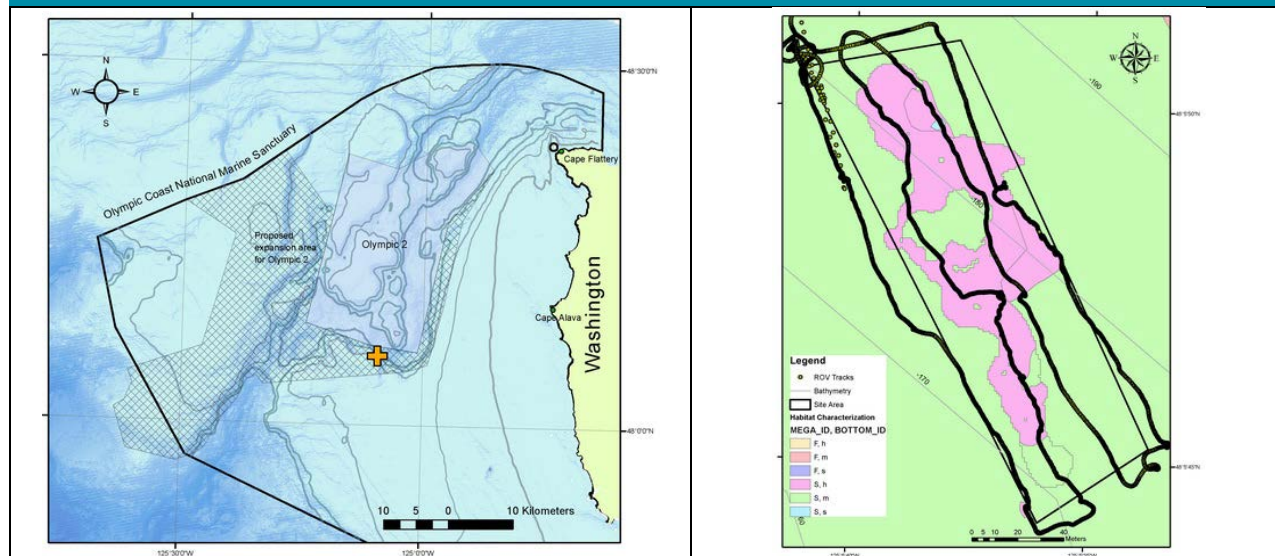
ADDITIONAL COMMENTS

We surveyed this site for approximately 14 hours and encountered very little current throughout (less than 0.5 knots) though the direction changed over time from the northwest, to from the west and eventually from the south. Due to the wall and slope at this site, the depth range was considerable. At the top of the wall the depth below the surface was only 44 meters, while at the deepest part of the site it was 289 meters. Lost fishing gear was observed, including a large net and some line. This area is highly fished and located outside the Olympic 2 Conservation Area.

DIVE NUMBER: 959

SURVEY AREA: 7

GENERAL LOCATION AND DIVE TRACK



SITE OVERVIEW

Project	2006 Deep Sea Coral Research Cruise, Olympic Coast National Marine Sanctuary		
Chief Scientist	Ed Bowlby ¹		
Co-Principal Investigators	Mary Sue Brancato and Jeff Hyland		
Contact Info ¹	ed.bowlby@noaa.gov Olympic Coast National Marine Sanctuary 115 E Railroad Ave. Suite 301, Port Angeles, WA, 98362		
Purpose	Locate and characterize the distribution and abundance of deep-sea coral and sponge habitats in OCNMS.		
Vehicle	NOAA Ship <i>McArthur II</i> , ROPOS ROV		
Science Observers	M.S. Brancato, P. Etnoyer, C. Whitmire J. Hyland and E. Bowlby		
Forward View Tape Count	1		
Digital Still Images	40		
Oxygen mg/L (avg)	3.4		
Salinity ppt (avg)	33.8		
Temperature °C (avg)	7.2		
# of Samples Collected	0		

SITE DATA

Start Date	2006-06-02	Start Latitude	N 48° 5' 50.4708"
End Date	2006-06-02	Start Longitude	W 125° 5' 40.9740"
Minimum Bottom Depth (m)	-169.7	End Latitude	N 48° 5' 51.0684"

Maximum Bottom Depth (m)	-215.9	End Longitude	W 125° 5' 38.2164"
Start Bottom (GMT)	13:25:33	Bottom Current (kts)	< 0.5 (estimated)
End Bottom (GMT)	14:47:17	Bottom Current Direction	W

IMAGE GALLERY



IMAGE A: mud wall habitat



IMAGE B: burrows along mud wall

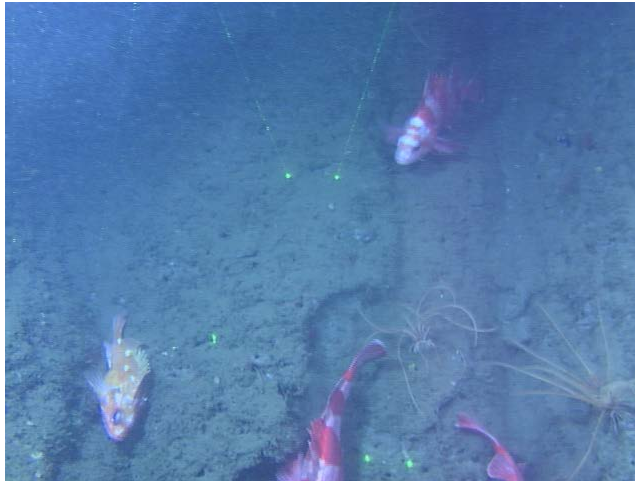


IMAGE C: rockfish along mud wall



IMAGE D: Crinoids (*Florometra serratissima*) and exposed cable on mud

PHYSICAL ENVIRONMENT

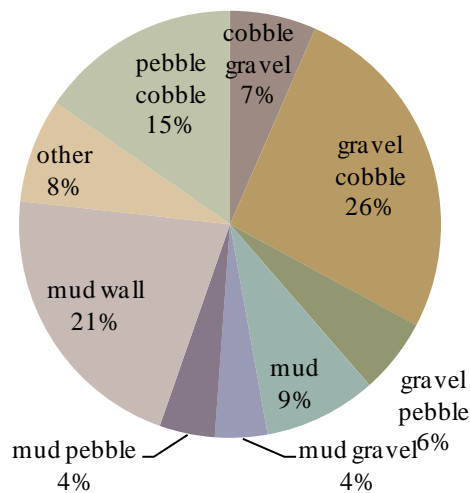
Habitats

The total area surveyed at site 7 was 1,393 m². The site was dominated by cobble and gravel (33%) with some areas of pebble cobble (15%). There was an area that consisted of a mud wall (21%) with other smaller low relief areas of mud (9%).

Survey site 7 was similar to site 6, but with a smaller wall and less diverse biota. It is located outside the Olympic 2 Conservation Area and highly fished. The wall appeared to be clay pavement and was riddled with burrows. Hard rock outcrop also was evident.

Habitats Surveyed

area = 1393 m²



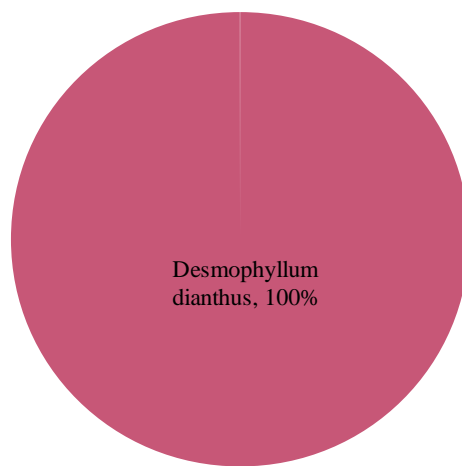
BIOLOGICAL ENVIRONMENT

Corals

Small numbers of cup corals (*Desmophyllum dianthus*) were observed at this site. No other corals were identified.

Density of Corals

2.8 corals 1,000 m²



Color Code	Coral Groups	Counts
	<i>Desmophyllum dianthus</i>	4

BIOLOGICAL ENVIRONMENT

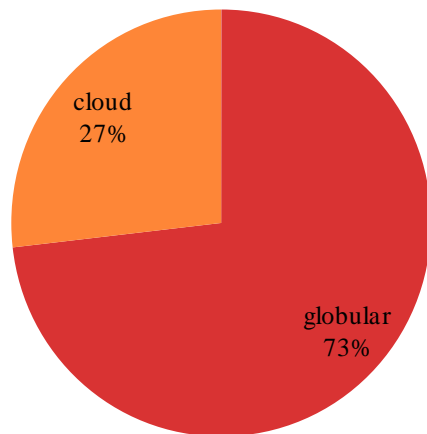
Sponges

Globular sponge morphs were the most abundant sponge (73%). The other sponge morph were cloud sponges (27%).

Other invertebrates included ophiroid brittle stars, crinoids (*Florometra serratissima*), urchins (*Strongylocentrotus pallidus*), metridium anemones, sea cucumbers (*Parastichopus leukothele* and *P. californicus*), box crabs (*Lopholithodes* sp.) and various sea star species.

Density of Sponges

30 sponges / 1,000 m²



Color Code	Class	Structural Morphs	Count
	Demosponge	globular	30
	Hexactinellids	cloud	11

BIOLOGICAL ENVIRONMENT

Fishes

The same rockfish species were observed at site 7 as were in site 6. They included rosethorn (*Sebastes helvomaculatus*), darkblotched (*Sebastes crameri*), redbanded (*Sebastes babcocki*), sharpchin (*Sebastes zacentrus*), bocaccio (*Sebastes paucispinis*), and greenstriped (*Sebastes elongatus*). Other fish species included thornyheads (*Sebastolobus* sp.), lingcod (*Ophiodon elongatus*), Pacific halibut (*Hippoglossus stenolepis*), and multiple flatfish species (Pleuronectidae). Also observed were spotted ratfish (*Hydrolagus colliei*), hagfish (*Eptatretus* sp.) and sculpin (Cottidae).

Scientific Name	Common Name
<i>Sebastes helvomaculatus</i>	rosethorn rockfish
<i>Sebastes crameri</i>	darkblotched rockfish
<i>Sebastes babcocki</i>	redbanded rockfish
<i>Sebastes zacentrus</i>	sharpchin rockfish
<i>Sebastes paucispinis</i>	bocaccio rockfish
<i>Sebastes elongatus</i>	greenstriped rockfish
<i>Sebastolobus</i> sp.	thornyhead
<i>Ophiodon elongatus</i>	lingcod
<i>Hippoglossus stenolepis</i>	Pacific halibut
Pleuronectidae	righteye flounders
<i>Eptatretus</i> sp.	hagfish
<i>Hydrolagus colliei</i>	spotted ratfish
Cottidae	sculpins

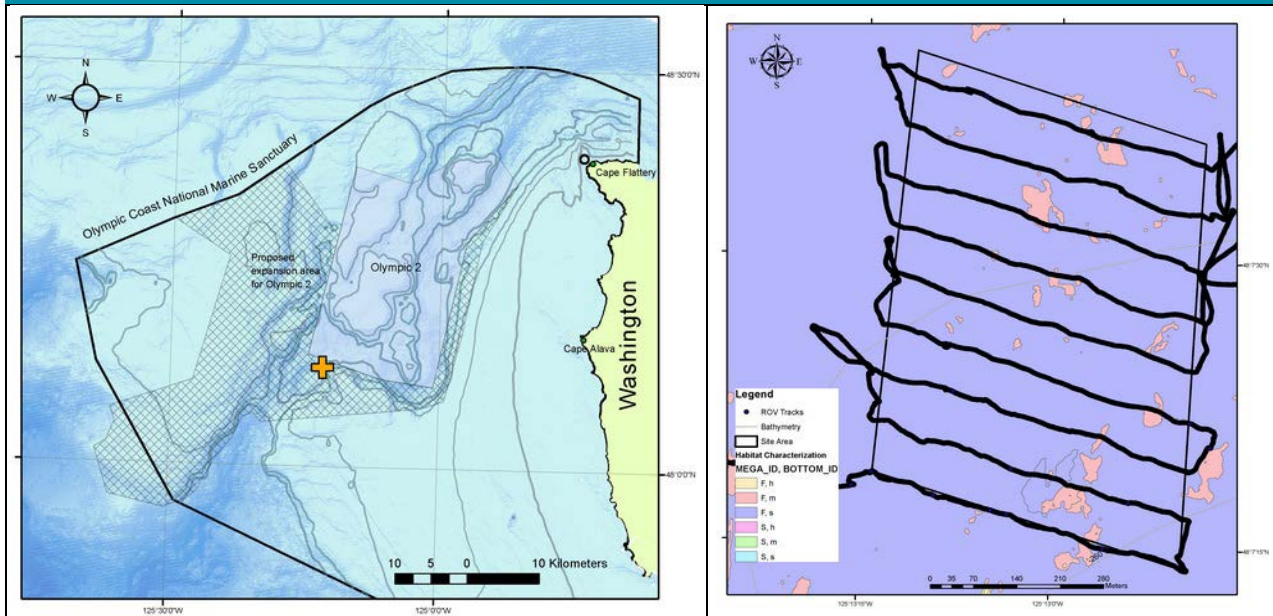
ADDITIONAL COMMENTS

This site was a small site and only surveyed for about an hour. Currents remained less than 0.5 knots from the west.

DIVE NUMBER: 961

SURVEY AREA: 12

GENERAL LOCATION AND DIVE TRACK



SITE OVERVIEW

Project	2006 Deep Sea Coral Research Cruise, Olympic Coast National Marine Sanctuary		
Chief Scientist	Ed Bowlby ¹		
Co-Principal Investigators	Mary Sue Brancato and Jeff Hyland		
Contact Info ¹	ed.bowlby@noaa.gov Olympic Coast National Marine Sanctuary 115 E Railroad Ave. Suite 301, Port Angeles, WA, 98362		
Purpose	Locate and characterize the distribution and abundance of deep-sea coral and sponge habitats in OCNMS.		
Vehicle	NOAA Ship <i>McArthur II</i> , ROPOS ROV		
Science Observers	M.S. Brancato, P. Etnoyer, C. Whitmire, J. Hyland and E. Bowlby		
Forward View Tape Count	2		
Digital Still Images	133		
Oxygen mg/L (avg)	2.2		
Salinity ppt (avg)	33.9		
Temperature °C (avg)	6.5		
# of Samples Collected	0		

SITE DATA

Start Date	2006-06-03	Start Latitude	N 48° 7' 18.7068"
End Date	2006-06-03	Start Longitude	W 125° 13' 13.8648"

Minimum Bottom Depth (m)	-261.0	End Latitude	N 48° 7' 35.0832"
Maximum Bottom Depth (m)	-304.4	End Longitude	W 125° 12' 48.4056"
Start Bottom (GMT)	11:44:45	Bottom Current (kts)	0.5 (estimated)
End Bottom (GMT)	16:50:04	Bottom Current Direction	undetermined

IMAGE GALLERY



IMAGE A: A partially incinerated waste dump with metal cans, line (bottom center) and a plastic weave bag still evident on sand cobble habitat

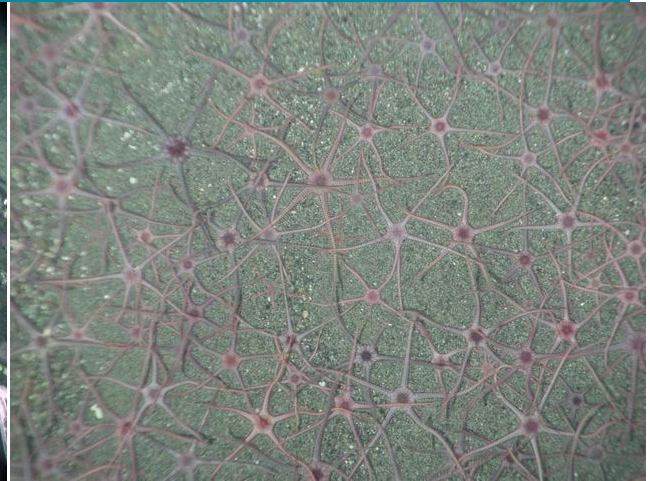


IMAGE B: mat of brittle stars on soft sediment of sand pebble habitat

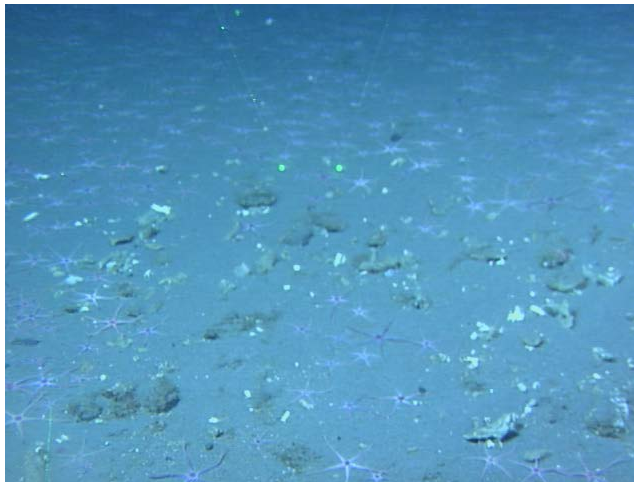


IMAGE C: Sponge fragments on sand pebble habitat



IMAGE D: sea star *Luidia foliolata* on sand habitat

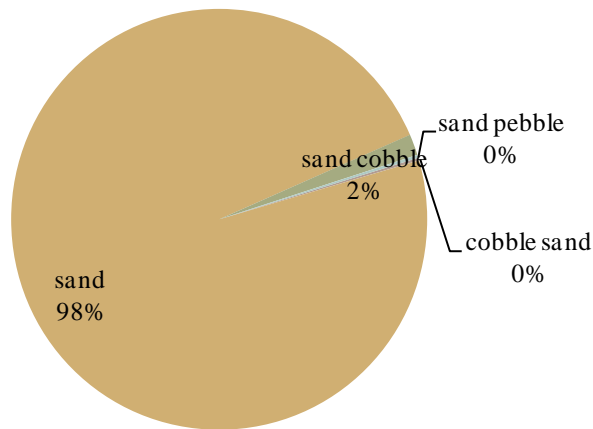
PHYSICAL ENVIRONMENT

Habitats

The total area surveyed at site 12 was 9,433 m². The site was primarily sand (98%). No hard substrate was located – the only site for which this was the case. The other 2% was a mixture of sand and cobble. Post cruise review of the digital video along with the side scan imagery revealed that areas assumed to be relief pockets were actually soft sediment pockets.

Habitats Surveyed

area = 9433 m²



BIOLOGICAL ENVIRONMENT

Corals

No corals were observed over the course of the approximate 5 hour survey of this site. Survey site 12 is outside Olympic 2 Conservation Area.

BIOLOGICAL ENVIRONMENT

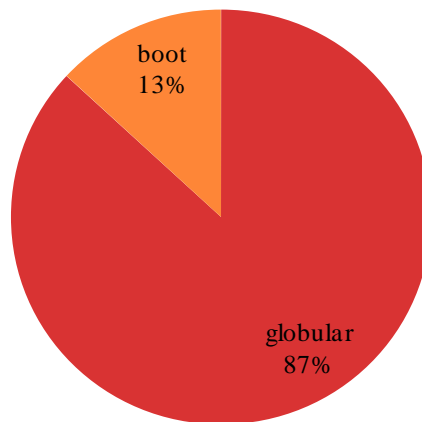
Sponges

Globular sponge morphs were the most abundant sponge at 87%. The other sponge morph consisted of boot sponges (13%).

Other invertebrates included thousands of ophiroid brittle stars, urchins (*Strongylocentrotus fragilis*), numerous sand stars (*Luidia foliolata*), and both tan and black sea stars (*Stylasterias forreri*).

Density of Sponges

4 sponges / 1000 m²



Color Code	Class	Structural Morphs	Count
Red	Demosponge	globular	33
Orange	Hexactinellids	boot	5

BIOLOGICAL ENVIRONMENT

Fishes

Few fish were observed at this low relief sandy site.

Scientific Name	Common Name
<i>Sebastolobus</i> sp.	thorneyhead
Pleuronectidae	righteye flounders
<i>Raja rhina</i>	longnose skate
Agonidae	poachers
<i>Eptatretus</i> sp.	hagfish

ADDITIONAL COMMENTS

A partially incinerated waste pile was observed at this site. Currents were negligible at less than 0.5 knots and the direction varied.

ACKNOWLEDGEMENTS

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The success of this mission was due in no small part to the diligence of the other members of the science party which included Peter Etnoyer (Aquanautix) and Curt Whitmire (NMFS/NWFSC). Public outreach efforts and support during the cruise was provided by Robert Steelquist (OCNMS).

REFERENCES

Boury-Esnault, N, and Klaus Rutzler (editors). 1997. Thesaurus of Sponge Morphology.

Smithsonian Contributions to Zoology, number 596.

- Brancato, M.S. and C.E. Bowlby. 2005. Survey of fishing gear and fiber optic cable impacts to benthic habitats in the Olympic Coast National Marine Sanctuary. Pages 629-630 in P.W. Barnes and J.P. Thomas, editors. Benthic habitats and the effects of fishing. American Fisheries Society, Symposium 41, Bethesda, Maryland.
- Brancato, M.S., C.E. Bowlby, J. Hyland, S.S. Intelmann, and K. Brenkman. 2007. Observations of Deep Coral and Sponge Assemblages in Olympic Coast National Marine Sanctuary, Washington. Cruise Report: NOAA Ship *McArthur II* Cruise AR06-06/07. Marine Sanctuaries Conservation Series NMSP-07-03. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Sanctuary Program, Silver Spring, MD. 48 pp. <http://sanctuaries.noaa.gov/science/conservation/bowlby.html>
- Cook, S.E., B. Burd, and K.W. Conway. 2008. Status of the glass sponge reefs in the Georgia Basin. *Mar Environ Res* 66:S80–S86.
- Greene, H.G., M.M. Yoklavich, R.M. Starr, V.M. O'Connell, W.W. Wakefield, D.E. Sullivan, J.E. McRea Jr, and G.M. Cailliet. 1999. A classification scheme for deep seafloor habitats. Marine benthic habitats and their living resources: monitoring, management and applications to Pacific Island countries. *Oceanologica Acta* 22:663-678.
- Hourigan, TF, SE Clarke, G Dorr, AW Bruckner, S Brooke, and RP Stone. 2007. Deep Coral Ecosystems of the United States: Introduction and National Overview, pp. 1-64. In: SE Lumsden, Hourigan TF, Bruckner AW and Dorr G (eds.) The State of Deep Coral Ecosystems of the United States. NOAA Technical Memorandum CRCP-3. Silver Spring, MD 365 pp. http://coris.noaa.gov/activities/deepcoral_rpt/
- Hyland, J., C. Cooksey, E. Bowlby, M.S. Brancato, and S. Intelmann. 2005. A Pilot Survey of Deepwater Coral/Sponge Assemblages and their Susceptibility to Fishing/Harvest Impacts at the Olympic Coast National Marine Sanctuary (OCNMS). Cruise Report for NOAA Ship McARTHUR II Cruise AR-04-04: Leg 2. NOAA Technical Memorandum NOS NCCOS 15. NOAA/NOS Center for Coastal Environmental Health and Biomolecular Research, Charleston, SC. 13 p. <http://www.coastalscience.noaa.gov/documents/ar0404leg2.pdf>
- Intelmann, S.S., G.R. Cochrane, C.E. Bowlby, M.S. Brancato, and J. Hyland. 2007. Survey report of NOAA Ship *McArthur II* cruises AR-04-04, AR-05-05 and AR-06-03: Habitat classification of side scan sonar imagery in support of deep-sea coral/sponge explorations at the Olympic Coast National Marine Sanctuary. Marine Sanctuaries Conservation Series MSD-07-01. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Sanctuary Program, Silver Spring, MD. 50 pp. <http://sanctuaries.noaa.gov/science/conservation/mcarthur.html>
- Leys, S.P., K. Wilson, C. Hopleton, H.M. Reiswig, W.C. Austin, and V. Tunnicliffe. 2004. Patterns of glass sponge (Porifera, Hexactinellida) distribution in coastal waters of British Columbia. Canada. *Mar. Ecol. Prog. Ser.*, 283:133-149

National Oceanic and Atmospheric Administration (NOAA). 2010. NOAA Strategic Plan for Deep-Sea Coral and Sponge Ecosystems: Research, Management, and International Cooperation. Silver Spring, MD: NOAA Coral Reef Conservation Program. NOAA Technical Memorandum CRCP 11. 67 pp. http://coris.noaa.gov/activities/deepsea_coral/

National Oceanic and Atmospheric Administration (NOAA). 2011. Olympic Coast National Marine Sanctuary Final Management Plan and Environmental Assessment. Office of National Marine Sanctuaries. Silver Spring, MD.

National Research Council (NRC). 2002. Effects of trawling and dredging on seafloor habitat. National Academy Press, Washington, D.C. 136 pp.

Stone, R.P., H. Lehnert, and H. Reiswig. 2011. A guide to the deep-water sponges of the Aleutian Island Archipelago. NOAA Professional Paper 12:1-216.

Whitmire, C.E. and M.E. Clarke. 2007. State of the U.S. Deep Coral Ecosystems in the United States Pacific Coast: California to Washington, pp. 109-154. In: SE Lumsden, Hourigan TF, Bruckner AW and Dorr G (eds.) The State of Deep Coral Ecosystems of the United States. NOAA Technical Memorandum CRCP-3. Silver Spring, MD 365 pp.