

**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 2008**

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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). Large gorgonian coral patches were identified in 2006 during a more extensive research cruise dedicated to observing deep-sea corals (Brancato et al. 2007).

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 our research were to:

1. Survey and characterize the distribution, abundance, and condition of deep-sea coral and sponge communities in OCNMS;
2. Quantify fish and invertebrate associations with DSC to help understand the value of DSC as habitat;
3. Collect limited DSC and sponge specimens to confirm taxonomic identification;
4. Make visual observations of sea floor substratum to ground-truth and to refine habitat classifications derived from side scan and/or multibeam sonar data.

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.

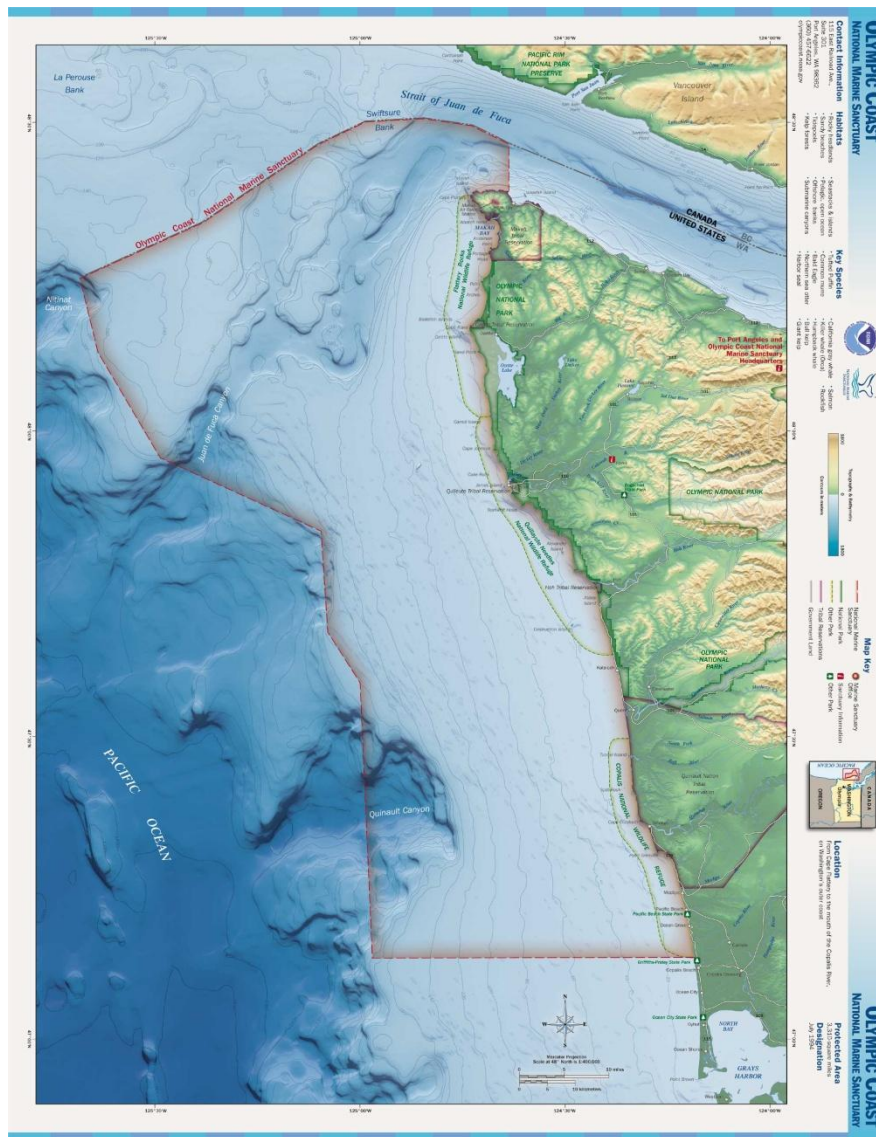


Figure 1. Map of the Olympic Coast National Marine Sanctuary showing shelf and canyon bathymetric relief off the Washington coast of the United States.

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 (Brancato et al. 2007). Some of the remaining candidate sites that were not surveyed in 2006 were part of this 2008 survey effort (Figure 2).

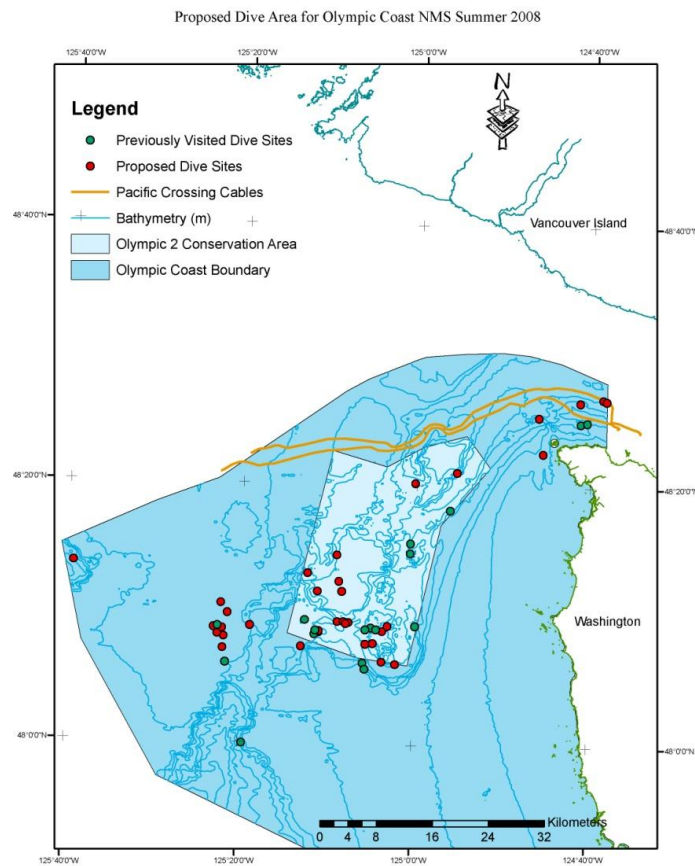


Figure 2. Proposed ROV dive sites for 2008 in relation to the Olympic 2 EFH Conservation Area.

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 (Brancato et al. 2007), which indicates that this preliminary analysis may underestimate the historic or current distribution of biogenic habitat.

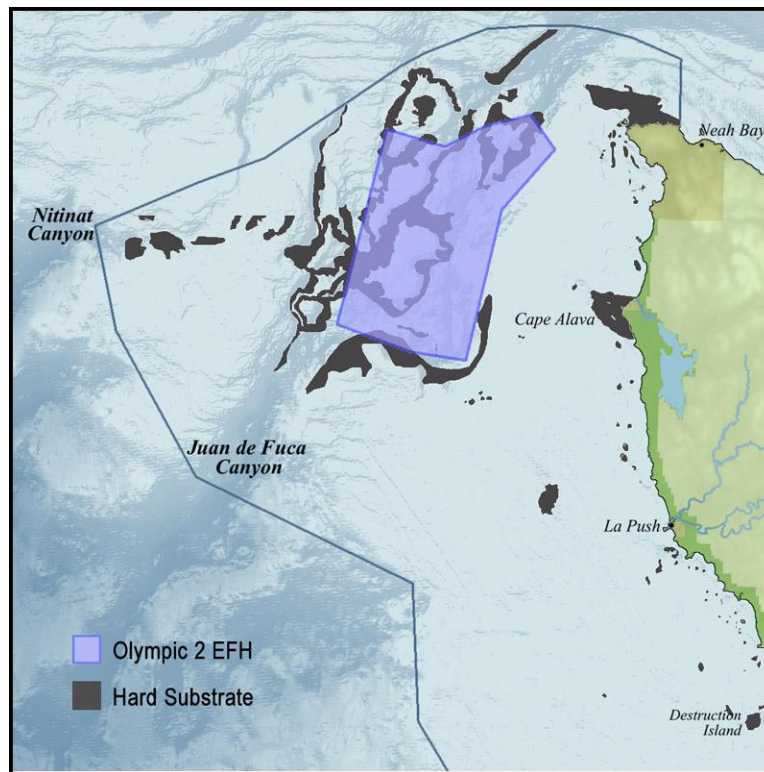


Figure 3. Potential historic distribution of biologically structured habitat associated with hard substrate overlaid on Olympic 2 EFH Conservation Area (data from Curt Whitmire, NOAA, as recorded in NOAA 2011).

FIELD SURVEY METHODS



Canadian Coast Guard vessel *John P. Tully*



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 Canadian Coast Guard vessel *John P. Tully*.

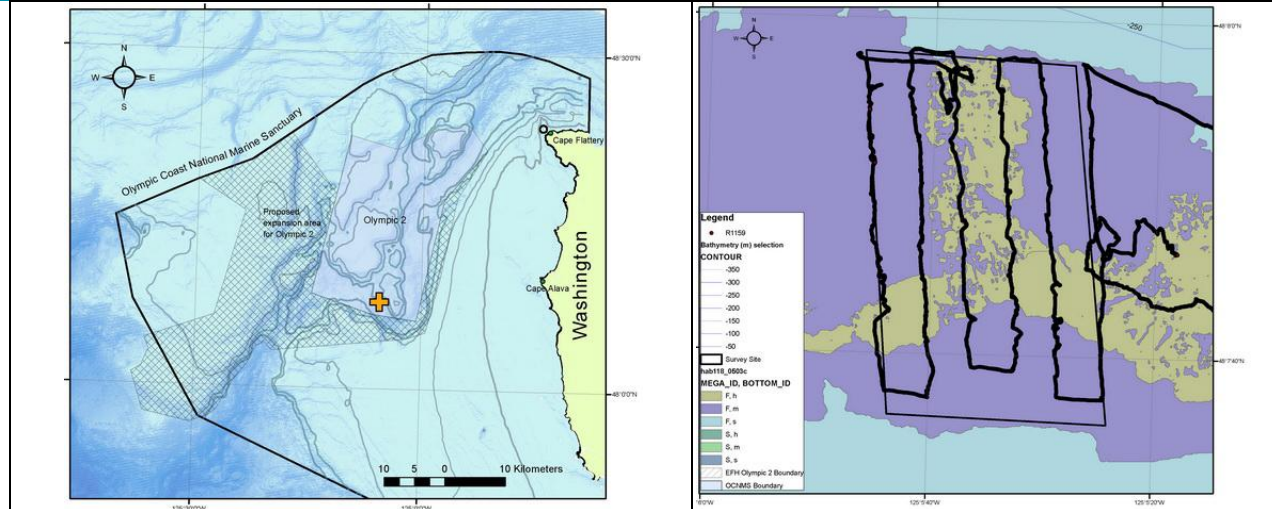
The ROV survey followed scientific protocols previously established by OCNMS and NCCOS (Hyland et al. 2005; Brancato et al. 2007). Pre-selected transect lines spaced 40m apart were developed for each of the sites in order for the ROPOS ROV to run quantitative video surveys, operating at depths between 105-360 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.

SITE CHARACTERIZATIONS FOR EACH DIVE

DIVE NUMBER: 1159

SURVEY AREA: 8

GENERAL LOCATION AND DIVE TRACK



SITE OVERVIEW

Project	2008 Deep Sea Coral Research Cruise, Olympic Coast National Marine Sanctuary
Chief Scientist	Ed Bowlby ¹
Co-Principal Investigators	Mary Sue Brancato and James Boutillier
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 after monitoring benthic recovery sites along fiber optic cable routes.
Vehicle	Canadian Coast Guard vessel <i>John P. Tully</i> , ROPOS ROV
Science Observers	M.S. Brancato, J. Bright, J. Boutillier, G. Workman, E. Edinger, P. Lambert, J. Chu, and E. Bowlby
Forward View HD File Hrs	20
Forward View Tape Count	6
Digital Still Images	713
Oxygen mg/L (avg)	no data
Salinity ppt (avg)	no data
Temperature °C (avg)	no data
# of Samples Collected	16

DIVE NUMBER: 1159

SURVEY AREA: 8

SITE DATA

Start Date	7/10/2008	Start Latitude	N 48° 7' 57.407"
End Date	7/10/2008	Start Longitude	W 125° 5' 46.115"
Minimum Bottom Depth (m)	-222.4	End Latitude	N 48° 7' 56.848"
Maximum Bottom Depth (m)	-347.4	End Longitude	W 125° 5' 26.434"
Start Bottom (GMT)	02:12:00	Bottom Current (kts)	0.75 (estimated)
End Bottom (GMT)	22:29:00	Bottom Current Direction	W

IMAGE GALLERY



IMAGE A: *Lophelia*, *Desmophyllum* and *Primnoa* in cobble mud habitat
N 48° 7' 40.3464", W 125° 5' 28.6656"



IMAGE B: *Paragorgia arborea pacifica* on boulder in mud cobble habitat
N 48° 7' 52.7736", W 125° 5' 45.3912"



IMAGE C: *Paragorgia arborea pacifica* on cobble habitat
N 48° 7' 49.0224", W 125° 5' 25.5768"

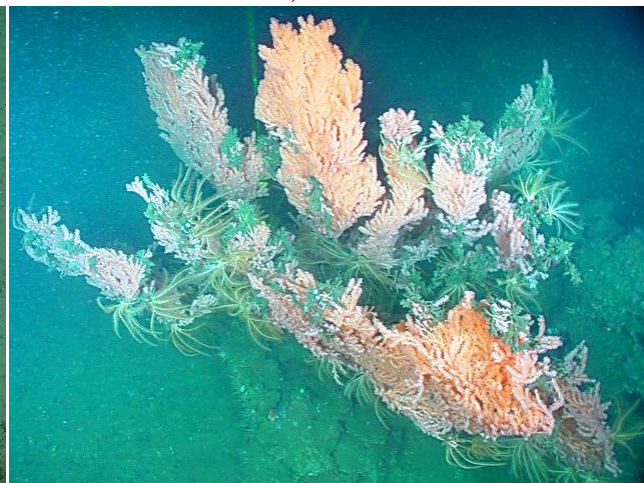


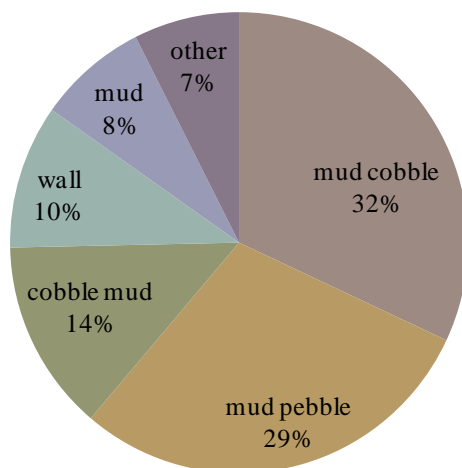
IMAGE D: *Primnoa pacifica* colony on a boulder in cobble habitat
N 48° 7' 41.6892", W 125° 5' 28.68"

Habitats

The total area surveyed at site 8 was 14,831 m². This site was predominantly mud seafloor (69% of total area) mostly associated with cobble and pebbles. The dive also traversed areas where cobble on mud was the dominant habitat type (14%) and a steep, high relief mud wall.

Habitats Surveyed

area = 14,831 m²

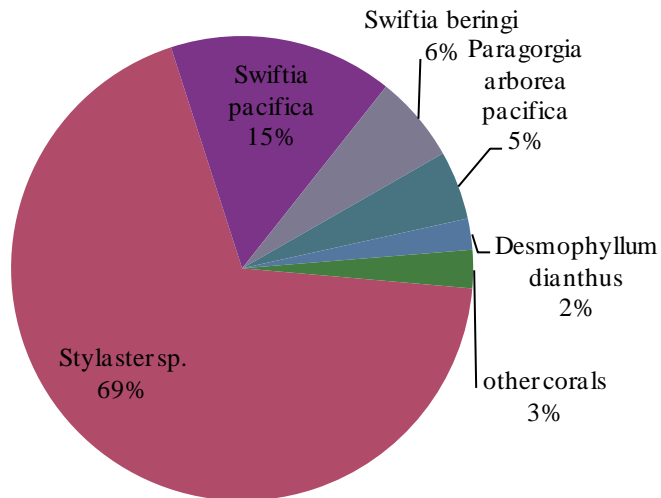


Corals

More than 4,500 individual corals were observed at site 8 for a mean density of 316 individual corals/1,000 m². Coral species diversity was high, with at least 10 coral species identified including the gorgonians *Paragorgia arborea pacifica*, *Primnoa pacifica*, *Plumarella longispina*, and various *Swiftia* species. Also at this site were numerous *Stylaster* sp. hydrocorals and the giant cup coral *Desmophyllum dianthus*.

Density of Corals

316 corals / 1,000 m²



Color Code	Coral Groups	Counts
	<i>Stylaster</i> sp.	3,214
	<i>Swiftia pacifica</i>	732
	<i>Swiftia beringi</i>	284
	<i>Paragorgia arborea pacifica</i>	225
	<i>Desmophyllum dianthus</i>	102
	<i>Plumarella longispina</i>	100
	<i>Primnoa pacifica</i>	11
	<i>Lophelia pertusa</i> clusters	9
	<i>Swiftia spauldingi</i>	4
	Pennatulacea	1

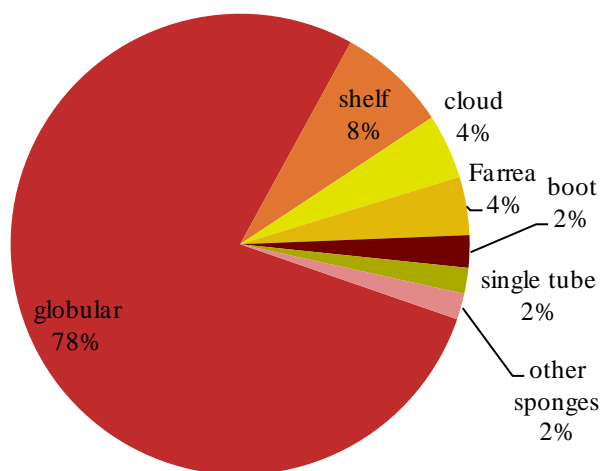
Sponges

The mean density of sponges at site 8 was 15 individuals/1,000 m². Globular/ball sponges comprised 78% of sponges, and several other structural morphs of sponge were identified.

Other invertebrate observations included crinoids (*Florometra serratissima*), urchins *Strongylocentrotus fragilis* and *S. pallidus*, various sea star species, red ophiuroid brittle stars, zoanthids, shrimp, whelks, an octopus (*Benthoctopus* sp.), and sea pens.

Density of Sponges

15 sponges / 1,000 m²



Color Bar	Class	Structural Morphs	Count
	Demosponges	globular	171
	Demosponges	shelf	17
	Demosponges	cloud	10
	Hexactinellids	farrea	9
	Hexactinellids	boot	5
	Demosponges	single tube	4
	Hexactinellids	encrusting	2
	Hexactinellids	cloud	1
	Demosponges	multi-tube	1

BIOLOGICAL ENVIRONMENT

Fishes

Fish were observed throughout the dive site, including multiple rockfish species, flatfish, Pacific halibut (*Hippoglossus stenolepis*), lingcod (*Ophiodon elongatus*), thornyhead (*Sebastolobus* sp.), and skate.

Scientific Name	Common Name
<i>Sebastes helvomaculatus</i>	rosethorn rockfish
<i>Sebastes crameri</i>	darkblotched rockfish
<i>Sebastes babcocki</i>	redbanded rockfish
<i>Sebastolobus</i> sp.	thornyhead
<i>Hippoglossus stenolepis</i>	Pacific halibut
<i>Pleuronectidae</i> sp.	multiple flatfish
Rajidae	skates
<i>Ophiodon elongatus</i>	lingcod
<i>Eptatretus</i> sp.	hagfish
<i>Anoplopoma fimbria</i>	sablefish
Scyliorhinidae	cat sharks
Agonidae	poachers
<i>Hydrolagus colliei</i>	spotted ratfish

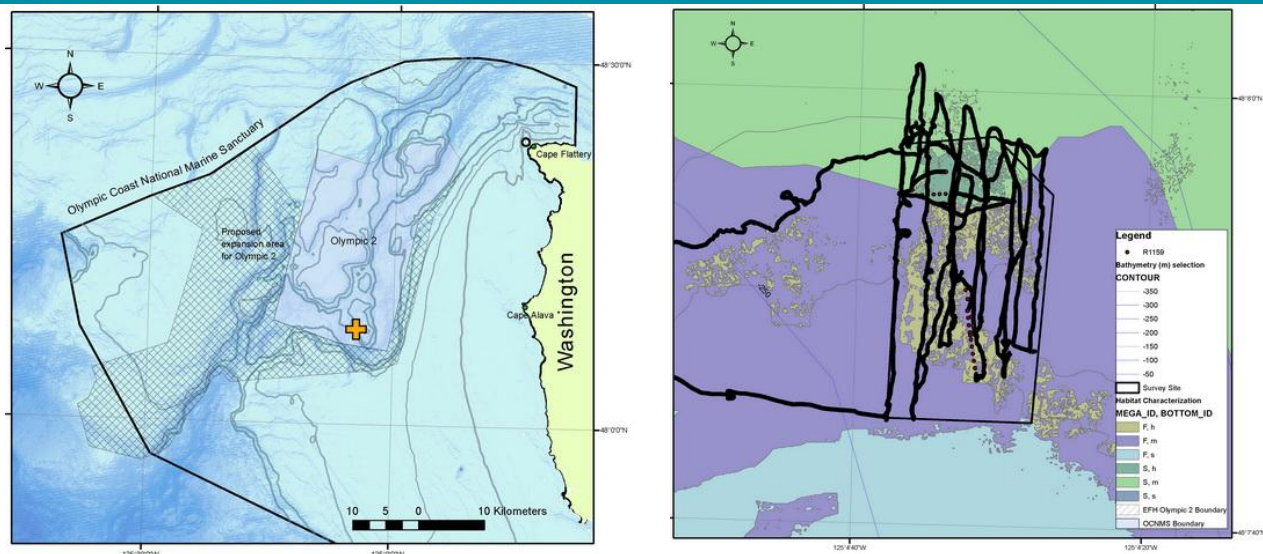
ADDITIONAL COMMENTS

Transects were run at 80 m spacing due to encountering mostly mud/cobble and mud/pebble substrate.

DIVE NUMBER: 1159

SURVEY AREA: 36

GENERAL LOCATION AND DIVE TRACK



SITE OVERVIEW

Project	2008 Deep Sea Coral Research Cruise, Olympic Coast National Marine Sanctuary
Chief Scientist	Ed Bowlby ¹
Co-Principal Investigators	Mary Sue Brancato and James Boutillier
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Forward View HD File Hrs	20
Forward View Tape Count	6
Digital Still Images	156
Oxygen mg/L (avg)	no data
Salinity ppt (avg)	no data
Temperature °C (avg)	no data
# of Samples Collected	8

DIVE NUMBER: 1159

SURVEY AREA: 36

SITE DATA

Start Date	7/10/2008	Start Latitude	N 48° 7' 45.078"
End Date	7/10/2008	Start Longitude	W 125° 4' 37.571"
Minimum Bottom Depth (m)	-105.5	End Latitude	N 48° 7' 56.938"
Maximum Bottom Depth (m)	-302.3	End Longitude	W 125° 4' 27.289"
Start Bottom (GMT)	02:12:00	Bottom Current (kts)	0.2-0.5 (estimated)
End Bottom (GMT)	22:29:00	Bottom Current Direction	variable

IMAGE GALLERY

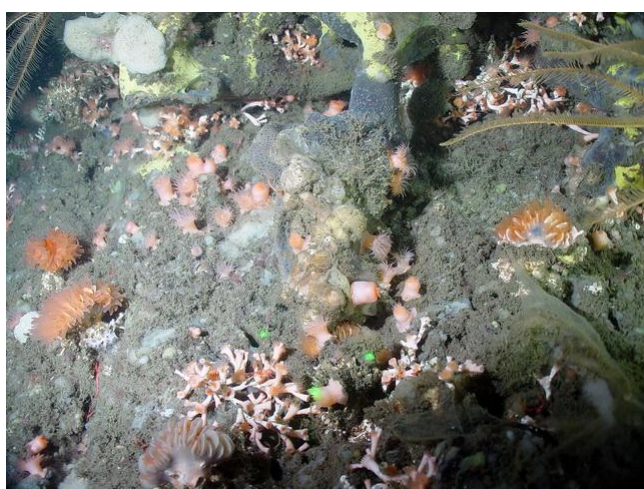


IMAGE A: *Lophelia* and *Desmophyllum* on a wall in hard substrate

N 48° 7' 51.69", W 125° 4' 34.9068"



IMAGE B: *Swiftia beringi* and *Farrea* sp. (white glass sponge) on a wall in soft substrate

N 48° 7' 53.2164", W 125° 4' 37.0992"



IMAGE C: *Muricedes* coral in mud habitat

N 48° 7' 58.3104", W 125° 4' 36.6204"



IMAGE D: Anemone, rockfish, coral (*Muricedes* sp.), and whelk with eggs on boulder in pebble mud habitat

N 48° 7' 46.3764", W 125° 4' 35.6052"

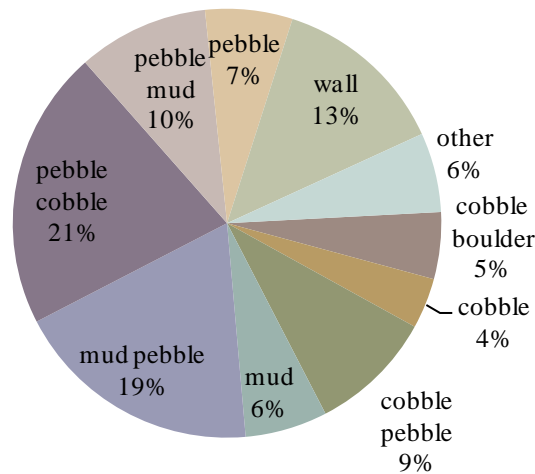
PHYSICAL ENVIRONMENT

Habitats

The total area surveyed at site 36 was 7,048 m². This dive traversed several geological habitat types, including low relief habitats where pebble and mud were predominant (63% of total area), seafloor where cobble dominated (18%), and a high relief, steep rock wall with areas of unconsolidated material containing burrows (13%). Cobble boulder habitat was located on a sloped area (9%).

Habitats Surveyed

area = 7,048 m²

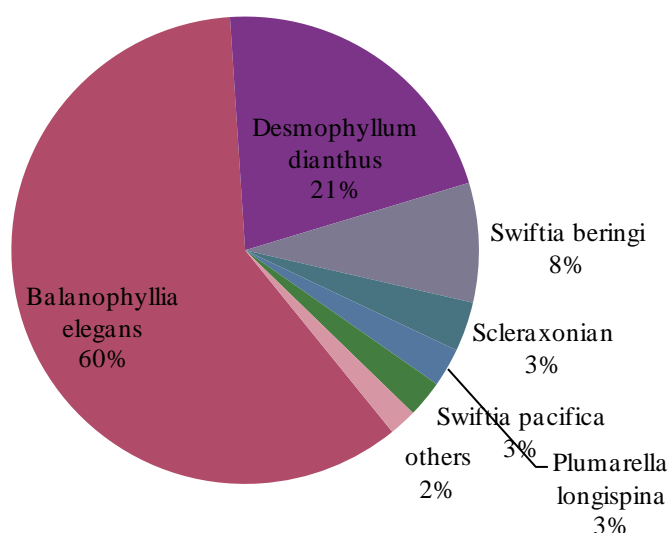


BIOLOGICAL ENVIRONMENT

Corals

Predominant corals were the small, orange cup coral *Balanophyllia elegans* (60% of all corals identified), and the giant cup coral *Desmophyllum dianthus* (21%). Also identified were two *Swiftia* species (11%) and a few *Plumarella longispina* (3%), as well as a few *Muriceides* sp. clusters. This site included a long rock wall hosting colonies of *Lophelia pertusa*, but along the wall was unconsolidated material with burrows and evidence of slides.

Density of Corals

112 corals / 1,000 m²

Color Code	Coral Groups	Counts
	<i>Balanophyllia elegans</i>	470
	<i>Desmophyllum dianthus</i>	168
	<i>Swiftia beringi</i>	65
	<i>Scleraxonia</i>	27
	<i>Plumarella longispina</i>	21
	<i>Swiftia pacifica</i>	20
	<i>Lophelia pertusa</i> clusters	8
	unknown coral	4
	<i>Swiftia spauldingi</i>	1
	<i>Stylaster</i> sp.	1
	<i>Paragorgia arborea pacifica</i>	1

BIOLOGICAL ENVIRONMENT

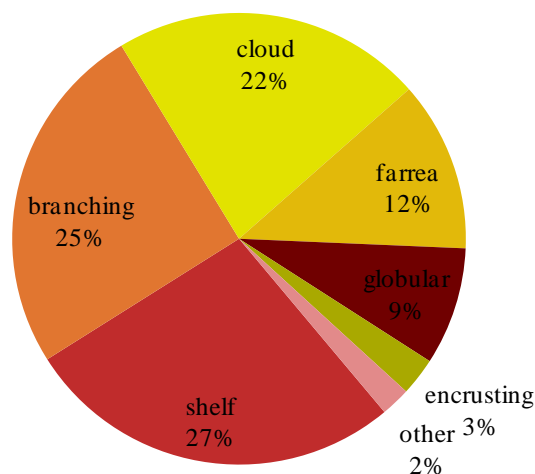
Sponges

Both Demosponge and Hexactinellids were observed throughout the site. The dominant structural sponge morphs were shelf sponges (27% of total), branching sponge (25%), and cloud sponges (22%). The glass sponge *Farrea occa*, ball sponges and a few encrusting sponges also were observed.

Other invertebrate species observed included crinoids (*Florometra serratissima*), brittle stars, sea cucumbers (*Parastichopus leukothele*, *P. californicus*, and *Psolus* sp.), squat lobsters (*Munida quadrispina*), sea urchins, various anemones and sea stars, and fields of zoanthids.

Density of Sponges

94 sponges / 1,000 m²



Color Bar	Class	Structural Morphs	Count
[Red]	Demosponge	shelf	181
[Orange]	Demosponge	branching	168
[Yellow]	Hexactinellids	cloud	148
[Light Yellow]	Hexactinellids	farrea occa	81
[Dark Red]	Demosponge	globular	57
[Light Green]	Hexactinellids	encrusting	18
[Light Pink]	Demosponge	multi-tube	5
[Light Pink]	Hexactinellids	boot	3
[Light Pink]	Demosponge	vase	3
[Light Pink]	Demosponge	single tube	2

BIOLOGICAL ENVIRONMENT

Fishes

Large numbers of rockfish were observed at site 36 in mud, cobble and boulder habitat and along the rock wall. Many of the rockfish appeared gravid with swollen bellies. Rockfish species observed were rosethorn (*Sebastes helvomaculatus*), darkblotched (*Sebastes crameri*), redbanded (*Sebastes babcocki*), sharpchin (*Sebastes zacentrus*), yelloweye (*Sebastes ruberrimus*), redstripe (*Sebastes proriger*), silvergray (*Sebastes brevispinis*), and greenstriped (*Sebastes elongatus*).

This site also contained large numbers of other fish species including Pacific halibut (*Hippoglossus stenolepis*), spotted ratfish (*Hydrolagus colliei*), lingcod (*Ophiodon elongatus*), multiple flatfish species and skate.

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 ruberrimus</i>	yelloweye rockfish
<i>Sebastes proriger</i>	redstripe rockfish
<i>Sebastes brevispinis</i>	silvergray rockfish
<i>Sebastes elongatus</i>	greenstriped rockfish
<i>Sebastes elongatus</i>	greenstriped rockfish
<i>Sebastolobus</i> sp.	thorneyhead
<i>Hippoglossus stenolepis</i>	Pacific halibut
<i>Ophiodon elongatus</i>	lingcod
Pleuronectidae	righteye flounders
Rajidae	skates
<i>Eptatretus</i> sp.	hagfish
Zoarcidae	eelpouts
<i>Hydrolagus colliei</i>	spotted ratfish

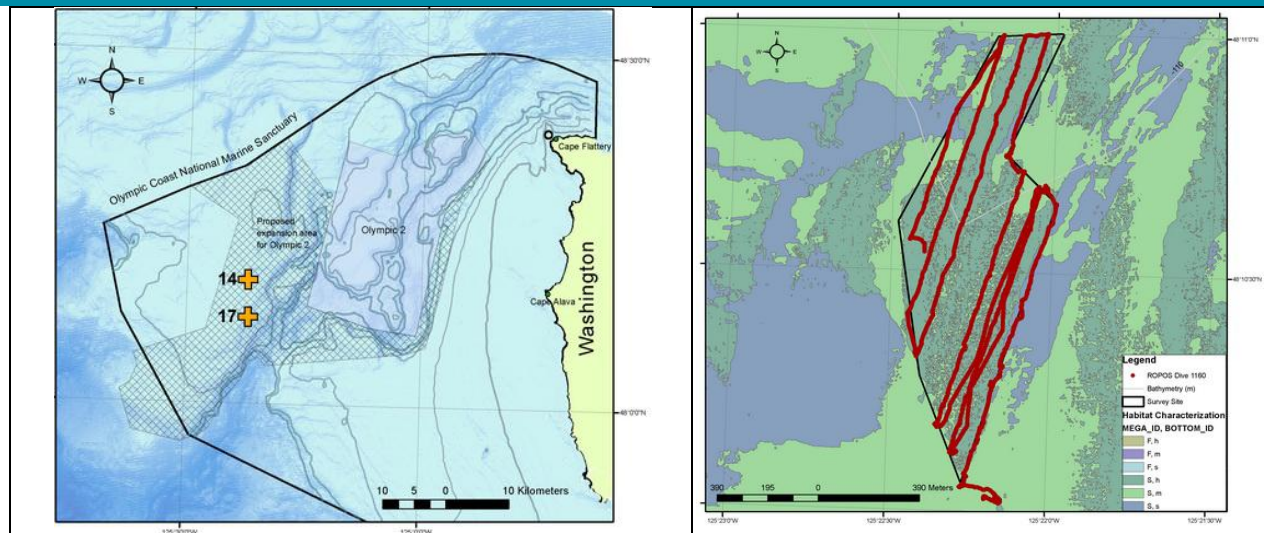
ADDITIONAL COMMENTS

Two transect-like runs were done between site 8 and site 36 in a crisscross pattern but are not reported here. Site transects were spaced 40m apart.

DIVE NUMBER: 1160

SURVEY AREA: 14

GENERAL LOCATION AND DIVE TRACK



SITE OVERVIEW

Project	2008 Deep Sea Coral Research Cruise, Olympic Coast National Marine Sanctuary
Chief Scientist	Ed Bowlby ¹
Co-Principal Investigators	Mary Sue Brancato and James Boutillier
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 after monitoring benthic recovery sites along fiber optic cable routes.
Vehicle	Canadian Coast Guard vessel <i>John P. Tully</i> , ROPOS ROV
Science Observers	M.S. Brancato, J. Bright, J. Boutillier, G. Workman, E. Edinger, P. Lambert, J. Chu, and E. Bowlby
Forward View HD File Hrs	11
Forward View Tape Count	4
Digital Still Images	571
Oxygen mg/L (avg)	1.75
Salinity ppt (avg)	33.957
Temperature °C (avg)	6.47
# of Samples Collected	2

DIVE NUMBER: 1160

SURVEY AREA: 14

SITE DATA

Start Date	7/11/2008	Start Latitude	N48° 10' 3.339"
End Date	7/11/2008	Start Longitude	W125° 22' 15.270"
Minimum Bottom Depth (m)	-105.6	End Latitude	N48° 10' 34.236"
Maximum Bottom Depth (m)	-115.1	End Longitude	W125° 22' 26.307"
Start Bottom (GMT)	01:51:00	Bottom Current (kts)	2-3 (estimated)
End Bottom (GMT)	13:34:00	Bottom Current Direction:	SE

IMAGE GALLERY



IMAGE A: *Swiftia beringi* and sponge assemblage on sand pebble habitat
N 48° 10' 2.9748", W 125° 22' 15.9852"

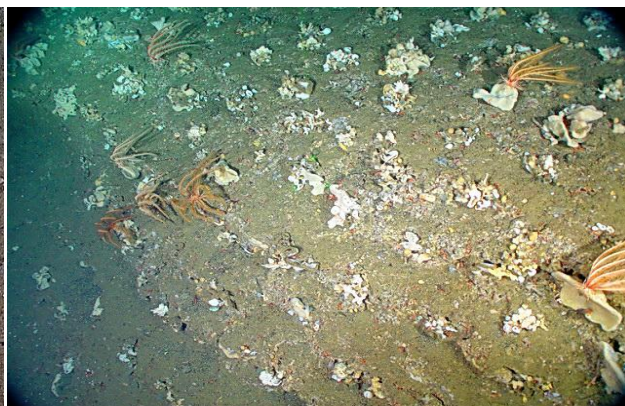


IMAGE B: Field of sponge assemblage on sand gravel covered wall
N 48° 10' 16.9392", W 125° 22' 9.0120"



IMAGE C: Orange sea pen (*Ptilosarcus gurneyi*) on sand habitat
N 48° 10' 49.9620", W 125° 22' 6.4200"



IMAGE D: Rockfish above sponge assemblage on sand gravel habitat
N 48° 10' 4.3428", W 125° 22' 36.1200"

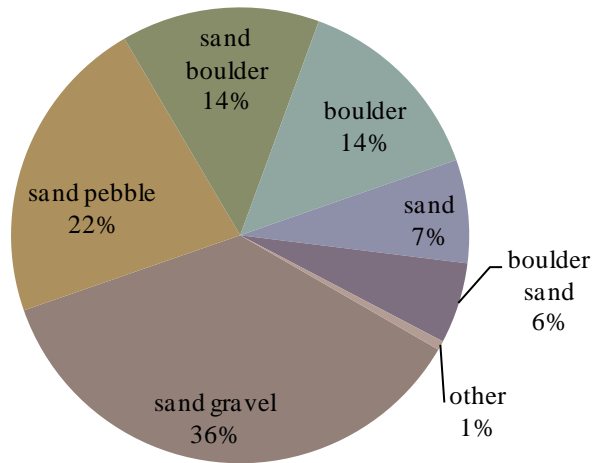
PHYSICAL ENVIRONMENT

Habitats

The total area surveyed at site 14 was 27,168 m², the majority of which consisted of low relief areas of predominately sand (65% of total area) with little rugosity. Larger geological features included small boulder (14%), boulder sand (6%), and sand boulder (14%) habitats. There were small areas of sand slope, mud terrace, and sand waves.

Habitats Surveyed

area = 27,168 m²



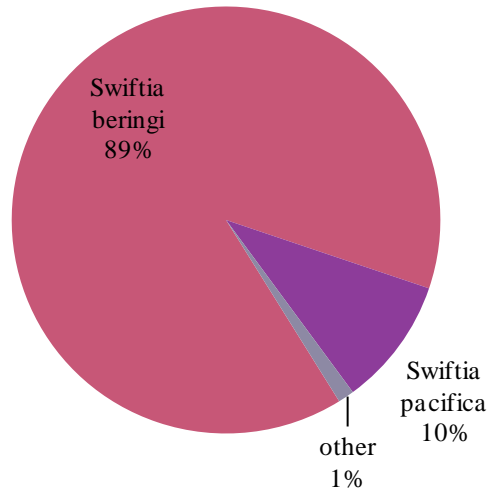
BIOLOGICAL ENVIRONMENT

Corals

The mean coral density at site 14 was 253 individuals/1,000 m². This site was dominated by smaller coral specimens in the sponge fields, with *Swiftia beringi* the predominant species (89% of all corals). *Swiftia pacifica* and *Leptogorgia* sp. were also found.

Density of Corals

253 corals / 1,000 m²



Color Code	Coral Groups	Counts
	<i>Swiftia beringi</i>	6,117
	<i>Swiftia pacifica</i>	668
	<i>Leptogorgia</i> sp.	80
	<i>Ptilosarcus gurneyi</i>	2
	Pennatulacea	2

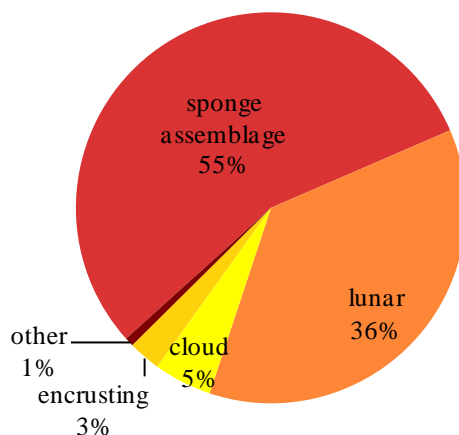
Sponges

The mean sponge density at site 14 was 529 individuals/1,000 m². Many sponges observed at site 14 were found in multi-species assemblages (55% of all sponges observed), growing in clumps ≤ 20 cm across, separated by approximately 40 cm. Both Demosponges and Hexactinellids were found in these sponge assemblages. Where boulders were present, lunar sponges (a globular/ball morph that can be identified as *Latrunculia* sp.) were the dominant sponge species and large rockfish were present. Various structural morphs were found, including white and yellow cloud, branching, and brown globular sponges.

Other invertebrates found at the site were crinoids (*Florometra serratissima*) and sea cucumbers (*Parastichopus leukothele* and *P. californicus*).

Density of Sponges

529 sponges / 1,000 m²



Color Code	Class	Structural Morphs	Count
	mixture	sponge assemblage	7,925
	Demosponge	lunar (<i>Latrunculia</i> sp.)-globular morph	5,256
	Hexactinellids	cloud	693
	Demosponge	encrusting	384
	Hexactinellids	boot	87
	Demosponge	single tube	9
	Demosponge	globular	6
	Demosponge	branching	2
	Demosponge	multi-tube	1

BIOLOGICAL ENVIRONMENT

Fishes

Rockfish species observed in the boulder areas were canary (*Sebastes pinniger*), rosethorn (*Sebastes helvomaculatus*), greenstriped (*Sebastes elongatus*) and tiger (*Sebastes nigrocinctus*).

Small, unidentified rockfish species (possibly juvenile) were observed in close approximation with some sponges. Other fish observations were of juvenile lingcod (*Ophiodon elongatus*) and juvenile flatfish.

Scientific Name	Common Name
<i>Sebastes helvomaculatus</i>	rosethorn rockfish
<i>Sebastes ruberrimus</i>	yelloweye rockfish
<i>Sebastes pinniger</i>	canary rockfish
<i>Sebastes nigrocinctus</i>	tiger rockfish
<i>Ophiodon elongatus</i>	lingcod
<i>Hydrolagus coliei</i>	spotted ratfish
Pleuronectidae	righteye flounders

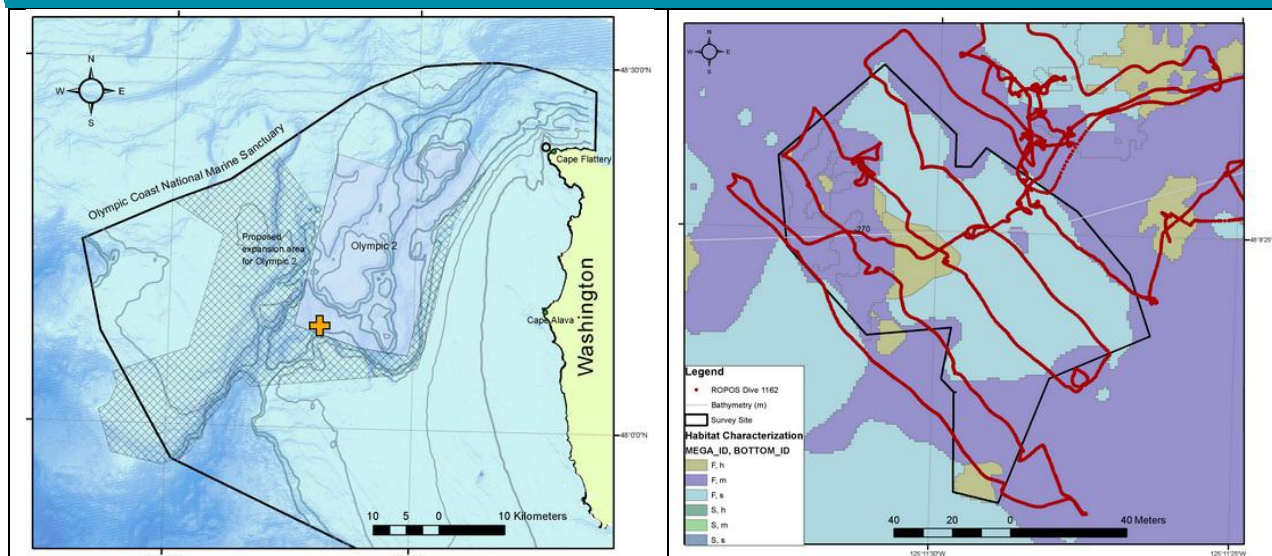
ADDITIONAL COMMENTS

Transects were run at 80 m spacing.

DIVE NUMBER: 1162

SURVEY AREA: 10

GENERAL LOCATION AND DIVE TRACK



SITE OVERVIEW

Project	2008 Deep Sea Coral Research Cruise, Olympic Coast National Marine Sanctuary
Chief Scientist	Ed Bowlby ¹
Co-Principal Investigators	Mary Sue Brancato and James Boutillier
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 after monitoring benthic recovery sites along fiber optic cable routes.
Vehicle	Canadian Coast Guard vessel <i>John P. Tully</i> , ROPOS ROV
Science Observers	M.S. Brancato, J. Bright, J. Boutillier, G. Workman, E. Edinger, P. Lambert, J. Chu, and E. Bowlby
Forward View HD File Hrs	11
Forward View Tape Count	6
Digital Still Images	165
Oxygen mg/L (avg)	1.611
Salinity ppt (avg)	34.04
Temperature °C (avg)	6.14
# of Samples Collected	8

DIVE NUMBER: 1162

SURVEY AREA: 10

SITE DATA

Start Date	7/12/2008	Start Latitude	N48° 8' 24.314"
End Date	7/13/2008	Start Longitude	W125° 11' 26.299"
Minimum Bottom Depth (m)	-260.3	End Latitude	N48° 8' 25.170"
Maximum Bottom Depth (m)	-270.3	End Longitude	W125° 11' 32.959"
Start Bottom (GMT)	15:35:00	Bottom Current (kts)	0.5 (estimated)
End Bottom (GMT)	07:32:00	Bottom Current Direction:	NE

IMAGE GALLERY



IMAGE A: *Primnoa pacifica* on cobble sand habitat
N 48° 8' 26.556", W 125° 11' 28.6296"



IMAGE B: *Paragorgia arborea pacifica* on cobble sand habitat
N 48° 8' 26.1816", W 125° 11' 27.7584"

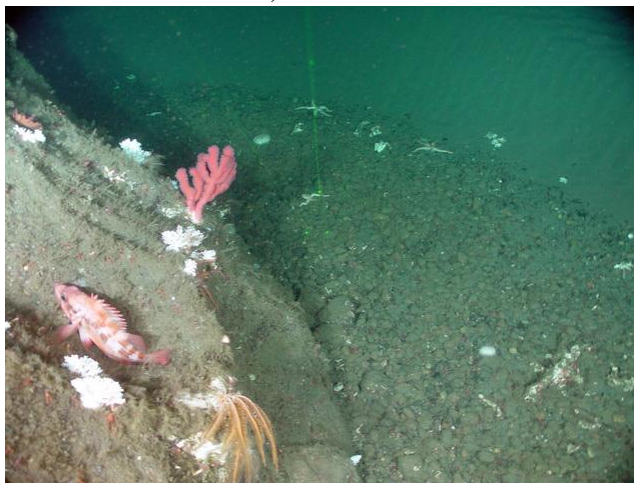


IMAGE C: Coral-fish community with habitat transition boulder to cobble sand
N 48° 8' 25.7316", W 125° 11' 31.3188"



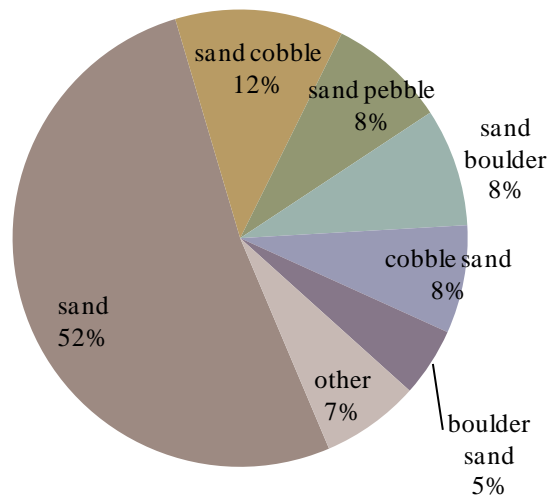
IMAGE D: Boulder covered with Stylaster in boulder sand habitat
N 48° 8' 25.512", W 125° 11' 28.428"

Habitats

The total area surveyed at site 10 was 2,481 m². The site was dominated by low relief sand (52% of total area) and sand pebble habitat (8%), where brittle stars were abundant. Patches of sand waves were noted. The site also included areas with rugosity where cobble (20%) or boulders (13%) were present.

Habitats Surveyed

area = 2,481 m²

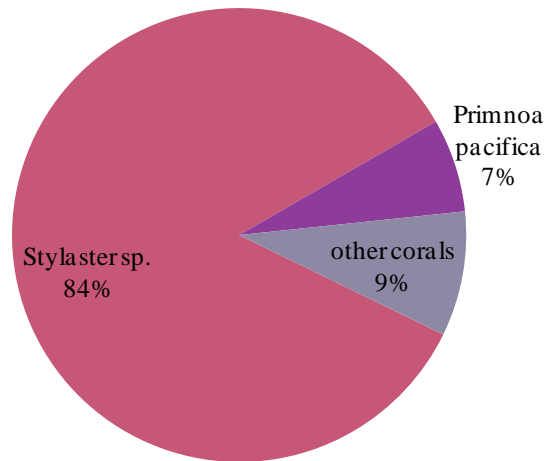


Corals

Corals at site 10 were dominated by fields of the hydrocoral *Stylaster* sp., and also included *Swiftia pacifica* and large gorgonians (*Primnoa pacifica* and *Paragorgia arborea pacifica*). Numerous large dead coral stalks were noted in sand boulder habitat.

Density of Corals

36 corals / 1,000 m²



Color Code	Coral Groups	Counts
	<i>Stylaster</i> sp.	76
	<i>Primnoa pacifica</i>	6
	<i>Swiftia pacifica</i>	4
	<i>Paragorgia arborea pacifica</i>	4

BIOLOGICAL ENVIRONMENT

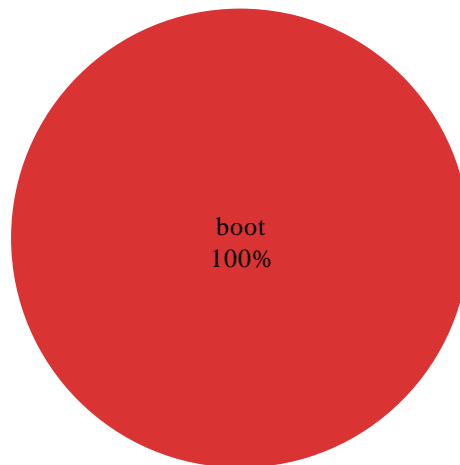
Sponges

The only sponges located at site 10 were two boot sponges.

Other invertebrates identified were crinoids (*Florometra serratissima*), brittle stars and small shrimps on the *Primnoa* branches.

Density of Sponges

sponges = 1 / 1,000 m²



Color Code	Class	Structural Morphs	Count
	Hexactinellids	boot	2

BIOLOGICAL ENVIRONMENT

Fishes

Fish species observed included rosethorn (*Sebastes helvomaculatus*), darkblotched (*Sebastes crameri*) and redbanded (*Sebastes babcocki*) rockfish, and thorneyhead (*Sebastolobus* sp.). Other observations included Pacific halibut (*Hippoglossus stenolepis*), multiple flounder species and skate.

Scientific Name	Common Name
<i>Sebastes helvomaculatus</i>	rosethorn rockfish
<i>Sebastes crameri</i>	darkblotched rockfish
<i>Sebastes babcocki</i>	redbanded rockfish
<i>Sebastolobus</i> sp.	thorneyhead
<i>Hippoglossus stenolepis</i>	Pacific halibut
Pleuronectidae	righteye flounders
Rajidae	skates

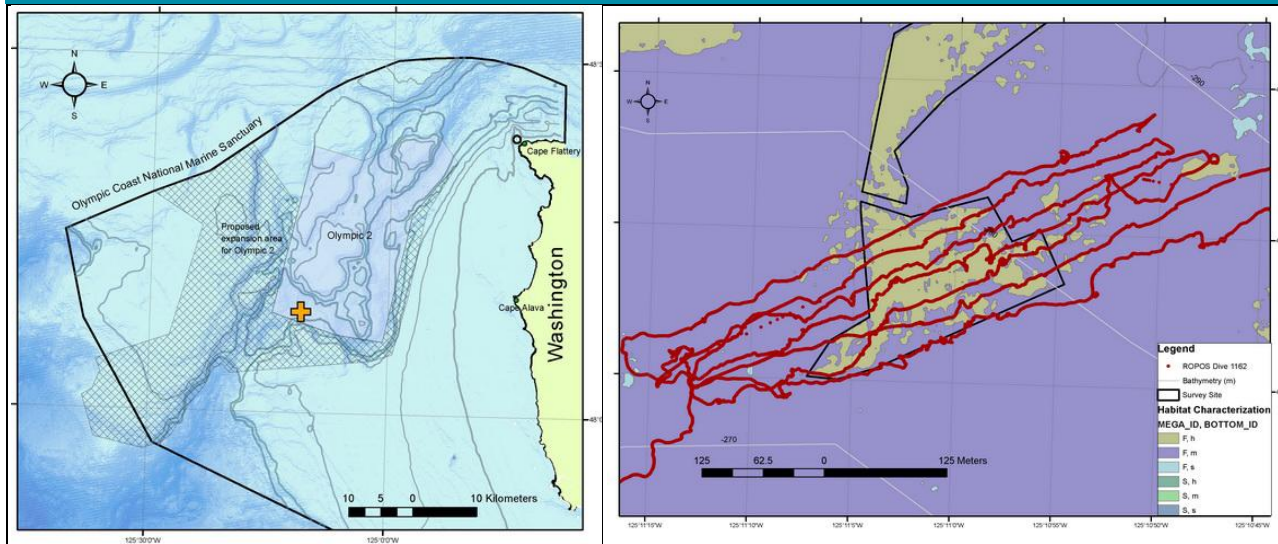
ADDITIONAL COMMENTS

Site 10 was incompletely surveyed in 2006 due to vessel time running out. Rocky substrates were found in the SW corner of the site, with large *Primnoa* colonies. The site was resurveyed in 2008 to complete quantitative transects.

DIVE NUMBER: 1162

SURVEY AREA: 38

GENERAL LOCATION AND DIVE TRACK



SITE OVERVIEW

Project	2008 Deep Sea Coral Research Cruise, Olympic Coast National Marine Sanctuary
Chief Scientist	Ed Bowlby ¹
Co-Principal Investigators	Mary Sue Brancato and James Boutillier
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 after monitoring benthic recovery sites along fiber optic cable routes.
Vehicle	Canadian Coast Guard vessel <i>John P. Tully</i> , ROPOS ROV
Science Observers	M.S. Brancato, J. Bright, J. Boutillier, G. Workman, E. Edinger, P. Lambert, J. Chu, and E. Bowlby
Forward View HD File Hrs	11
Forward View Tape Count	6
Digital Still Images	580
Oxygen mg/L (avg)	1.561
Salinity ppt (avg)	34.04
Temperature °C (avg)	6.1
# of Samples Collected	9

DIVE NUMBER: 1162

SURVEY AREA: 38

SITE DATA

Start Date	7/12/2008	Start Latitude	N48° 8' 25.249"
End Date	7/13/2008	Start Longitude	W125° 11' 28.440"
Minimum Bottom Depth (m)	-230.4	End Latitude	N48° 8' 29.981"
Maximum Bottom Depth (m)	-359.3	End Longitude	W125° 11' 12.859"
Start Bottom (GMT)	15:35:00	Bottom Current (kts)	no data
End Bottom (GMT)	07:32:00	Bottom Current Direction	no data

IMAGE GALLERY



IMAGE A: *Primnoa pacifica* on cobble boulder habitat
N 48° 8' 26.4012", W 125° 11' 16.4256"



IMAGE B: *Plumarella longispina* and crinoids on cobble pebble habitat
N 48° 8' 34.8792", W 125° 10' 49.4472"

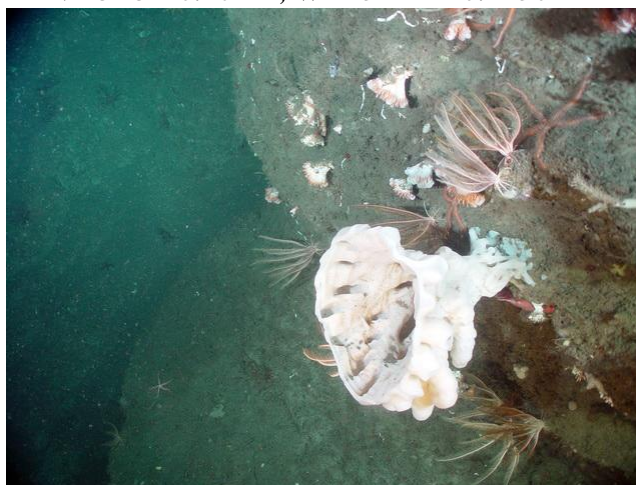


IMAGE C: *Heterochone calyx* and *Desmophyllum diantus* on steep mud wall
N 48° 8' 38.5656", W 125° 10' 38.1072"



IMAGE D: *Primnoa pacifica* and Pacific halibut on mud boulder habitat
N 48° 8' 35.8836", W 125° 10' 39.288"

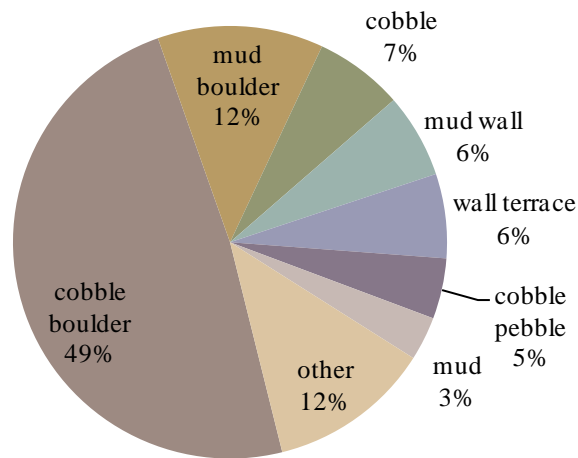
PHYSICAL ENVIRONMENT

Habitats

The total area surveyed at site 38 was 15,238/m². Half the site was dominated by cobble boulder habitat (49% of total area). Other areas with rugosity included mud boulder (12%), wall terrace (6%) and mud wall (6%) habitats. Many habitat transitions were observed at this site, particularly adjacent to slopes of mud boulder and mud habitats.

Habitats Surveyed

area = 15,238 m²

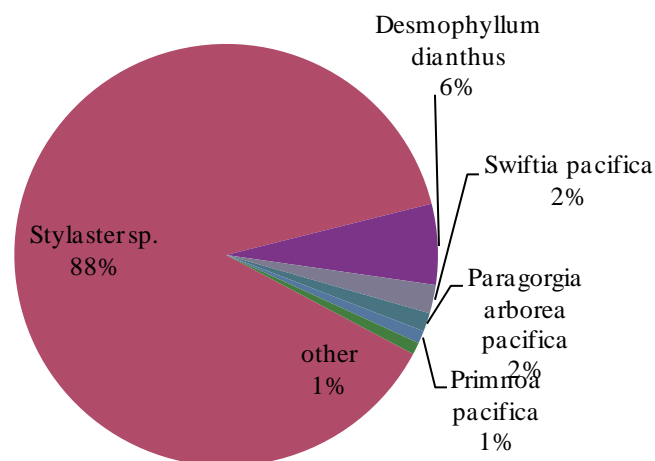


Corals

More than 7,700 individual corals were counted at site 38, for a mean density of 505 corals/1,000 m². The most abundant coral species at site 38 was *Styaster* sp. (88% of coral individuals), which was commonly found growing in boulder fields. A unique feature of site 38 was a box canyon surrounded by high mud terraced walls with a large *Primnoa pacifica* growing at the entrance to the canyon (Image A). This site was also a new documented area of *Lophelia pertusa*. Other coral species included *Swiftia pacifica*, *Paragorgia arborea pacifica*, *Primnoa pacifica* and *Plumarella longispina*. The giant cup coral *Desmophyllum dianthus* dominated the terraced walls along with some clusters of *Lophelia pertusa* in the box canyon. At least one white *Paragorgia* with pink polyps was also found.

Density of Corals

505 corals / 1,000 m²



Color Code	Coral Groups	Counts
	<i>Styaster</i> sp.	6,807
	<i>Desmophyllum dianthus</i>	477
	<i>Swiftia pacifica</i>	168
	<i>Paragorgia arborea pacifica</i>	110
	<i>Primnoa pacifica</i>	75
	<i>Swiftia spauldingi</i>	25
	<i>Swiftia beringi</i>	20
	<i>Lophelia pertusa</i>	19
	<i>Plumarella longispina</i>	7

BIOLOGICAL ENVIRONMENT

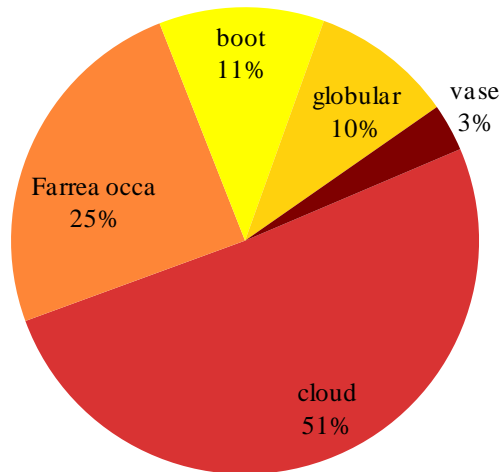
Sponges

Cloud sponges were the most abundant sponge, comprising 51% of all sponges found. *Farrea occa*, a glass sponge, was also common (25%). Other sponge morphs observed were boot sponges (11%), ball sponges (10%) and vase sponges (3%).

Other invertebrate species present were pom pom anemones (*Liponema* sp.) and red ophiuroid brittle stars.

Density of Sponges

sponges = 4 / 1,000 m²



Color Code	Class	Structural Morphs	Count
Red	Hexactinellids	cloud	31
Orange	Hexactinellids	farrea	15
Yellow	Hexactinellids	boot	7
Light Yellow	Demosponge	globular	6
Dark Red	Demosponge	vase	2

BIOLOGICAL ENVIRONMENT

Fishes

Fish observations included rosethorn (*Sebastes helvomaculatus*) and redbanded (*Sebastes babcocki*) rockfish, thorneyhead (*Sebastolobus* sp.), Pacific halibut (*Hippoglossus stenolepis*), multiple flatfish species, skate and hagfish.

Scientific Name	Common Name
<i>Sebastes helvomaculatus</i>	rosethorn rockfish
<i>Sebastes babcocki</i>	redbanded rockfish
<i>Sebastolobus</i> sp.	thorneyhead
<i>Hippoglossus stenolepis</i>	Pacific halibut
Pleuronectidae	righteye flounders
<i>Raja rhina</i>	longnose skate
Agonidae	poacher
<i>Eptatretus</i> sp.	hagfish

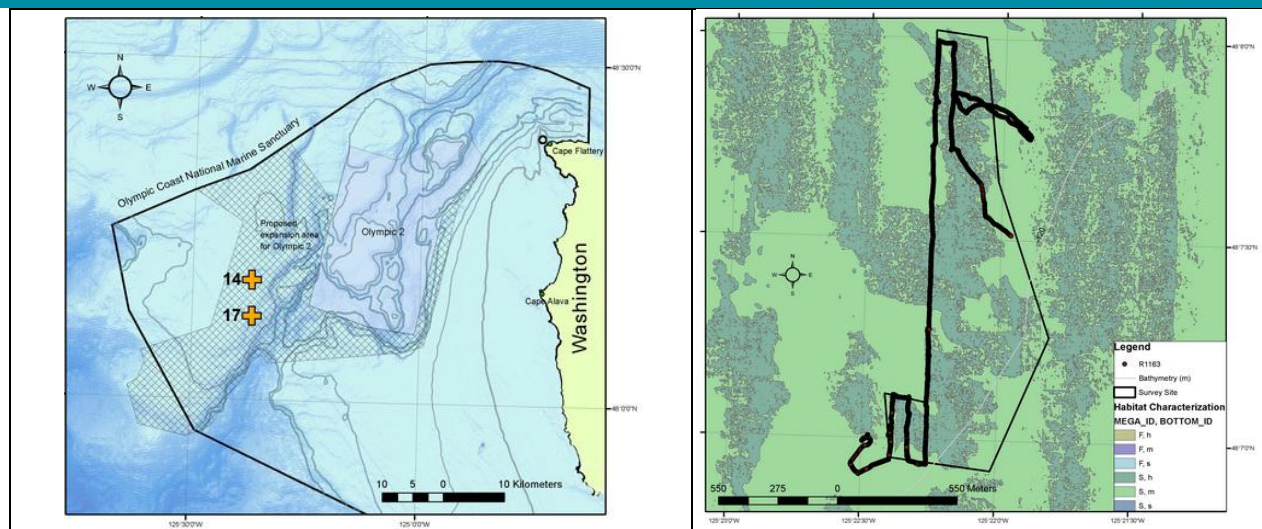
ADDITIONAL COMMENTS

Transects were run at 20m spacing.

DIVE NUMBER: 1163

SURVEY AREA: 17

GENERAL LOCATION AND DIVE TRACK



SITE OVERVIEW

Project	2008 Deep Sea Coral Research Cruise, Olympic Coast National Marine Sanctuary
Chief Scientist	Ed Bowlby ¹
Co-Principal Investigators	Mary Sue Brancato and James Boutillier
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 after monitoring benthic recovery sites along fiber optic cable routes.
Vehicle	Canadian Coast Guard vessel <i>John P. Tully</i> , ROPOS ROV
Science Observers	M.S. Brancato, J. Bright, J. Boutillier, G. Workman, E. Edinger, P. Lambert, J. Chu, and E. Bowlby
Forward View HD File Hrs	5
Forward View Tape Count	4
Digital Still Images	142
Oxygen mg/L (avg)	2.37
Salinity ppt (avg)	33.92
Temperature °C (avg)	6.76
# of Samples Collected	0

DIVE NUMBER: 1163

SURVEY AREA: 17

SITE DATA

Start Date	7/13/2008	Start Latitude	N48° 6' 56.831"
End Date	7/13/2008	Start Longitude	W125° 22' 23.488"
Minimum Bottom Depth (m)	-112.5	End Latitude	N48° 7' 59.295"
Maximum Bottom Depth (m)	-121.14	End Longitude	W125° 22' 11.799"
Start Bottom (GMT)	11:32:00	Bottom Current (kts)	0.25 (estimated)
End Bottom (GMT)	16:04:00	Bottom Current Direction	NNW

IMAGE GALLERY



IMAGE A: Yelloweye rockfish (*Sebastes ruberrimus*) in boulder habitat
N 48° 7' 6.0888", W 125° 22' 20.5824"

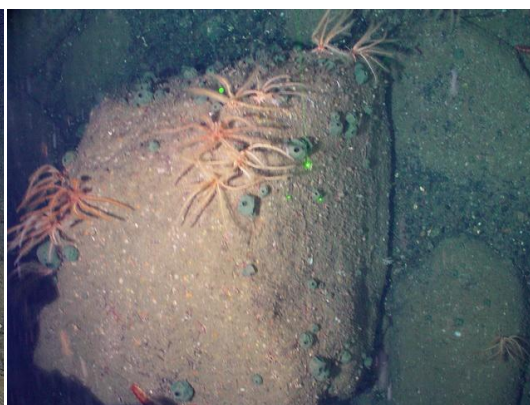


IMAGE B: Green lunar sponges (*Latrunculia* sp.) and crinoids on boulder habitat
N 48° 7' 19.4196", W 125° 22' 15.4416"

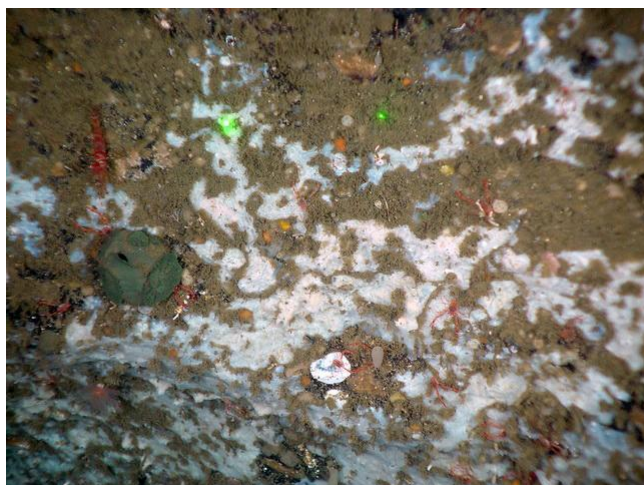


IMAGE C: Encrusting white sponge on boulder habitat
N 48° 7' 43.7268", W 125° 22' 15.7440"

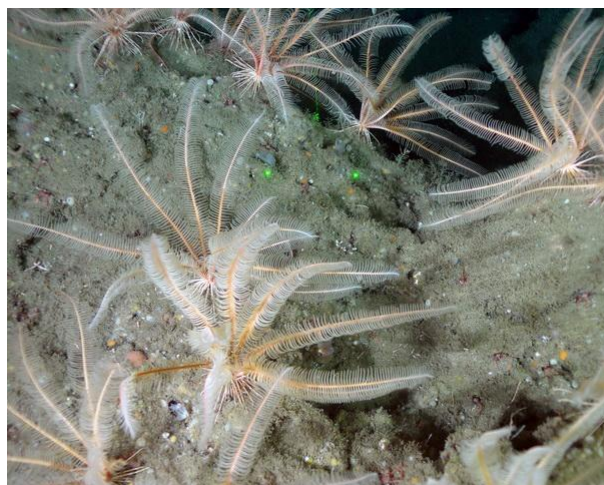


IMAGE D: Crinoid covered boulder on boulder habitat
N 48° 7' 12.4032", W 125° 22' 15.2220"

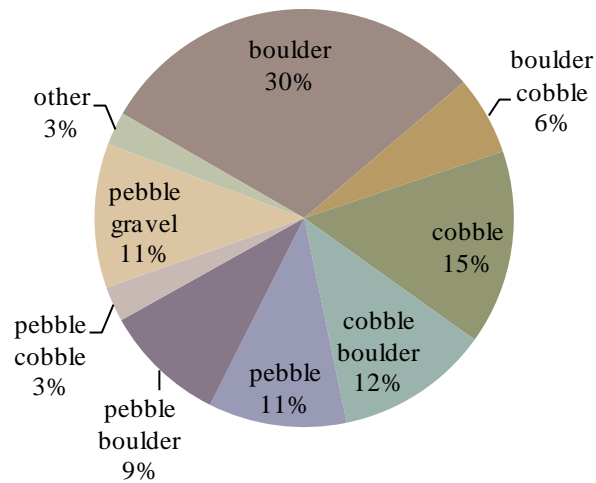
PHYSICAL ENVIRONMENT

Habitats

The total area surveyed at site 17 was 14,690/m². The site consisted of boulder and boulder cobble habitat interspersed with areas of pebble and cobble. Multiple fish species were observed, primarily in the boulder fields. A relatively small area of large sand waves was also found, with few invertebrates or fish present.

Habitats Surveyed

area = 14,690 m²

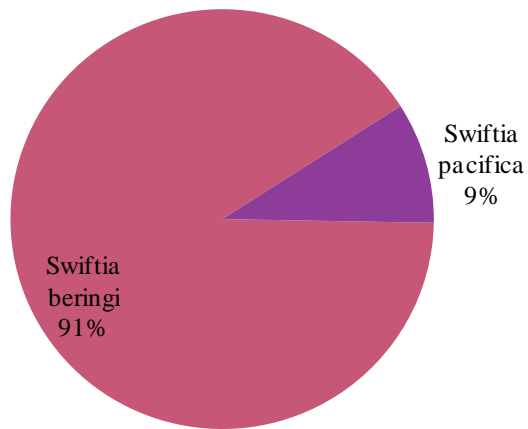


Corals

Relatively few corals were observed at site 17, with a mean coral density of 25 individuals/1,000 m². *Swiftia beringi* were the predominant coral species (91% of corals identified), found primarily on boulders. *Swiftia pacifica* was also observed on boulders.

Density of Corals

25 corals / 1,000 m²



Color Code	Coral Groups	Counts
	<i>Swiftia beringi</i>	332
	<i>Swiftia pacifica</i>	34

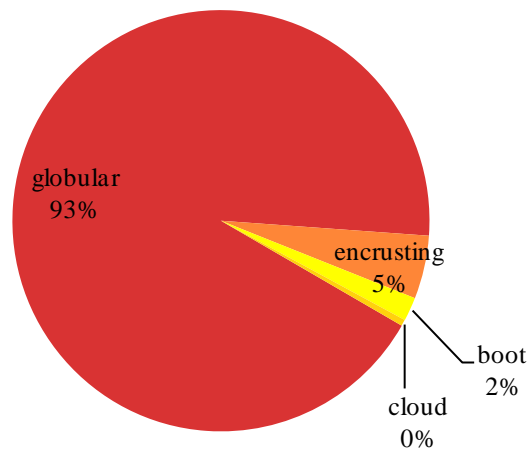
BIOLOGICAL ENVIRONMENT

Sponges

The green lunar sponge (*Latrunculia* sp.), a globular sponge primarily found on boulders, was the most abundant sponge, comprising 93% of all sponges found. Other sponge morphs at site 17 were encrusting, boot and cloud sponges.

Other invertebrates observed included crinoids (*Florometra serratissima*), sea cucumbers (*Parastichopus leukothele* and *P. californicus*), various sea star species, red ophiuroid brittle stars, and a few anemones.

Density of Sponges
55 sponges / 1,000 m²



Color Code	Class	Structural Morphs	Count
Red	Demosponges	globular	761
Orange	Hexactinellids	encrusting	40
Yellow	Hexactinellids	boot	15
Light Blue	Hexactinellids	cloud	4

BIOLOGICAL ENVIRONMENT

Fishes

Most of the species diversity at site 17 occurred in the boulder areas where rockfish were abundant. Rockfish species observed included yelloweye (*Sebastes ruberrimus*), tiger (*S. nigrocinctus*), yellowtail (*S. flavidus*), rosethorn (*S. helvomaculatus*), redstripe (*S. proriger*), and canary (*S. pinniger*). Other fish species included lingcod (*Ophiodon elongatus*), spotted ratfish (*Hydrolagus coliei*), cat shark and flounders.

Scientific Name	Common Name
<i>Sebastes helvomaculatus</i>	rosethorn rockfish
<i>Sebastes flavidus</i>	yellowtail rockfish
<i>Sebastes ruberrimus</i>	yelloweye rockfish
<i>Sebastes pinniger</i>	canary rockfish
<i>Sebastes nigrocinctus</i>	tiger rockfish
<i>Sebastes proriger</i>	redstripe rockfish
<i>Ophiodon elongatus</i>	lingcod
<i>Hydrolagus coliei</i>	spotted ratfish
<i>Apristurus</i> sp.	cat shark
Pleuronectidae	righteye flounders

ADDITIONAL COMMENTS

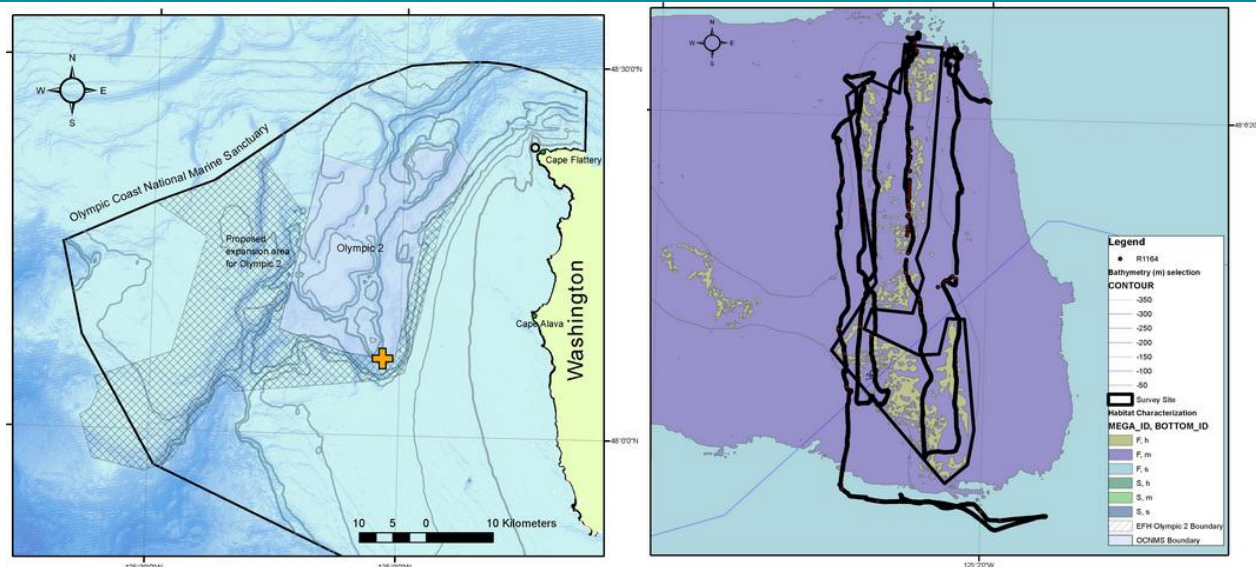
ROV transects were spaced 80m apart due to time constraints to complete the large area. Seven transects were completed. One perpendicular transect was surveyed to traverse anticipated habitat transitions.

In 2006, site 17 was attempted but only one transect was completed due to the proximity of commercial fishing vessels in the area, which forced termination of the survey.

DIVE NUMBER: 1164

SURVEY AREA: 35

GENERAL LOCATION AND DIVE TRACK



SITE OVERVIEW

Project	2008 Deep Sea Coral Research Cruise, Olympic Coast National Marine Sanctuary
Chief Scientist	Ed Bowlby ¹
Co-Principal Investigators	Mary Sue Brancato and James Boutillier
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 after monitoring benthic recovery sites along fiber optic cable routes.
Vehicle	Canadian Coast Guard vessel <i>John P. Tully</i> , ROPOS ROV
Science Observers	M.S. Brancato, J. Bright, J. Boutillier, G. Workman, E. Edinger, P. Lambert, J. Chu, and E. Bowlby
Forward View HD File Hrs	3
Forward View Tape Count	2
Digital Still Images	94
Oxygen mg/L (avg)	1.92
Salinity ppt (avg)	33.96
Temperature °C (avg)	6.48
# of Samples Collected	2

DIVE NUMBER: 1164

SURVEY AREA: 35

SITE DATA

Start Date	7/13/2008	Start Latitude	N 48° 6' 4.997"
End Date	7/13/2008	Start Longitude	W 125° 2' 8.436"
Minimum Bottom Depth (m)	-114.3	End Latitude	N 48° 6' 6.628"
Maximum Bottom Depth (m)	-302.0	End Longitude	W 125° 2' 3.385"
Start Bottom (GMT)	18:52:00	Bottom Current (kts)	0.5 (estimated)
End Bottom (GMT)	21:58:00	Bottom Current Direction	W

IMAGE GALLERY



IMAGE A: *Paragorgia arborea pacifica* on mud boulder habitat

N 48° 6' 14.7312", W 125° 2' 1.8312"



IMAGE B: *Swiftia pacifica* on boulder mud habitat

N 48° 6' 18.9792", W 125° 2' 8.9844"



IMAGE C: *Plumarella longispina* on mud boulder habitat

N 48° 6' 8.3340", W 125° 2' 6.8172"

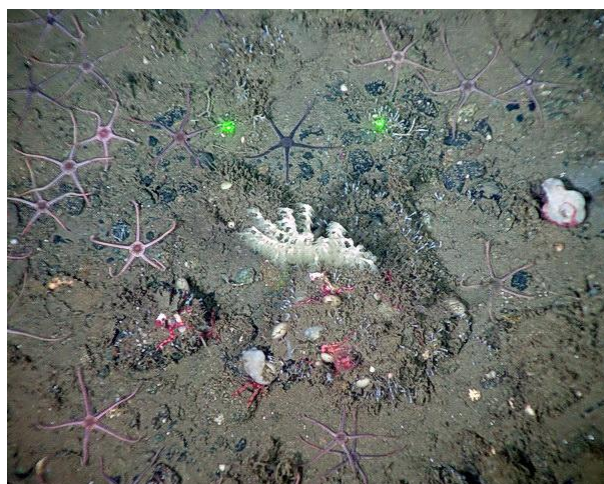


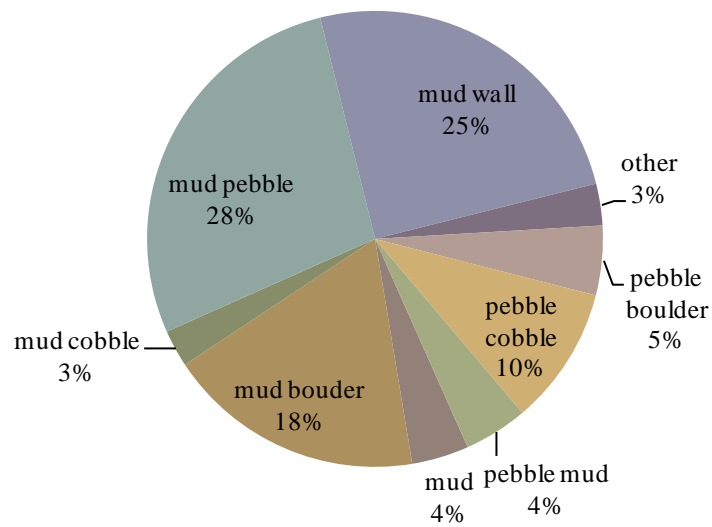
IMAGE D: *Swiftia beringi* on mud pebble habitat

N 48° 6' 20.1204", W 125° 2' 8.1708"

PHYSICAL ENVIRONMENT

Habitats

The total area surveyed at site 35 was 10,566 m². Most of the site consisted of areas of low relief mud pebble (28% of total area), pebble cobble (10%), mud (4%), pebble mud (4%), and mud cobble (3%). Mud boulder (18%) and pebble boulder (5%) habitat was interspersed with habitat transitions to high relief mud walls and/or mud terraces (25%).

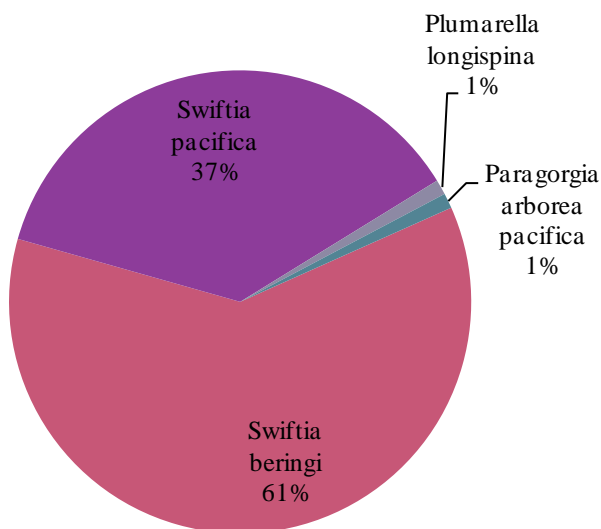
Habitats Surveyedarea = 10,566 m²

Corals

Approximately 100 corals were observed at site 35, for a mean density of 9 individual corals/1,000 m². Two *Swiftia* species were observed at this site - *S. beringi* (61% of all corals observed) and *S. pacifica* (37%). One colony of *Plumarella longispina* and one colony of *Paragorgia arborea pacifica* were observed.

Denisty of Corals

9 corals / 1,000 m²



Color Code	Coral Groups	Counts
	<i>Swiftia beringi</i>	58
	<i>Swiftia pacifica</i>	35
	<i>Plumarella longispina</i>	1
	<i>Paragorgia arborea pacifica</i>	1

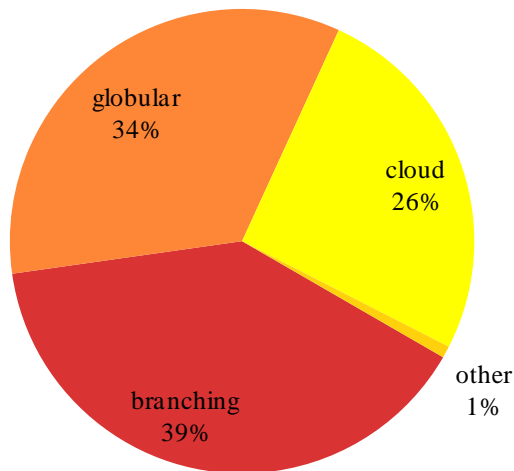
Sponges

The mean sponge density at site 35 was 46 sponges/1,000 m². Three predominant sponge morphs were observed. The branching sponge morph was the most abundant (39% of all sponges observed) followed by the globular morph (34%) and cloud morph (26%).

Other invertebrate species consisted of crinoids (*Florometra serratissima*), various sea star species, sea cucumbers (*Parastichopus leukothele* and *P. californicus*), and anemones.

Density of Sponges

46 sponges / 1,000 m²



Color Code	Class	Structural Morphs	Count
	Demosponge	branching	192
	Demosponge	globular	166
	Hexactinellids	cloud	125
	Hexactinellids	encrusting	2
	Hexactinellids	boot	1
	Demosponge	single tube	1

BIOLOGICAL ENVIRONMENT

Fishes

Rockfish were observed throughout the site, including rosethorn (*Sebastes helvomaculatus*), darkblotched (*Sebastes crameri*), and greenstriped (*Sebastes elongates*). Rockfish were observed on boulders and resting on finer substrate. A few rockfish appeared gravid, with extended abdomens.

Other fish observed were Pacific halibut (*Hippoglassus strenolepis*), lingcod (*Ophiodon elongates*), flounders (Pleuronectidae), and spotted ratfish (*Hydrolagus colliei*).

Scientific Name	Common Name
<i>Sebastes helvomaculatus</i>	rosethorn rockfish
<i>Sebastes elongatus</i>	greenstriped rockfish
<i>Sebastes crameri</i>	darkblotched rockfish
<i>Sebastolobus</i> sp.	thorneyhead
Rajidae	skate
<i>Ophiodon elongatus</i>	lingcod
<i>Hydrolagus colliei</i>	spotted ratfish
<i>Hippoglassus strenolepis</i>	Pacific halibut
<i>Eptatretus</i> sp.	hagfish
Pleuronectidae	righteye flounders

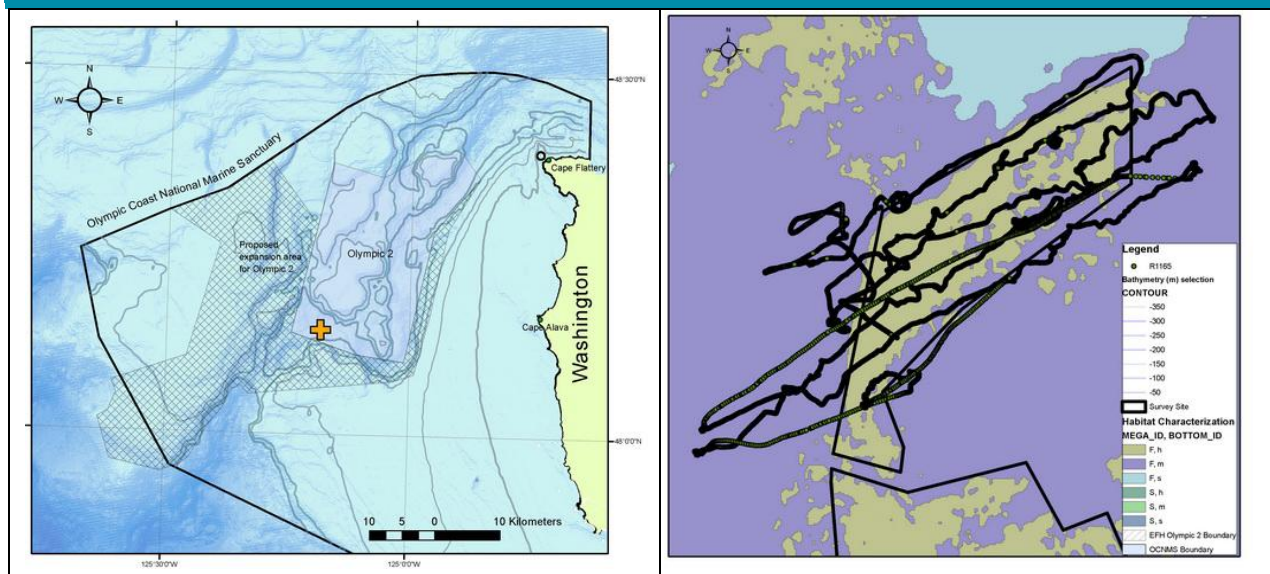
ADDITIONAL COMMENTS

A total of 5 transects were completed, spaced 40m apart.

DIVE NUMBER: 1165

SURVEY AREA: 39

GENERAL LOCATION AND DIVE TRACK



SITE OVERVIEW

Project	2008 Deep Sea Coral Research Cruise, Olympic Coast National Marine Sanctuary
Chief Scientist	Ed Bowlby ¹
Co-Principal Investigators	Mary Sue Brancato and James Boutillier
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 after monitoring benthic recovery sites along fiber optic cable routes.
Vehicle	Canadian Coast Guard vessel <i>John P. Tully</i> , ROPOS ROV
Science Observers	M.S. Brancato, J. Bright, J. Boutillier, G. Workman, E. Edinger, P. Lambert, J. Chu, and E. Bowlby
Forward View HD File Hrs	5
Forward View Tape Count	2
Digital Still Images	498
Oxygen mg/L (avg)	34.04
Salinity ppt (avg)	1.38
Temperature °C (avg)	6.02
# of Samples Collected	11

DIVE NUMBER: 1165

SURVEY AREA: 39

SITE DATA

Start Date	7/14/2008	Start Latitude	N 48° 8' 40.376"
End Date	7/14/2008	Start Longitude	W 125° 11' 5.276"
Minimum Bottom Depth (m)	-287.3	End Latitude	N 48° 8' 36.163"
Maximum Bottom Depth (m)	-349.9	End Longitude	W 125° 11' 9.048"
Start Bottom (GMT)	01:39:00	Bottom Current (kts)	1 (estimated)
End Bottom (GMT)	07:03:00	Bottom Current Direction	W

IMAGE GALLERY

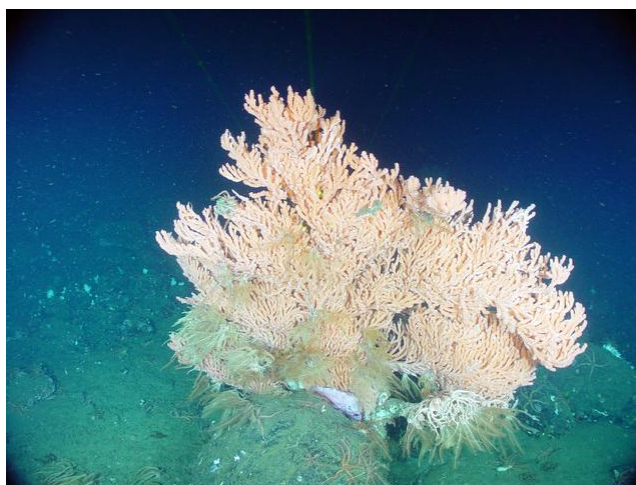


IMAGE A: *Primnoa pacifica* on mud boulder habitat
N 48° 8' 36.1968", W 125° 11' 9.0744"

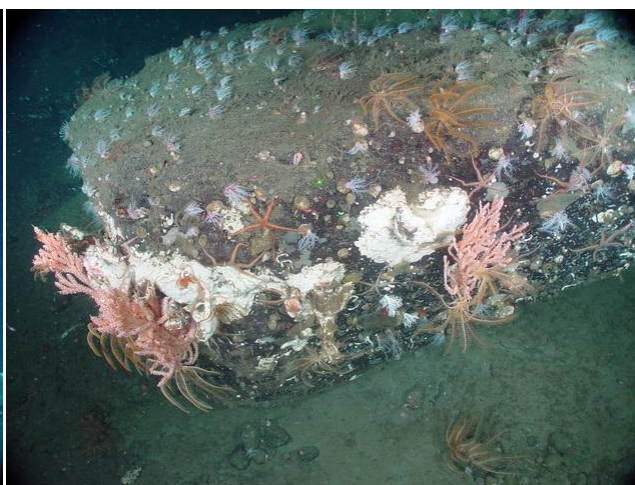


IMAGE B: *Primnoa pacifica* on mud boulder habitat
N 48° 8' 41.4744", W 125° 10' 57.7164"



IMAGE C: White *Primnoa* with crinoids on mud boulder habitat
N 48° 8' 38.0508", W 125° 11' 2.2236"

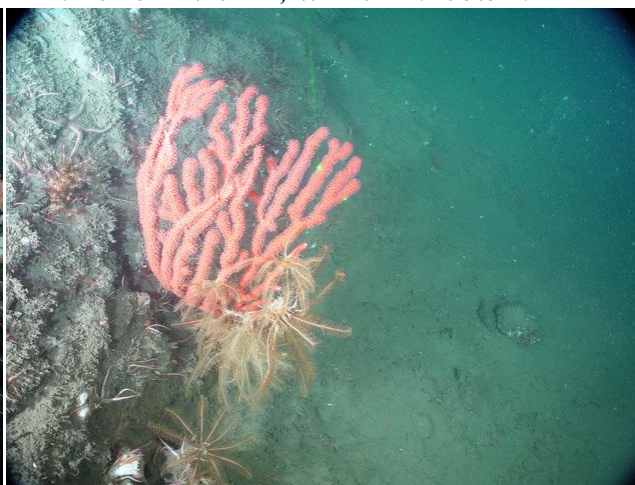
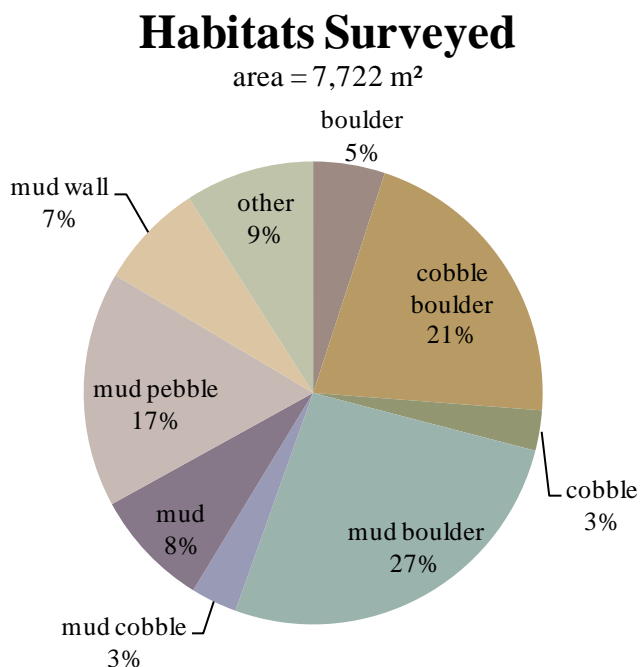


IMAGE D: *Paragorgia arborea pacifica* on mud boulder habitat
N 48° 8' 43.8504", W 125° 10' 55.9524"

PHYSICAL ENVIRONMENT

Habitats

The total area surveyed at site 39 was 7,722 m². This highly diverse site consisted of multiple areas of habitat transitions. A high relief mud wall occupied approximately 7% of the total area. Areas of mud slopes (8%) were interspersed with areas of low relief mud pebble (17%), mud cobble and cobble substrates. Additionally, there were areas of rugosity including mud boulder patches (27%) and multiple areas of cobble boulder habitat (21%).

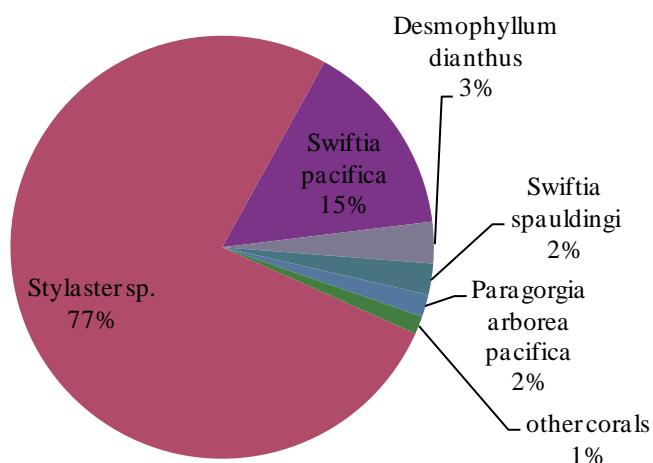


Corals

More than 2,000 individual corals were observed at this site, with a mean density of 266 corals/1,000 m². The most abundant coral observed at site 39 was the hydrocoral *Stylaster* sp. (77% of all individual corals), which was typically found on cobble habitat. Diversity of corals at site 39 was augmented by the gorgonians *Paragorgia arborea pacifica*, white *Paragorgia* with pink polyps, *Primnoa pacifica*, a white *Primnoa* and various *Swiftia* species. Additional coral species observed were the giant cup coral *Desmophyllum dianthus*. Another observation was of very small corals on a few boulders which could possibly indicate coral recruitment. Seven large dead corals were observed, as well as areas of dead coral stalks.

Density of Corals

266 corals / 1,000 m²



Color Code	Coral Groups	Counts
	<i>Stylaster</i> sp	1,573
	<i>Swiftia pacifica</i>	309
	<i>Desmophyllum dianthus</i>	65
	<i>Swiftia spauldingi</i>	49
	<i>Paragorgia arborea pacifica</i>	35
	<i>Primnoa pacifica</i>	15
	<i>Swiftia beringi</i>	10
	<i>Muriceides</i> sp.	2
	<i>Plumarella longispina</i>	1

BIOLOGICAL ENVIRONMENT

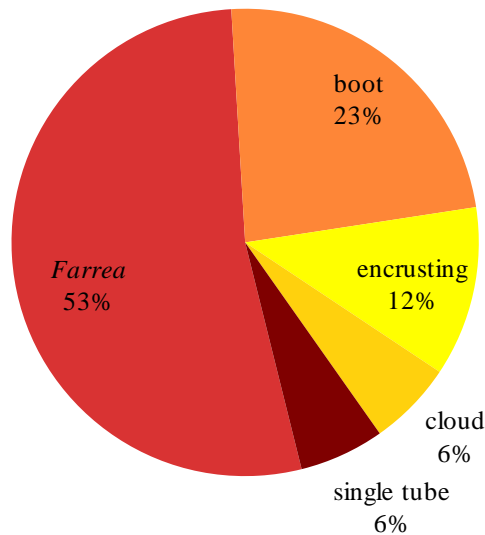
Sponges

Although coral density was relatively high, few sponges were observed at site 39. Sponge species observed included boot sponges (possibly *Rhabdocalyptus dawsoni*) and, most notably, areas containing the reef building farrea morph (possibly *Farrea occa*).

There was a relatively high diversity of invertebrates at this site, including pom pom (*Liponema* sp.) and fly trap (*Hormathidae* sp.) anemones, sea cucumbers (*Parastichopus leukothele* and *P. californicus*), red ophiuroid brittle stars, basket stars (*Gorgonocephalus* sp.), and an octopus (*Benthoctopus* sp.)

Density of Sponges

2 sponges / 1,000 m²



Color Code	Class	Structural Morphs	Count
Red	Hexactinellids	farrea	9
Orange	Hexactinellids	boot	4
Yellow	Hexactinellids	encrusting	2
Light Yellow	Hexactinellids	cloud	1
Dark Red	Demosponge	single tube	1

BIOLOGICAL ENVIRONMENT

Fishes

Rockfish species observed at this highly diverse site were rosethorn (*Sebastes helvomaculatus*), darkblotched (*Sebastes crameri*), and redbanded (*Sebastes babcocki*). Other fishes observed included thornyhead (*Sebastolobus* sp.), and Pacific halibut (*Hippoglossus stenolepis*) as well as multiple flatfish species.

Scientific Name	Common Name
<i>Sebastes helvomaculatus</i>	rosethorn rockfish
<i>Sebastes crameri</i>	darkblotched rockfish
<i>Sebastes babcocki</i>	redbanded rockfish
<i>Sebastolobus</i> sp.	thornyhead
<i>Hippoglossus stenolepis</i>	Pacific halibut
Pleuronectidae	righteye flounders
Rajidae	skates
<i>Eptatretus</i> sp.	hagfish
<i>Anoplopoma fimbria</i>	sablefish
Scyliorhinidae	cat sharks
<i>Agonidae</i> sp.	poacher

ADDITIONAL COMMENTS

Five transect lines were run at a 20m spacing.

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 Greg Workman (DFO), Wolf Carolsfeld (DFO), Evan Edinger (Memorial Univ. of Newfoundland), Phil Lambert (Royal British Columbia Museum), Jackson Chu (Univ. Alberta) and Jonathon Rose (Univ. British Columbia).

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). 2010a. 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.