

# A REPORT TO NOAA'S DEEP-SEA CORAL RESEARCH AND TECHNOLOGY PROGRAM

## A CHARACTERIZATION OF DEEP-SEA CORAL COMMUNITIES IN THE OLYMPIC COAST NATIONAL MARINE SANCTUARY FROM A SURVEY USING AN AUTONOMOUS UNDERWATER VEHICLE, JUNE 2010

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### INTRODUCTION AND SCIENTIFIC OBJECTIVES

The Olympic Coast National Marine Sanctuary (OCNMS) is located off of Washington's Olympic Peninsula and encompasses over 8,000 square miles of the continental shelf. In the deeper waters of the Sanctuary, scattered communities of deep-sea corals (DSC) and sponges have been found. A number of surveys of deep-sea coral and sponge habitats have occurred over the last several years; however, many areas within the Sanctuary have not been explored using photographic methods. As part of measures to minimize impacts to essential fish habitat (EFH) for Pacific coast groundfish, the Pacific Fishery Management Council (PFMC) created a conservation area known as Olympic 2 in 2006. This designation was partially based on historical deep-sea coral information and the recognition that these particularly vulnerable communities may provide important habitat for fishes. Current proposals to expand or modify the boundaries and restrictions in this area would greatly benefit from additional information on coral and sponge communities located both within and outside existing EFH conservation areas.

## CHARACTERIZATION OF DEEP-SEA CORAL COMMUNITIES: OLYMPIC COAST NATIONAL MARINE SANCTUARY

In order to meet the needs for additional information on deep-sea corals (DSC), surveys of DSC ecosystems in the OCNMS were conducted utilizing a ROV and an AUV off the NOAA Ship *McArthur II* in June 2010. Both survey vehicles targeted known or suspected DSC sites both inside the current EFH conservation area known as 'Olympic 2'. Sampling also targeted adjacent areas that have been proposed as boundary expansions and/or have additional fishery restrictions. Thus, new information on the locations, densities, and condition of DSCs and their role as EFH will not only help to fill scientific data gaps, but will provide new information pertinent to pending management considerations (via provisions of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) and/or National Marine Sanctuaries Act (NMSA)).

The goals of this project were to:

- 1) To locate and characterize DSC and sponge habitats in priority areas and to make this information available to support related fisheries and sanctuary management needs under MSA and NMSA requirements.
- 2) To collect information to help understand the value of DSC as habitat for other associated species.
- 3) To assess the condition of DSC assemblages in relation to potential anthropogenic or environmental disturbances.





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## Study Site

The study site was in the region of the OCNMS in waters greater than 100m. The habitat in this region is generally sand and silt, grading into gravel and cobbles. Rocky habitat is patchy and occurs as scattered outcrops or as canyon walls. It is on hard or rocky bottom that stands of structure forming corals are most likely to occur. Existing bathymetric information was used to select potential hard bottom sites that had not been surveyed and were within or around the Olympic 2 conservation area (Figure 1.)

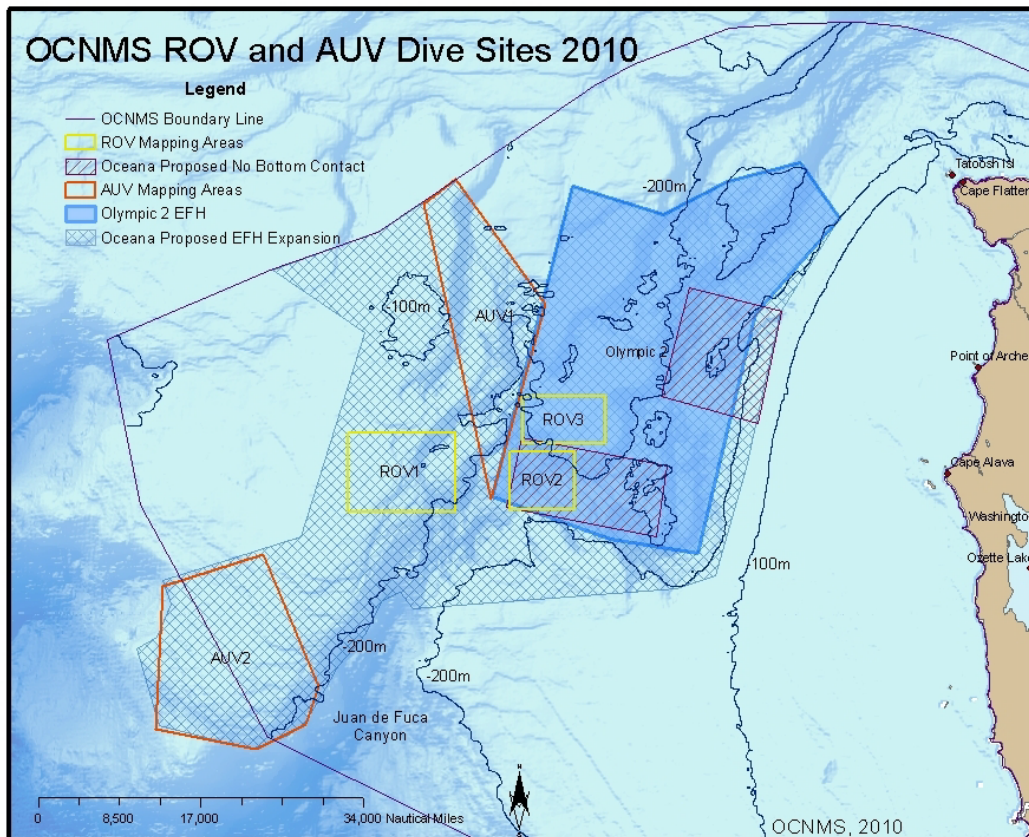


Figure 1. Planned survey sites for ROV and AUV dives in the Olympic Coast National Marine Sanctuary (OCNMS), off the coast of Washington state.

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Due to poor weather conditions the cruise was truncated and only two AUV sites were sampled (Figure 2). One site was within the Olympic 2 region and the second was west of the current Olympic 2 area. Both dives began after sunset and were in waters less than 140 meters (Table 1).

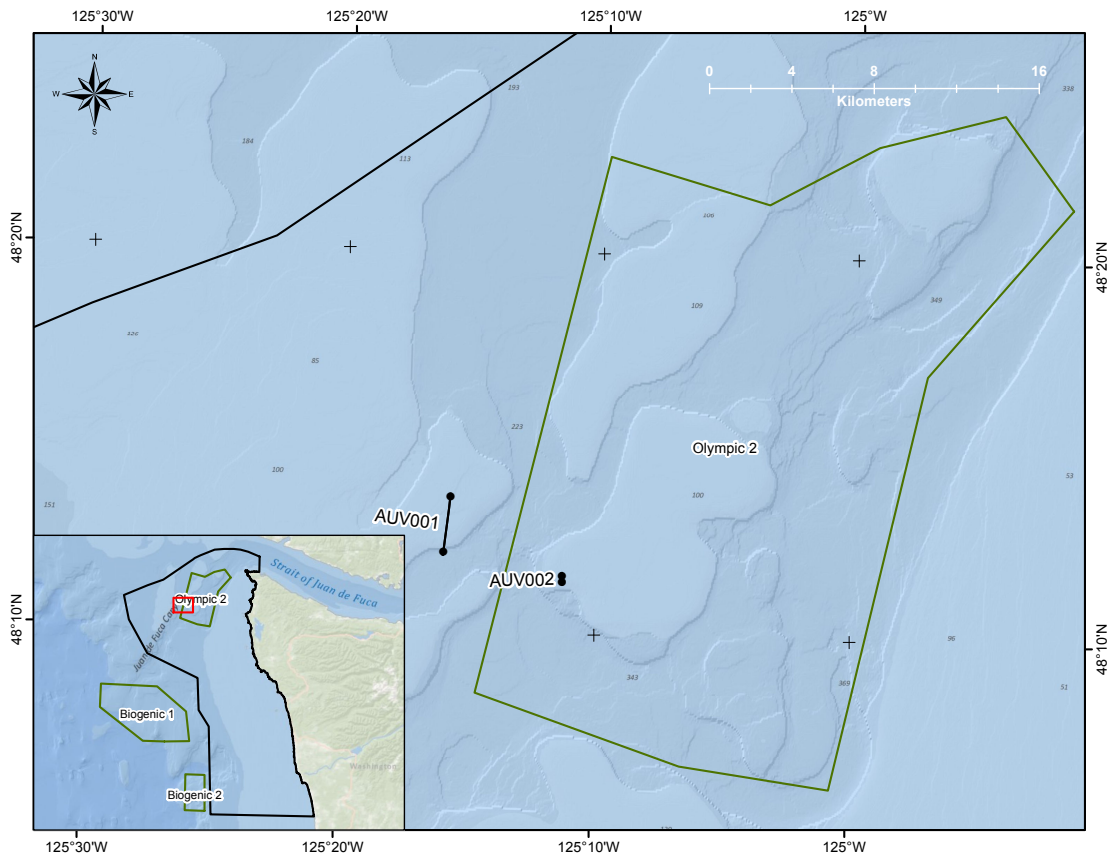


Figure 2. Locations of AUV dives relative to the 'Olympic 2' EFH conservation area located within the Olympic Coast National Marine Sanctuary.

Table 1. Summary Dive Information

Date (local)	Dive #	Start Time	End Time	Start Lat (N)	Start Long (W)	End Lat (N)	End Long (W)	max depth (m)
6/12/10	1	23:43	04:41	48.2276°	125.2626°	48.200°	125.266°	117
6/15/10	2	02:31	07:45	48.1945°	125.1888°	48.1883°	125.1883°	129

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### Field Survey Methods

Underwater surveys of sponges, habitats and associated fishes were conducted using the SeaBed type Autonomous Underwater Vehicle (AUV) *Lucille* (Figure 3) deployed from the NOAA Ship *McArthur II*. Images of the seafloor were collected using two 5 Megapixel, 12 bit dynamic range Prosilica GigE cameras. One camera was mounted to look directly downward and the second camera was angled forward at 30° to provide an oblique perspective. Lighting was provided by a strobe synchronized with the camera shutters.

The AUV was equipped with two navigational sensors: the RDI 1200 kHz Doppler Velocity Log as the primary navigational sensor and the iXSea OCTANS gyrocompass and motion sensor. The AUV was tracked using a LinkQuest TrackLink 1500MA USBL acoustic navigation system. Subsurface communication was provided by the WHOI 256008 acoustic micromodem and surface communication used a FreeWave FGR-115 RCRF radio modem. Depth was determined using a Paroscientific Depth Sensor. Salinity, temperature and pressure were collected using a Sea-Bird Electronics model 49 FastCat CTD mounted on the AUV.

Two sites were sampled during 3 days (Figure 2). Cameras were programmed to take photographs once every 5 seconds and the AUV was programmed to maintain an altitude of three meters from the bottom while conducting photographic surveys. During Dive 2, the AUV was programmed to rise to altitude of 15 meters from the bottom in order to collect sonar information using an Imagenex Delta T multibeam echosounder. Images were downloaded and color-corrected at the end of each dive. All non-overlapping color-corrected digital images from the downward-looking camera were reviewed following the cruise, and invertebrates as well as associated fishes were identified and counted. Photos from the oblique perspective camera were used to assist in species identification only.



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Figure 3. SeaBed type Autonomous Underwater Vehicle, *Lucille*, being deployed from research vessel.

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## Post-Dive Analysis

Location of the AUV during each dive was estimated by using USBL range and bearing measurements relative to the ship, the xy coordinates of the vehicle position relative to its dive origin, and the GPS coordinates of the dive launch point.

All non-overlapping color-corrected digital images from the downward looking camera were reviewed following the cruise. Corals, sponges and other invertebrates as well as associated fishes were identified and counted from all images. The area of each image was estimated using the measured altitude off the bottom and the specified camera field of view. Since the AUV was programmed to maintain a height of 3 meters from the seabed and did so with little variation there was minimal variation in the field of view of each image. Marine debris and any evidence of anthropogenic effects were noted.

Seafloor habitats in each photograph were categorized using a two-character code (Table 2.) The first character signified the primary habitat type that covered greater than 50% of the field of view, while the second character defined the secondary habitat type covering between 20% and 50%. If the primary habitat coverage exceeded 80%, that letter was denoted twice (e.g., CC).

Temperature and salinity were processed, plotted, and analyzed using SeaBird Electronics' data processing software. Large spikes in the data were edited by hand.

Table 2. Habitat types

Habitat Code	Description	Habitat Name
u	small particle size anywhere in grain size from finest mud to coarsest sand	Unconsolidated
m	small particle size; darker color than sand & generally deeper water	Mud
s	small particle size; white to light gray in color & generally in shallower water; > 0.0625 mm & < 4 mm	Sand/sediment
g	>4 mm & <2 cm	Gravel
p	>2 cm & <6.4 cm	Pebble
c	>6.4 cm & <25.6 cm; often rounded	Cobble
b	>25.6 cm; detached from outcrop of origin	Boulder
f	<1 m relief; slope angle, <30 deg; flat rock areas away from ridge	Flat Rock
r	generally >1 m relief consolidated rock; slope angle >30 deg & <60 deg	Ridge
t	>3 m relief; slope angle >60 deg	Pinnacle

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### Summary of Dives

Only two AUV dives were attempted and completed. The cruise was truncated at after the second dive due to weather.

Approximately 11,412 m<sup>2</sup> of seafloor habitat was classified. On Dive 001, several habitat types were encountered but the predominant primary habitat was sand. Gravel was the next most abundant habitat followed by pebble, cobble, boulder and sediment. Dive 2 also crossed different geological areas but most of the habitats observed were composed entirely of sand with no other secondary habitat. Over the course of Dive 002 a number of boulder fields were encountered scattered throughout the area.

Fish and invertebrates were identified to the lowest possible taxon and enumerated. Quantitative information was collected for 43 taxa of invertebrates (Table 3) and 22 taxa of fishes (Table 4).

Corals, except for sea pens were not abundant on either dive. The gorgonian *Swiftia beringi* was observed twice on Dive 001. Sponges were abundant in this area; however, sea stars and urchins were the predominant invertebrates observed. On Dive 002, sea pens dominated but sponges were also abundant.

Spotted ratfish (*Hydrolagus colliei*) was the most abundant fish species encountered on Dive 001, and greenstriped rockfish (*Sebastes elongates*) was the most abundant on Dive 002.

Below are summaries of the information collected during each of the two dives. This information includes observed densities of fishes and invertebrates as well as descriptions of the physical environment on each dive.



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Table 3. List of invertebrate taxa observed during two AUV dives, 13-15 June 2010.

	Scientific Name
	Majoidea-Unidentified Decorator crab
	Paguroidea-Unidentified Hermit crabs
	<i>Lopholithodes foraminatus</i>
	<i>Pandalus platyceros</i>
	Brachyura-Unidentified Crabs
	<i>Parastichopus californicus</i>
	<i>Parastichopus leukothele</i>
	<i>Allocentrotus fragilis</i>
	<i>Ceramaster</i> spp.
	<i>Crossaster papposus</i>
	<i>Henricia</i> spp.
	<i>Hippasterias</i> spp.
	<i>Leptasterias</i> spp.
	<i>Mediaster aequalis</i>
	<i>Orthasterias koehleri</i>
	<i>Parastichopus</i> spp.
	<i>Pteraster tessellatus</i>
	Pycnopodia/Rathbunaster
	<i>Solaster</i> sp.
	<i>Strongylocentrotus pallidus</i>
	<i>Stylasterias forreri</i>
	Asteriod-Unidentified sea stars
	<i>Florometra serratissima</i>
	<i>Cribrinopsis fernaldi</i>
	<i>Stomphia</i> sp.
	Actinaria - Unidentified anemones
	Subselliflorae sea pen
	<i>Swiftia beringi</i>
	<i>Fusitriton orgonensis</i>
	Opisthobranchia
	<i>Polyplacaphora</i> spp.
	<i>Latrunculia</i> sp.
	<i>Poecillastra</i> sp.
	Rosellidae-Unidentified Rosellid sponge
	Demospongiae-Unidentified branching demosponge
	Demospongiae-Unidentified stalked demosponge
	Demospongiae-Unidentified tubular demosponge
	Porifera-Unidentified Sponge Species
	Tunicata-Unidentified Tunicates
	Unidentified invertebrate
	Unidentified encrusting invertebrate

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Table 4. List of fish taxa observed during two AUV dives, 13-15 June 2010.

	Scientific Name	Common Name
	<i>Hydrolagus coliei</i>	spotted ratfish
	<i>Sebastes complex</i>	red rockfish complex ( <i>S. rufus</i> , <i>S. zacentrus</i> , <i>S. crameri</i> )
	<i>Sebastes elongatus</i>	greenstriped rockfish
	<i>Sebastes helvomaculatus</i>	rosethorn rockfish
	<i>Sebastes ruberrimus</i>	yelloweye rockfish
	<i>Sebastes rufus</i>	bank rockfish
	<i>Sebastes saxicola</i>	stripetail rockfish
	<i>Sebastes</i> spp.	Unidentified rockfish
	<i>Sebastes zacentrus</i>	sharpchin rockfish
	<i>Atheresthes stomias</i>	arrowtooth flounder
	<i>Eopsetta jordani</i>	petrale sole
	<i>Errex zachirus</i>	rex sole
	<i>Hippoglossus stenolepis</i>	Pacific halibut
	<i>Lyopsetta exilis</i>	slender sole
	<i>Microstomus pacificus</i>	Dover sole
	<i>Pleuronectes vetulus</i>	English sole
	Cottidae spp.	Unidentified sculpin
	unknown agonidae	poachers
	Unidentified fish	Unidentified fish
	Bathymasteridae spp	Unidentified ronquils
	Unidentified skate eggcase	Unidentified skate eggcase
	<i>Ophiodon elongatus</i>	lingcod

**DIVE NUMBER: AUV 001**  
**OLYMPIC COAST NATIONAL MARINE SANCTUARY**

**STATION OVERVIEW**

<b>Contact Information</b>	NOAA NWFSC elizabeth.clarke@noaa.gov
<b>Purpose</b>	Survey Deep-Sea Coral Communities in region of Olympic Coast National Marine Sanctuary
<b>Vessel</b>	NOAA Ship <i>McArthur II</i>
<b>Science Observers</b>	Elizabeth Clarke, Erica Fruh, Jeremy Taylor, Jeff Anderson, Curt Whitmire
<b>External Video Tapes</b>	None
<b>Internal Video Tapes</b>	None
<b>Digital Still Photos</b>	7781
<b>Positioning System</b>	Ship: GPS; AUV: DVL, gyrocompass, USBL
<b>CTD Sensors</b>	Yes
<b>O<sub>2</sub> Sensor</b>	No
<b>pH Sensor</b>	No
<b>Specimens collected</b>	No
<b>Report Authors</b>	Elizabeth Clarke, Erica Fruh, Curt Whitmire

**DIVE DATA**

Date	June 13, 2010	Starting Latitude (N)	48.2276°
Maximum Bottom Depth (m)	117	Starting Longitude (W)	125.2626°
Start Time (PDT)	23:43	Ending Latitude (N)	48.2000°
End Time (PDT)	02:31	Ending Longitude (W)	125.2660°

A total of approximately 7466 m<sup>2</sup> of seafloor was assessed from a sample of digital photographs taken from the AUV *Lucille* deployed from the NOAA Ship *McArthur II* during Dive 001. The AUV was pre-programmed to conduct a zig-zag pattern survey at an altitude of 3 meters from the seafloor (Figures 4,5). Photographs were taken every 5.0 seconds from the downward- and oblique-perspective cameras. Photographs taken by the downward-looking camera were used to collect quantitative information about habitat and fauna in the region.



DIVE NUMBER: AUV 001  
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GENERAL LOCATION AND DIVE TRACK

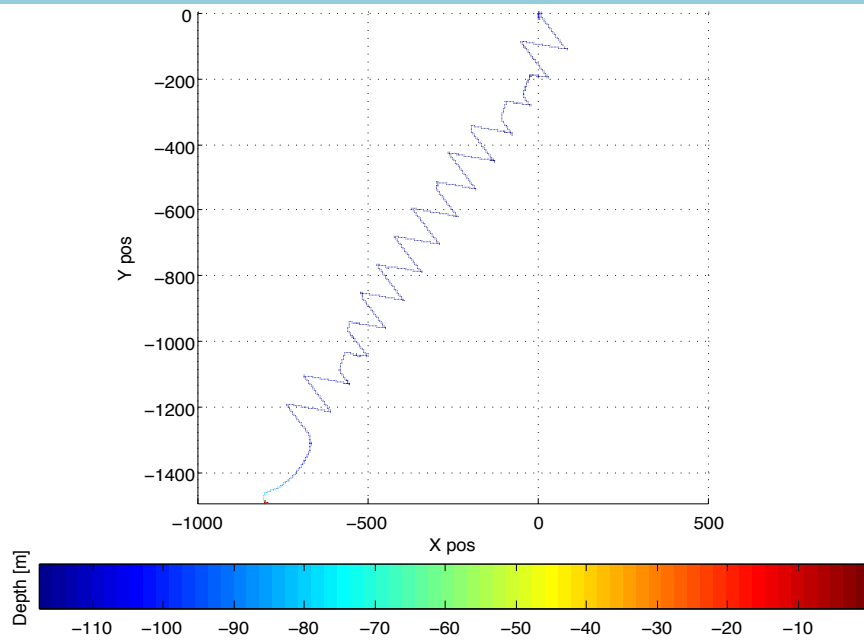


Figure 4. Survey pattern of dive AUV 001

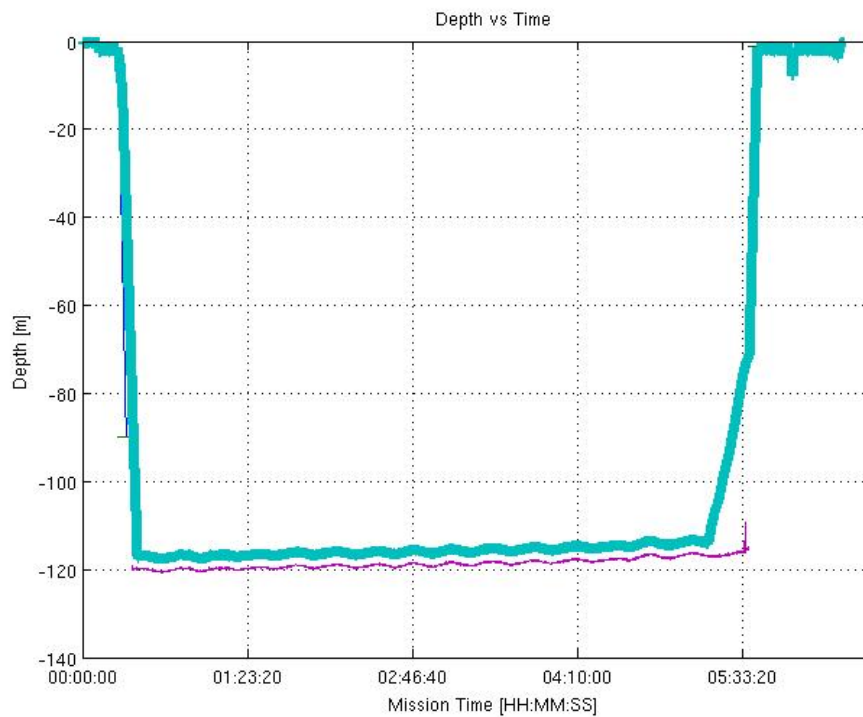


Figure 5. Depth track of dive AUV 001 showing bottom ( — ) and depth of vehicle ( — ).

**PHYSICAL ENVIRONMENT**

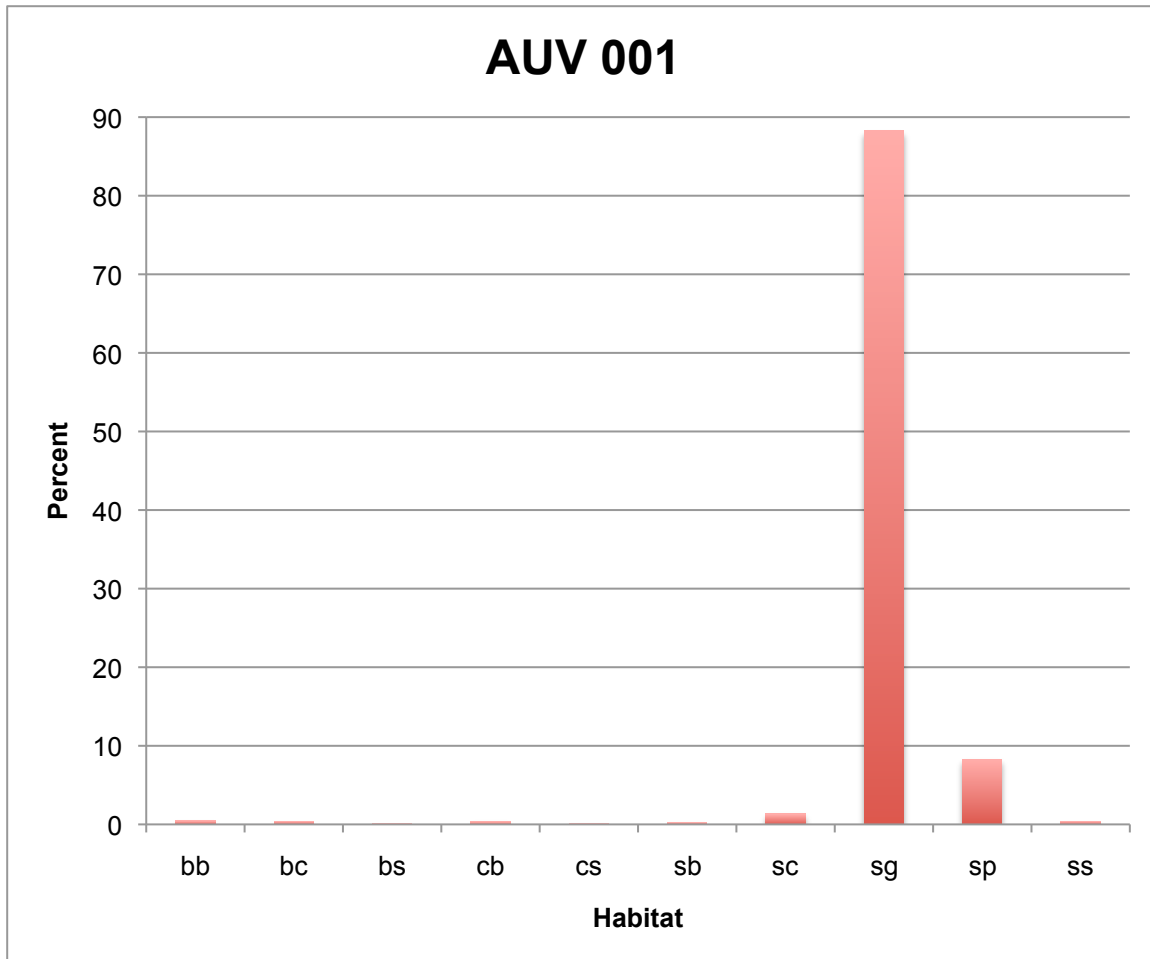


Figure 6. Percentage of habitat categories encountered in area sampled during dive AUV 001.

A two-character code was used to identify the habitat type (Table 2) in each photograph. The habitat varied little in this area (Figures 6, 7). A combination of sand and gravel was the primary habitat type (88%) with sand and pebble and sand and cobble being the next most common habitat at 8% and 1% respectively.

*DIVE NUMBER: AUV 001*  
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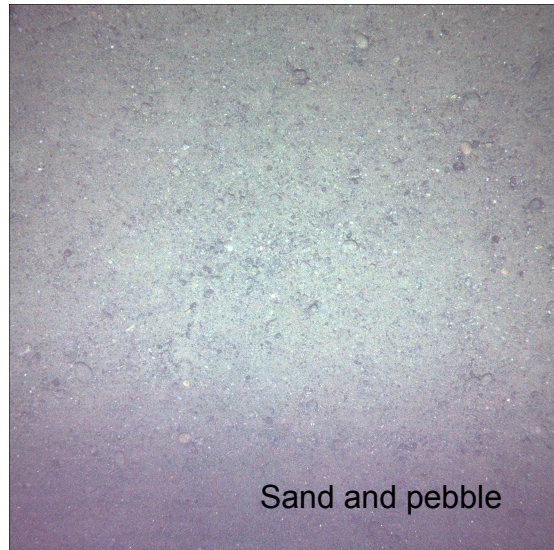


Figure 7. Predominant habitats observed during dive AUV 001.



**DIVE NUMBER: AUV 001**  
**OLYMPIC COAST NATIONAL MARINE SANCTUARY**

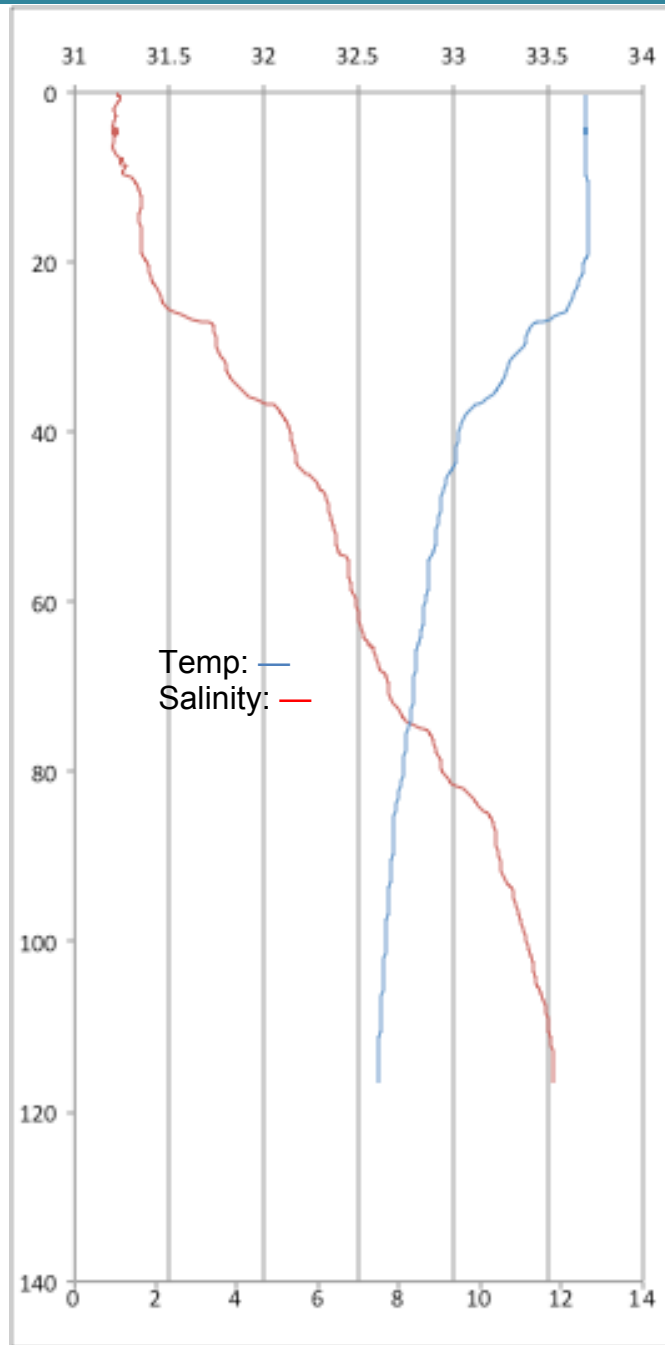


Figure 8. Salinity and temperature during descent of AUV during dive AUV 001.

The AUV was equipped with an onboard Sea-Bird model 49 FastCat CTD that collected temperature and salinity information during the AUV's descent as well as along the dive track. During dive AUV 001, the temperature varied from 12.66 to 7.47°C during descent and salinity varied from 31.19 to 33.53 (PSU) (Figure 8).

**BIOLOGICAL ENVIRONMENT: INVERTEBRATES**

A total of 1398 invertebrates from 24 taxonomic and morphometric groups were enumerated from 1659 photos covering 7466 m<sup>2</sup> during Dive 001 (Table 5). An overall density of 187 invertebrates per 1000 m<sup>2</sup> of seafloor was estimated from analysis of photographs (Figure 9). The urchin, *Strongylocentrotus pallidus*, was by far the most abundant invertebrate followed by sponges, the box crab *Lopholithodes foraminatus* and the crinoid, *Florometra serratissima*. There were two occurrences of the gorgonian coral, *Swiftia beringi*. Unidentified sponges were classified into 8 morphological types (Figure 10). The white massive morphological type was most abundant. It is likely that this morphological type represented several species.

Table 5. Invertebrates enumerated from dive AUV 001.

AUV001	Scientific Name	Number
	<i>Lopholithodes foraminatus</i>	81
	Unidentified crab spp.	2
	Unidentified decorator crab	3
	<i>Crossaster papposus</i>	17
	<i>Mediaster aequalis</i>	1
	<i>Hippasterias</i> spp.	1
	<i>Solaster</i> sp.	2
	<i>Henricia</i> spp.	4
	Hippasterias/Pteraster	1
	<i>Stylasterias forreri</i>	2
	<i>Orthasterias koehleri</i>	6
	<i>Strongylocentrotus pallidus</i>	842
	Asteriod-Unidentified sea star spp.	8
	<i>Florometra serratissima</i>	71
	<i>Fusitriton orgonensis</i>	1
	Demospongiae-Unidentified tubular demospunge	10
	Demospongiae-Unidentified branching demospunge	2
	Porifera-Unidentified Sponges	253
	<i>Poecillastra</i> sp.	2
	Rosellidae- Rossilid sponge	5
	<i>Swiftia beringi</i>	2
	Tunicata- Tunicate	6
	Unidentified encrusting invertebrates	42
	Unidentified invertebrates	34

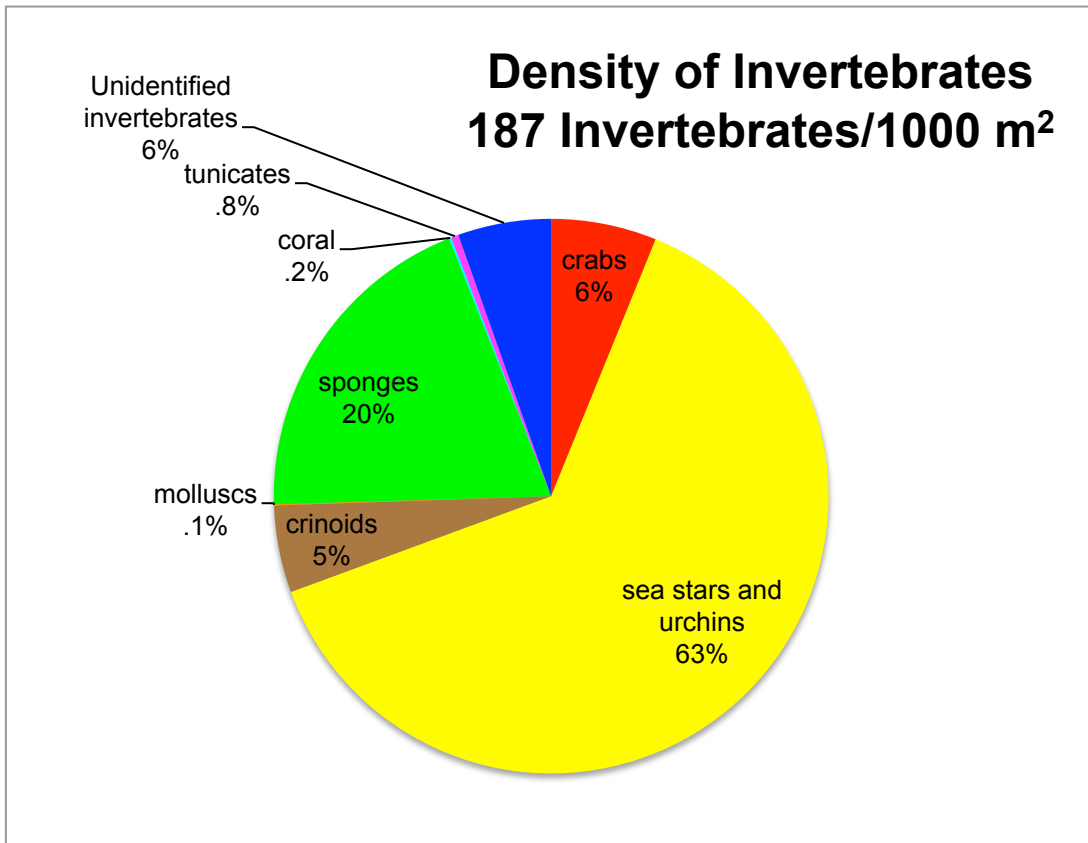


Figure 9. Percentage of invertebrates by group observed during dive AUV 001. Colors in pie diagram match colors in list of sponge taxa (Table 5).

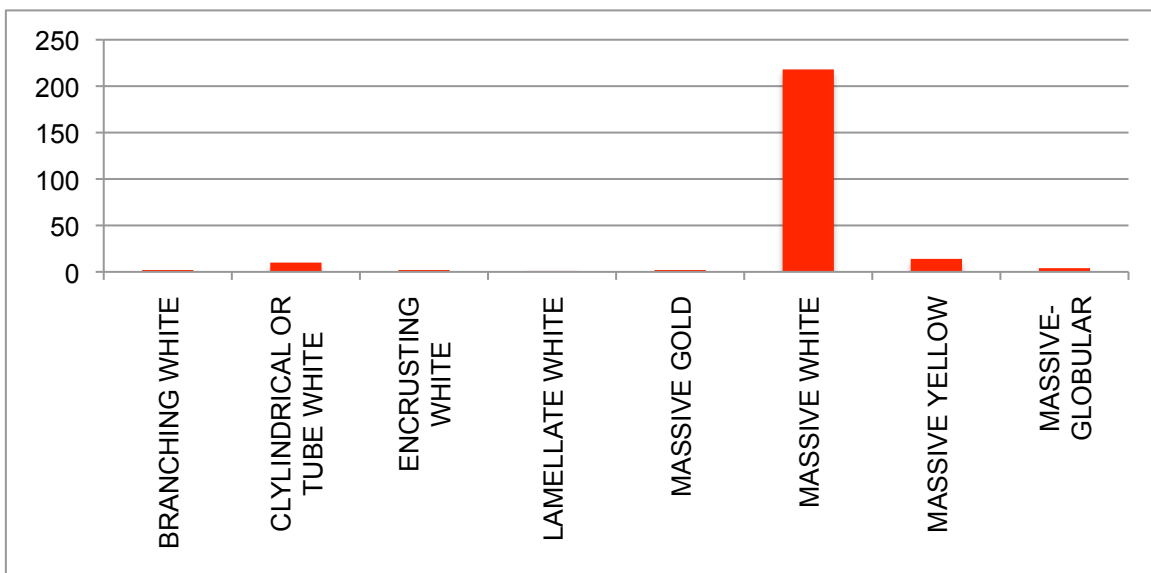


Figure 10: Morphotypes of unidentified sponges observed during dive AUV 001.

**BIOLOGICAL ENVIRONMENT: FISHES**

Twenty-one groups of fishes were identified in Dive 001 (Table 6). 137 fishes were enumerated for an overall density of 18 per 1000 m<sup>2</sup>. Ratfish and rockfish were the most abundant comprising 34% of the total fish density each (Figure 11). The most abundant rockfish species was the bank rockfish. The flatfish assemblage comprised 30% of the total density of fishes. A single lingcod was encountered.

Table 6. Number of fishes enumerated from dive AUV 001.

AUV01	Scientific Name	Common Name	Number
	<i>Hydrolagus colliei</i>	spotted ratfish	46
		unknown	
	<i>Sebastes</i> spp.	rockfish	10
		greenstriped	
	<i>Sebastes elongatus</i>	rockfish	7
	<i>Sebastes</i>	yelloweye	
	<i>ruberrimus</i>	rockfish	2
	<i>Sebastes</i>	rosethorn	
	<i>helvomaculatus</i>	rockfish	9
		sharpchin	
	<i>Sebastes zacentrus</i>	rockfish	1
		red rockfish	
		complex ( <i>S. rufus</i> , <i>S. zacentrus</i> , <i>S. crameri</i> )	4
	<i>Sebastes rufus</i>	bank rockfish	14
	<i>Microstomus pacificus</i>	Dover sole	1
	<i>Errex zachirus</i>	rex sole	1
	<i>Lyopsetta exilis</i>	slender sole	4
	<i>Eopsetta jordani</i>	petrale sole	33
	<i>Hipoglossus stenolepis</i>	Pacific halibut	1
	<i>Atheresthes stomias</i>	arrowtooth flounder	3
	<i>Ophiodon elongatus</i>	lingcod	1

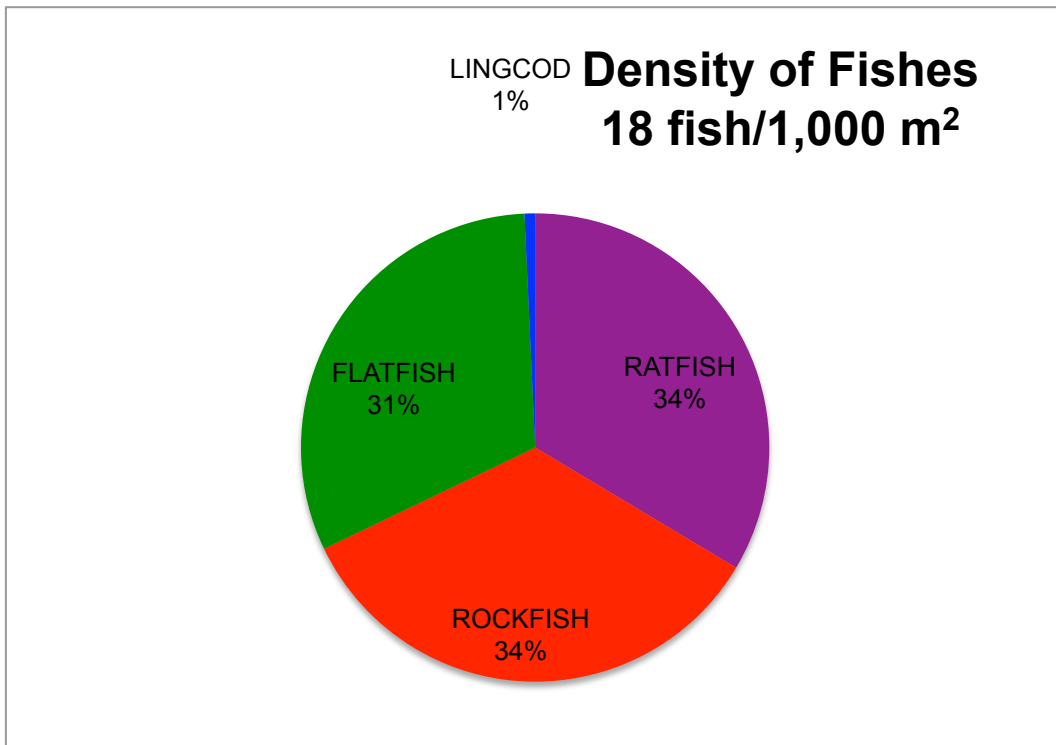


Figure 11. Percentage of fish density by group encountered during dive AUV 001. Colors in pie diagram match colors in list of fish taxa (Table 6).



## **MARINE DEBRIS**

Marine debris was found only in a few instances. The debris included a bottle, a long length of cable, and two unidentified pieces of debris (Figure 12).

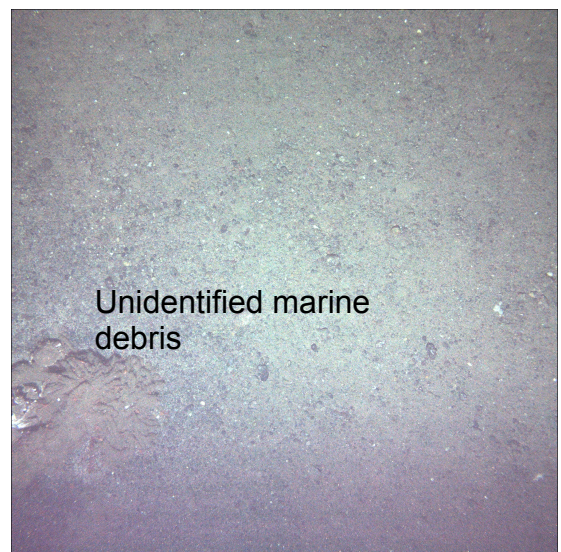
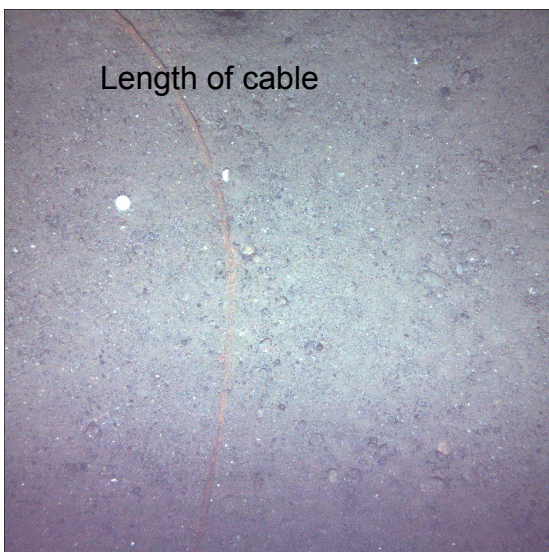
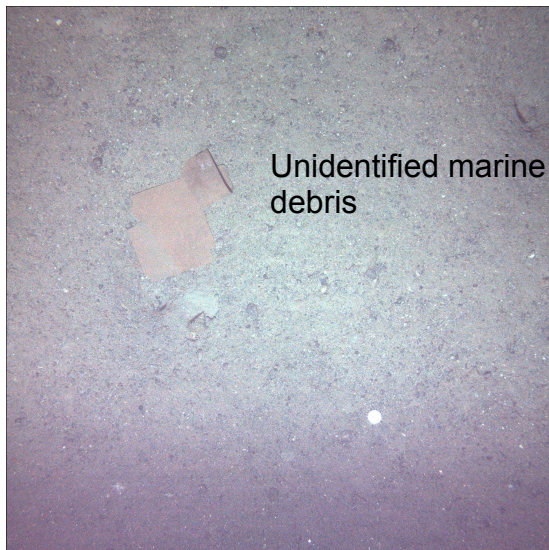
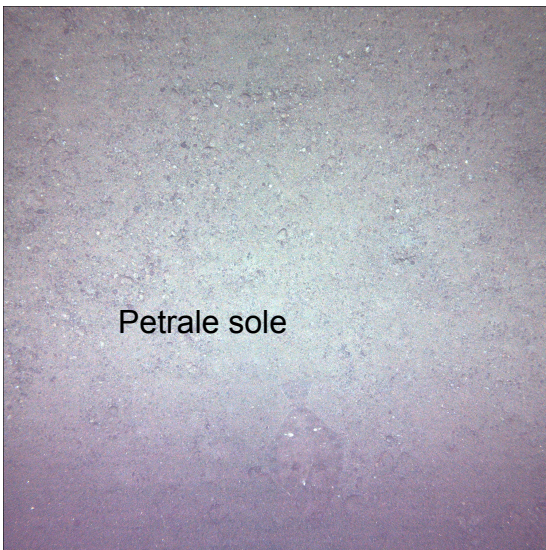
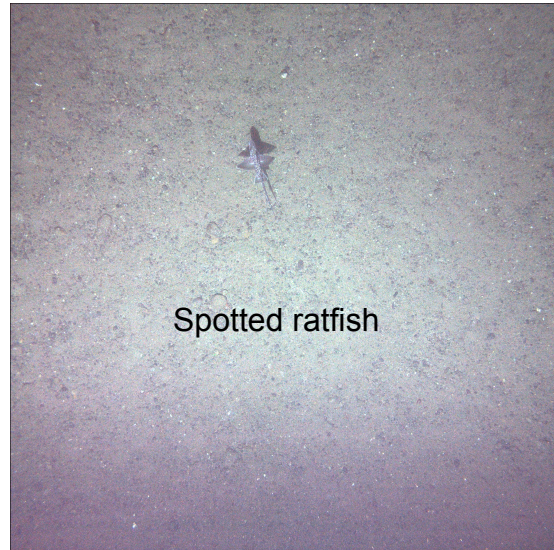


Figure 12. Examples of marine debris encountered on dive AUV 001.

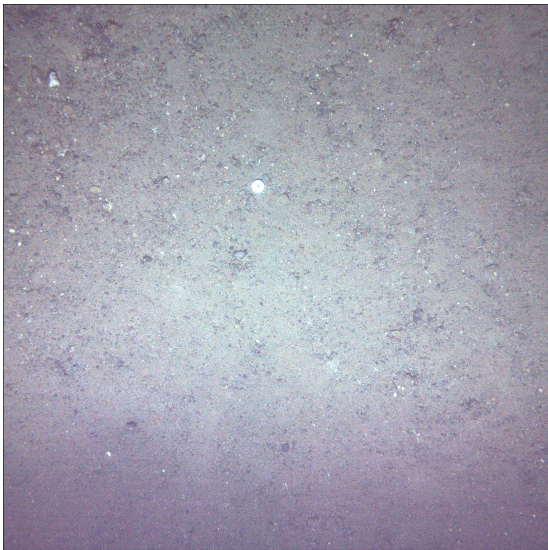


**IMAGE GALLERY**





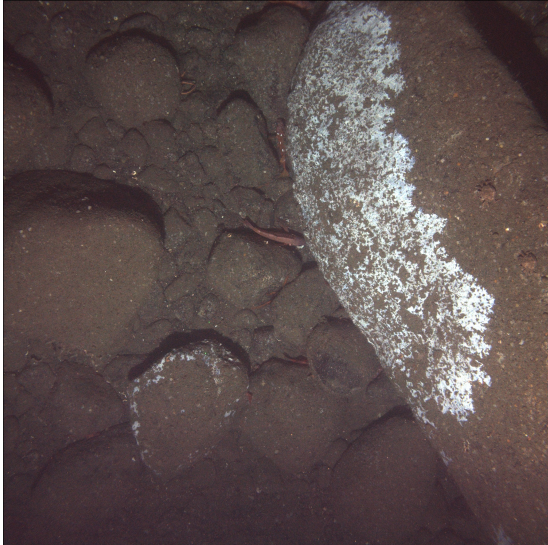
DIVE NUMBER: AUV 001  
OLYMPIC COAST NATIONAL MARINE SANCTUARY



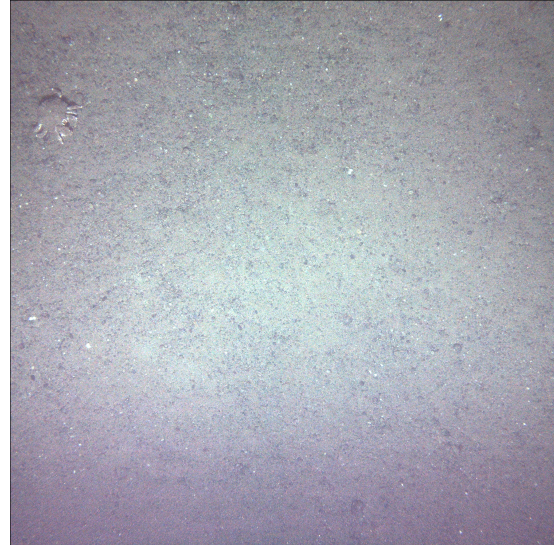
*Strongylocentrotus pallidus*



*Florometra serratissima*



Bank rockfish, rosethorn rockfish and unidentified rockfish, unidentified encrusting organism and box crab on boulder habitat.



Box crab, *Lopholithodes foraminatus*

**DIVE NUMBER: AUV 002**  
**OLYMPIC COAST NATIONAL MARINE SANCTUARY**

**STATION OVERVIEW**

<b>Contact Information</b>	NOAA NWFSC elizabeth.clarke@noaa.gov
<b>Purpose</b>	Survey Deep-Sea Coral Communities in region of Olympic Coast National Marine Sanctuary
<b>Vessel</b>	NOAA Ship <i>McArthur II</i>
<b>Science Observers</b>	Elizabeth Clarke, Erica Fruh, Jeremy Taylor, Jeff Anderson, Curt Whitmire
<b>External Video Tapes</b>	None
<b>Internal Video Tapes</b>	None
<b>Digital Still Photos</b>	3308
<b>Positioning System</b>	Ship: GPS; AUV: DVL, gyrocompass, USBL
<b>CTD Sensors</b>	Yes
<b>O<sub>2</sub> Sensor</b>	No
<b>pH Sensor</b>	No
<b>Specimens collected</b>	No
<b>Report Authors</b>	Elizabeth Clarke, Erica Fruh, Curt Whitmire

**DIVE DATA**

Date	June 15, 2010	Starting Latitude (N)	48.1945°
Maximum Bottom Depth (m)	129	Starting Longitude (W)	125.1888°
Start Time (PDT)	02:31	Ending Latitude (N)	48.1883°
End Time (PDT)	07:45	Ending Longitude (W)	125.1883°

A total of 3947m<sup>2</sup> of seafloor was assessed from a sample of digital photographs taken from the AUV *Lucille* deployed from NOAA Ship *McArthur II* during Dive 002. The AUV was pre-programmed to conduct a sparse grid pattern survey at an altitude of 3 meters from the seafloor (Figures 13, 14). Photographs were taken every 5.0 seconds from the downward- and oblique-perspective cameras. After 2 hours and 40 minutes the AUV was programmed to rise to 15 meters and collect multibeam sonar information. Photographs taken by the downward-looking camera were used to collect quantitative information about habitat and fauna in the region. The oblique perspective camera was only used to aid with identifications.

DIVE NUMBER: AUV 002  
OLYMPIC COAST NATIONAL MARINE SANCTUARY

GENERAL LOCATION AND DIVE TRACK

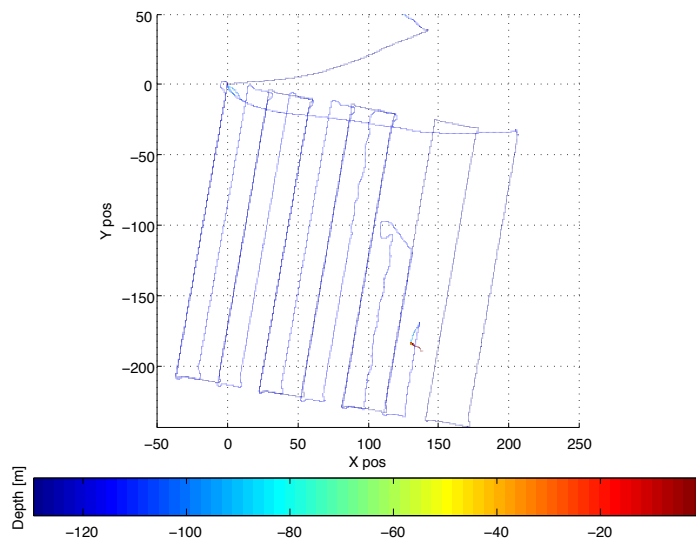


Figure 13. Survey pattern of dive AUV 002.

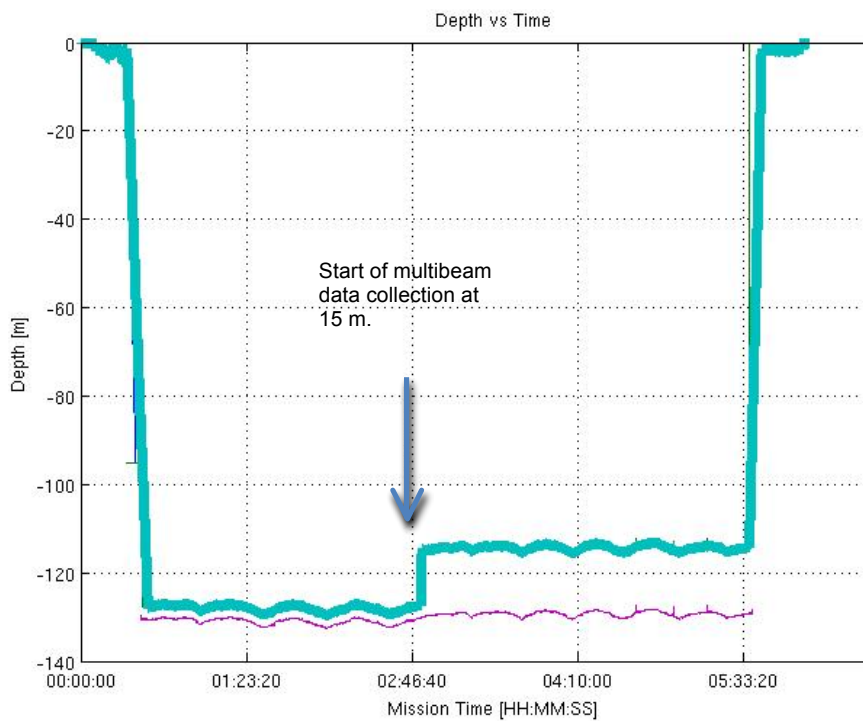


Figure 14. Depth track of dive AUV 002 showing bottom ( — ) and depth of vehicle ( — ).



## PHYSICAL ENVIRONMENT

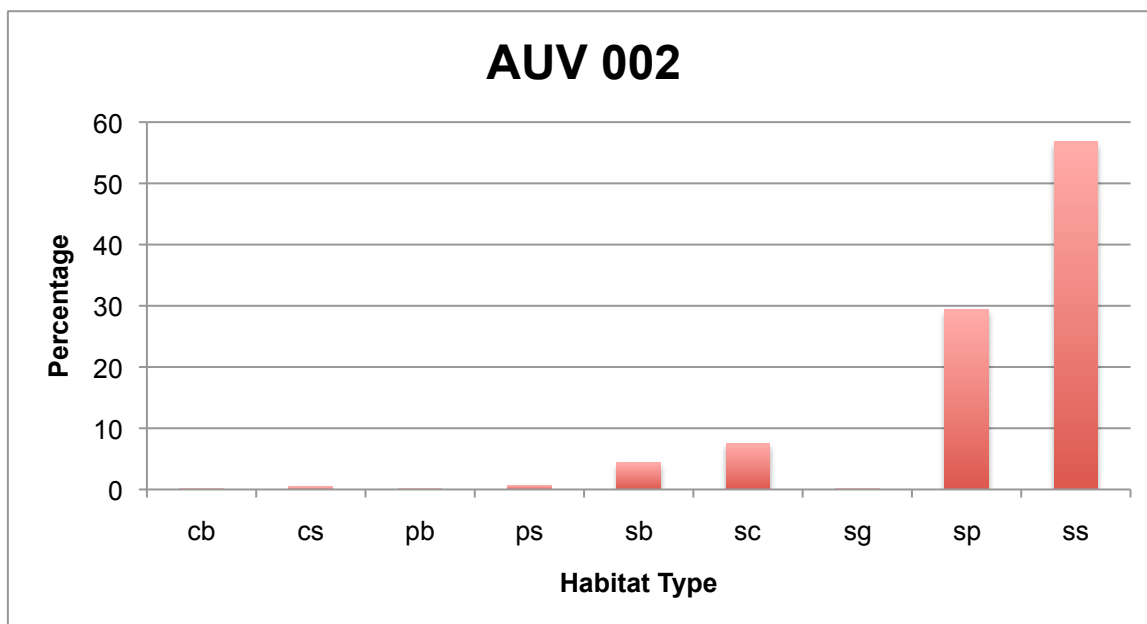


Figure 15. Percentage of nine habitat categories (Table 2) in area sampled during dive AUV 002.

A two-character code was used to identify the habitat type (Table 2). Nine habitat types were encountered. Fifty-seven percent of the area surveyed was sand covered and 29% sand/pebble (Figure 15). There also were significant areas covered with sand and boulder (4%) and sand and cobble (8%).

DIVE NUMBER: AUV 002  
OLYMPIC COAST NATIONAL MARINE SANCTUARY

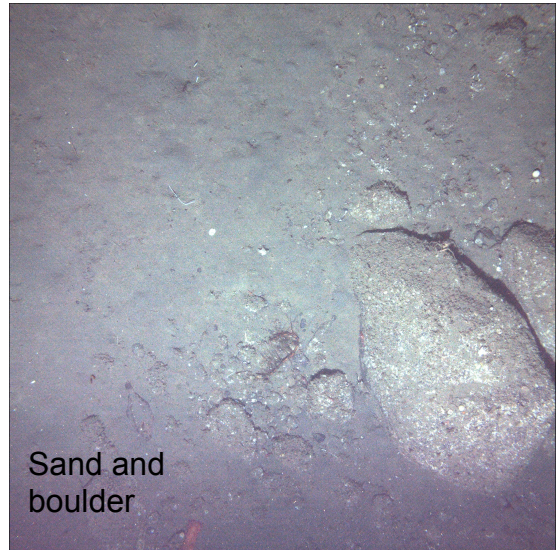
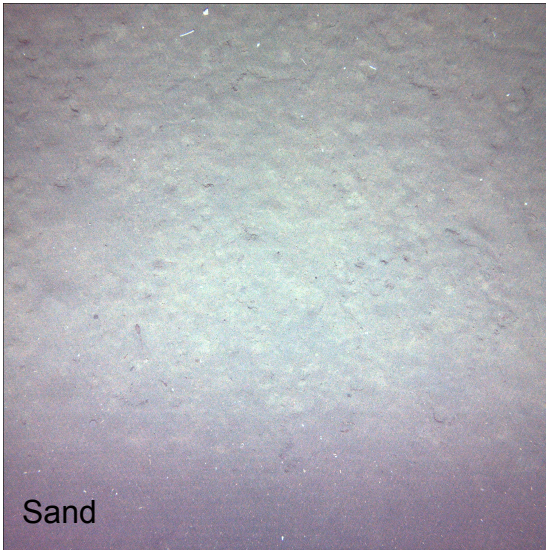


Figure 16. Examples of habitat types encountered on dive AUV 002.

**DIVE NUMBER: AUV 002**  
**OLYMPIC COAST NATIONAL MARINE SANCTUARY**

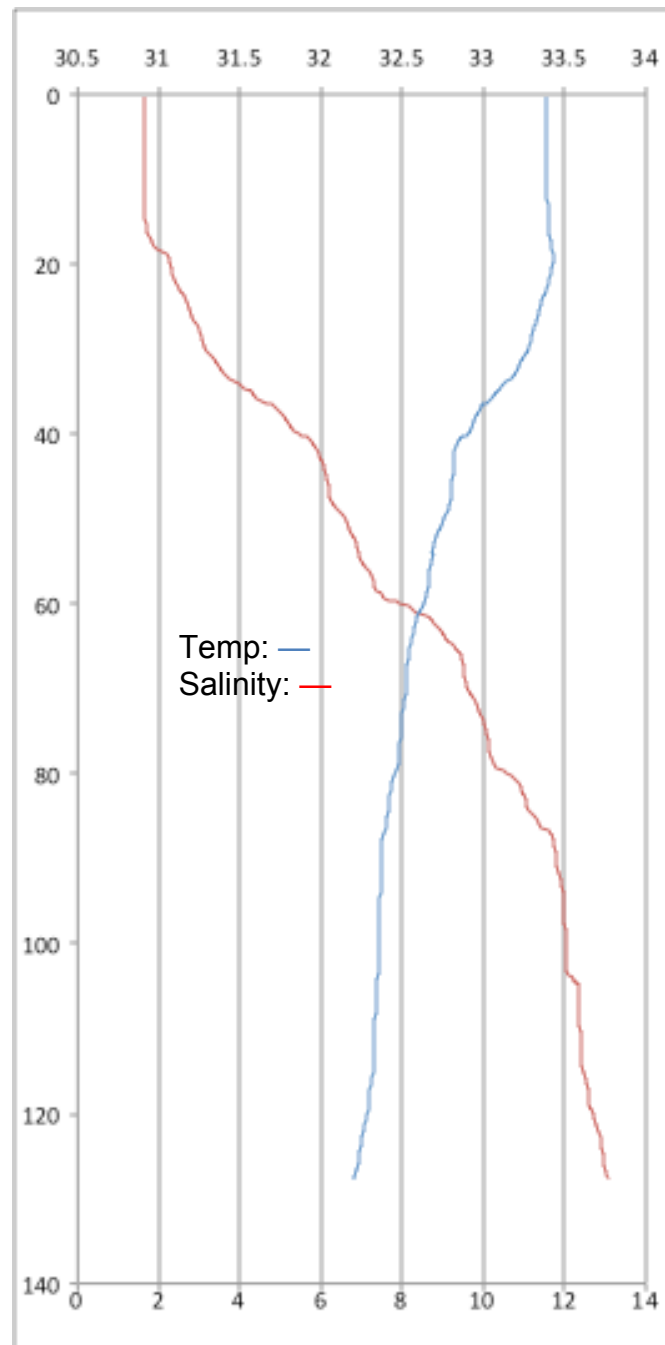


Figure 17. Salinity and temperature during descent of AUV during dive AUV 002.

The AUV was equipped with an onboard Sea-Bird model 49 FastCat CTD that collected temperature and salinity information during the AUV's descent as well as along the dive track. During dive AUV 002, the temperature varied from 11.72 to 6.78°C during descent and salinity varied from 30.90 to 33.77 (PSU) (Figure 17).

## **BIOLOGICAL ENVIRONMENT: INVERTEBRATES**

A total of 1,461 invertebrates from 35 taxa were enumerated from photos covering 7830 m<sup>2</sup> during Dive 002 (Table 7). The overall invertebrate density was 270 per 1000 m<sup>2</sup> (Figure 18). The most abundant taxa were sea pens (30%) followed by sponges (28%). Sea pens were the only corals encountered. Unidentified sponges were separated into 8 morphological types (Figure 19). The most abundant of these types was the white massive. This type likely encompassed several species.

DIVE NUMBER: AUV 002  
 OLYMPIC COAST NATIONAL MARINE SANCTUARY

Table 7. Invertebrates enumerated from Dive AUV 002.

AUV002	Scientific Name	Number	
Red	<i>Lopholithodes foraminatus</i>	1	
	<i>Pandalus platyceros</i>	28	
	Paguroidea-Hermit crab	1	
Green	<i>Parastichopus californicus</i>	24	
	<i>Parastichopus leukothele</i>	145	
Yellow	<i>Allocentrotus fragilis</i>	12	
	<i>Crossaster papposus</i>	14	
	<i>Pteraster tessellatus</i>	3	
	<i>Solaster sp.</i>	12	
	<i>Henricia spp.</i>	12	
	<i>Parastichopus spp.</i>	6	
	<i>Pycnopodia/Rathbunaster spp.</i>	2	
	<i>Leptasterias spp.</i>	1	
	<i>Strongylocentrotus pallidus</i>	12	
	<i>Ceramaster spp.</i>	3	
	Asteriod-Unidentified sea stars	28	
	<i>Stylasterias forreri</i>	20	
	<i>Orthasterias koehleri</i>	5	
	Brown	<i>Florometra serratissima</i>	69
	Purple	Actinaria - Unidentified anemones	26
<i>Cribrinopsis fernaldi</i>		1	
<i>Stomphia sp.</i>		35	
Cyan	Subselliflorae sea pen	438	
Orange	<i>Polyplacaphora spp.</i>	1	
	Opisthobranchia	4	
Light Green	Demospongiae-Unidentified branching demosponge	53	
	Demospongiae-Unidentified stalked demosponge	7	
	Demospongiae-Unidentified branching demosponge	2	
	Porifera-Unidentified Sponge Species	267	
	<i>Poecillastra sp.</i>	30	
	Rosellidae-Unidentified Rossellid sponge	2	
	<i>Latrunculia sp.</i>	48	
	Magenta	Tunicata-tunicates	17
Blue	Unidentified encrusting invertebrate	51	
	Unidentified invertebrate	81	



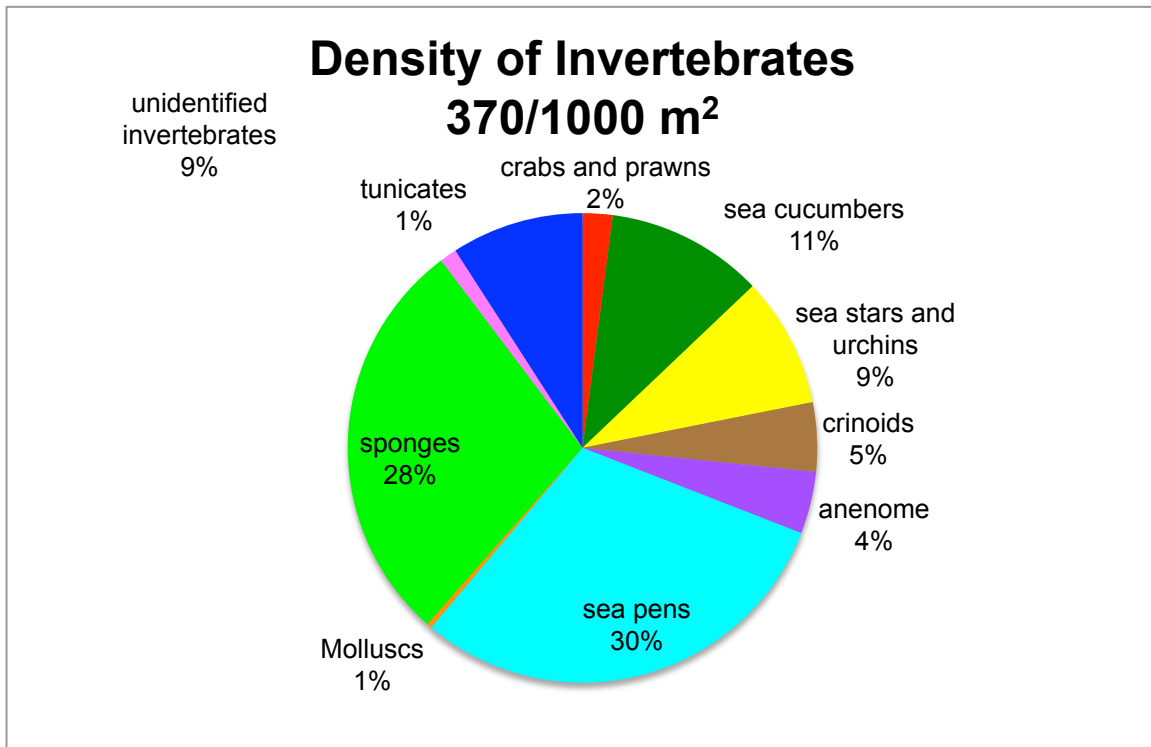


Figure 18. Percentage of invertebrates by group observed during dive AUV 002. Colors in pie diagram match colors in list of sponge taxa (Table 7).

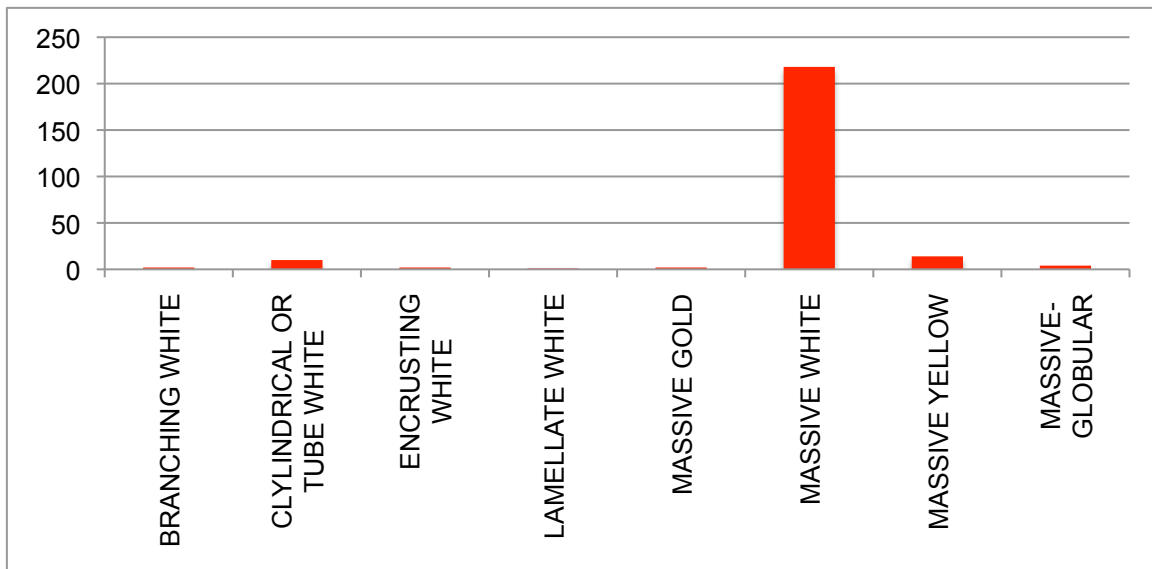


Figure 19. Abundance of morphological types of unidentified sponges observed during dive AUV 002.

DIVE NUMBER: AUV 002  
 OLYMPIC COAST NATIONAL MARINE SANCTUARY

**BIOLOGICAL ENVIRONMENT: FISHES**

Twenty groups of fishes were identified in Dive 002 (Table 8). A total of 282 fishes were enumerated for an overall density of 71 per 1000 m<sup>2</sup>. Rockfish comprised 63% of the total fish density (Figure 20). Greenstriped rockfish were the most abundant of these rockfish. The assemblage of flatfish including Dover sole, slender sole, rex sole, Pacific halibut and petrale sole comprised 24% of the overall density of fishes. Other fishes included lingcod, ratfish, and unidentified poachers, sculpins and ronquils.

Table 8. Number of fishes enumerated from dive AUV 002.

AUV002	Scientific Name	Common Name	Number
	<i>Hydrolagus colliei</i>	spotted ratfish	11
	<i>Sebastes</i> spp.	unknown rockfish	6
	<i>Sebastes elongatus</i>	greenstriped rockfish	74
	<i>Sebastes</i> <i>helvomaculatus</i>	rosethorn rockfish	17
	<i>Sebastes</i> complex	rockfish complex ( <i>S. rufus</i> , <i>S. zacentrus</i> , <i>S. crameri</i> )	42
	<i>Sebastes saxicola</i>	stripetail rockfish	1
	<i>Sebastes rufus</i>	bank rockfish	37
	Pleuronectiformes	Unidentified flatfish	2
	<i>Microstomus pacificus</i>	Dover sole	13
	<i>Errex zachirus</i>	rex sole	8
	<i>Lyopsetta exilis</i>	slender sole	39
	<i>Pleuronectes vetulus</i>	English sole	3
	<i>Eopsetta jordani</i>	petrale sole	2
	<i>Hippoglossus</i> <i>stenolepis</i>	Pacific halibut	1
	<i>Ophiodon elongatus</i>	lingcod	1
	Cottidae spp.	Unidentified sculpin	4
	Agonidae spp.	Unidentified poachers	16
	unidentified fish	Unidentified fish	1
	Bathymasteridae spp	Unidentified ronquils	3
	unknown skate	Unidentified skate	
	eggcase	eggcase	1

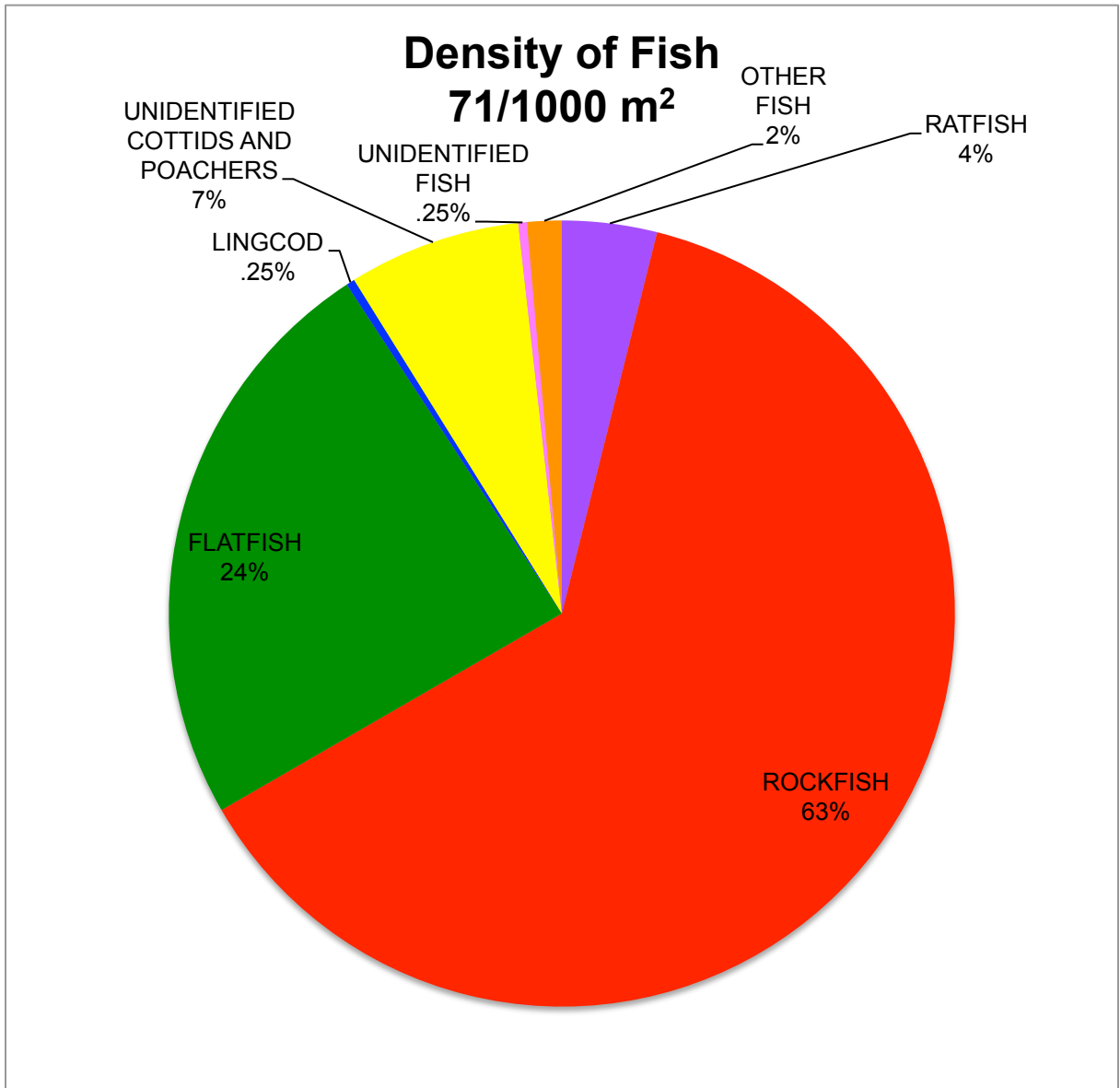


Figure 20. Percentage of fish density by group encountered during dive AUV 002. Colors in pie diagram match colors in list of fish taxa (Table 8).

**MARINE DEBRIS**

The presence of marine debris was noted on Dive 002. Fishing line, fishing net and cloth were seen at several sites and noted.

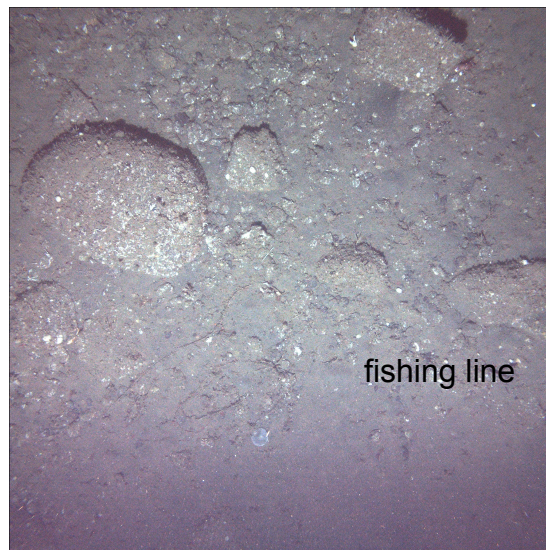
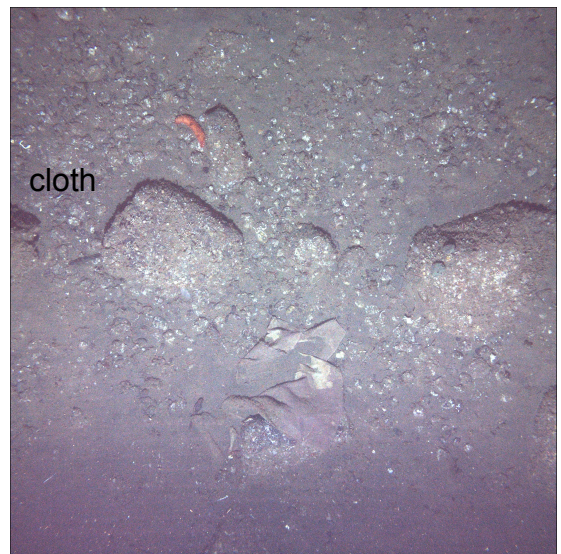
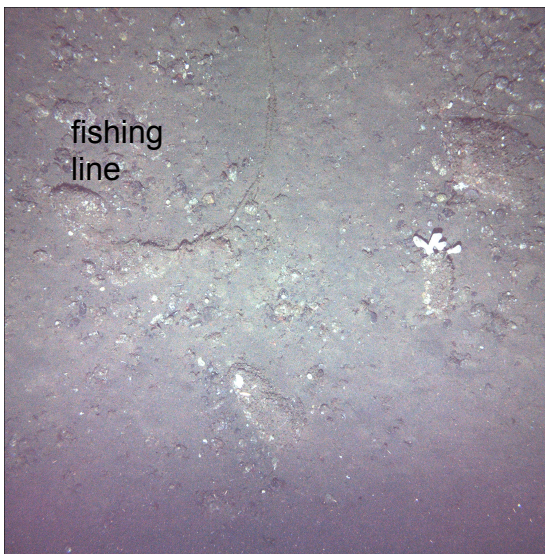
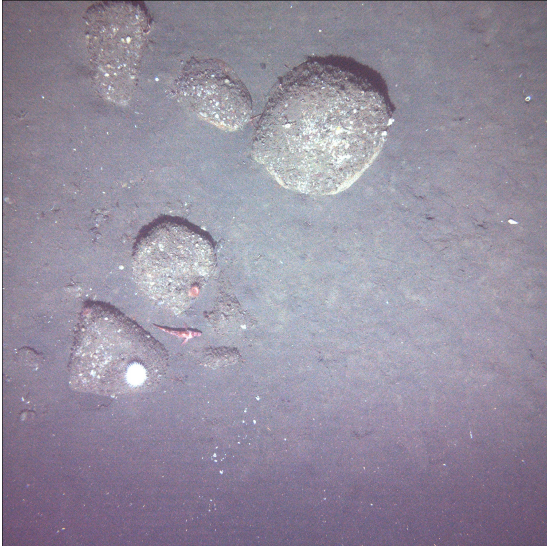


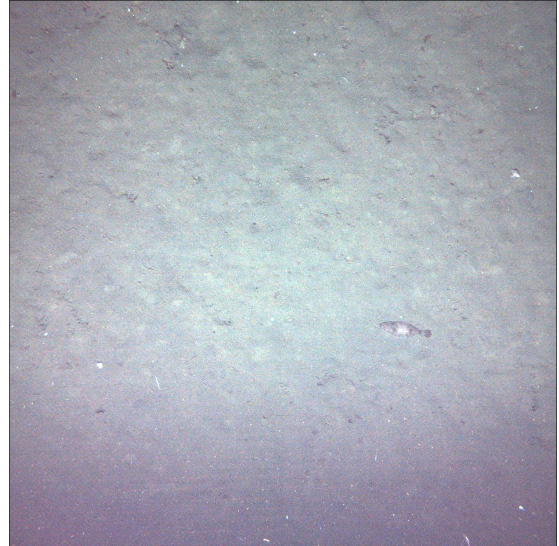
Figure 21. Examples of marine debris encountered on dive AUV 002.



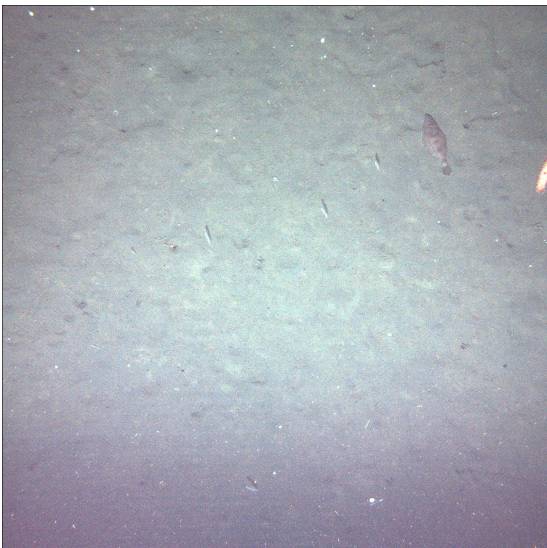
IMAGE GALLERY



Bank rockfish on sand and boulder habitat



Slender sole on sand habitat



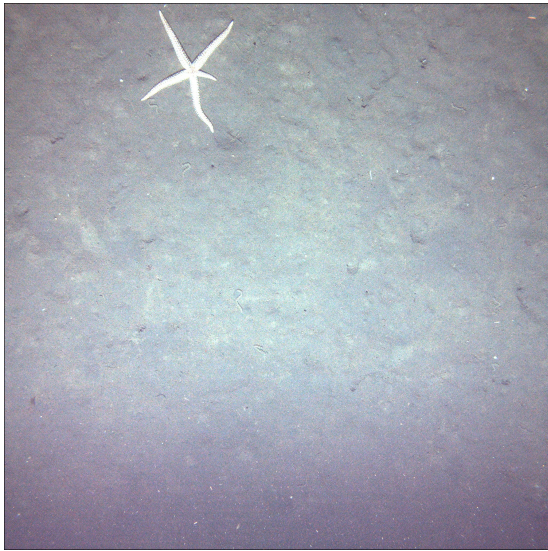
Subselliflorae sea pen, sea cucumber, *Parastichopus leukothele*, and slender sole, *Lyopsetta exilis*



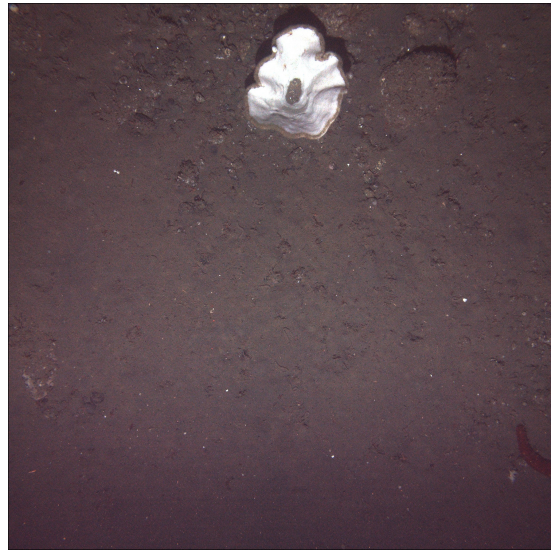
Unidentified encrusting organism, sea cucumber, *Parastichopus leukothele*, anemone, *Stomphia sp.* on sand and boulder habitat.



DIVE NUMBER: AUV 002  
OLYMPIC COAST NATIONAL MARINE SANCTUARY



Sea star, *Stylasterias forreri* on sand habitat.



Sponge, *Poecillastra sp.* and sea cucumber, *Parastichopus californicus* on sand and pebble habitat.