

**A REPORT TO
NOAA DEEP-SEA CORAL RESEARCH AND TECHNOLOGY PROGRAM
July 15, 2013**

**A CHARACTERIZATION OF THE CHRISTMAS TREE BLACK CORAL
(*ANTIPATHES DENDROCHRISTOS*) COMMUNITY ON THREE SEAMOUNTS
IN THE SOUTHERN CALIFORNIA BIGHT FROM A SURVEY USING A
MANNED SUBMERSIBLE**

Mary Yoklavich¹, Tom Laidig¹, Andrew Taylor¹, Diana Watters¹, Lisa Krigsman¹, Milton Love²

¹ NOAA Fisheries, SWFSC, Fisheries Ecology Division, Santa Cruz, CA

² University of California Santa Barbara, Marine Science Institute



INTRODUCTION AND SCIENTIFIC OBJECTIVES

Offshore sea floor habitats in the Southern California Bight (SCB) are diverse compared to other areas of the Pacific coast, and include a number of rocky banks, seamounts, basins, and submarine canyons spanning about 75,000 km². SCB habitats also are influenced by a dynamic mixing of cold, nutrient-rich water from the California Current and warmer water from the south. Complexity in both the oceanographic and topographic aspects of habitat promotes highly varied assemblages of demersal organisms, which include overfished and ESA-listed species (Love et al. 2002; Butler et al. 2006; Love et al. 2009) and dense stands of deep-sea corals and sponges (DSC; Tissot et al. 2006; Bright 2007). The SCB is bordered by one of the most populated areas along the Pacific coast, with 10 million residents in the greater Los Angeles area alone. Waters of the SCB have been intensively fished both commercially and recreationally to depths over 300 m for at least 40 years; most fishing has been by lines and traps, with little trawling activities in the SCB. Competing activities and multiple stressors in this area necessitate effective spatial management of marine resources. In an effort to protect these valuable resources from harvest or damage, large conservation areas and habitat areas of particular concern have been established by the Pacific Fisheries Management Council (NMFS 2005). The State of California and NOAA's Channel Islands National Marine Sanctuary also have implemented a series of smaller marine protected areas that are closed to fishing around the Channel Islands.

As is the case worldwide, most aspects of the taxonomy, biology, and ecology of the DSC on rocky banks and seamounts in the SCB remain to be studied. Much of what we know about any of these DSC has come from chance collections during research cruises or from fisheries bycatch, and more recently from in situ observations made during visual surveys using manned submersibles and remotely operated vehicles (Tissot et al. 2006; Love et al. 2007). Such opportunities have provided new insight into the ecology of DSC and its association with valuable fisheries, and have even resulted in the discovery of new species of corals (e.g., the Christmas tree black coral [*Antipathes dendrochristos*]; Opreško 2005; Yoklavich and Love 2005).

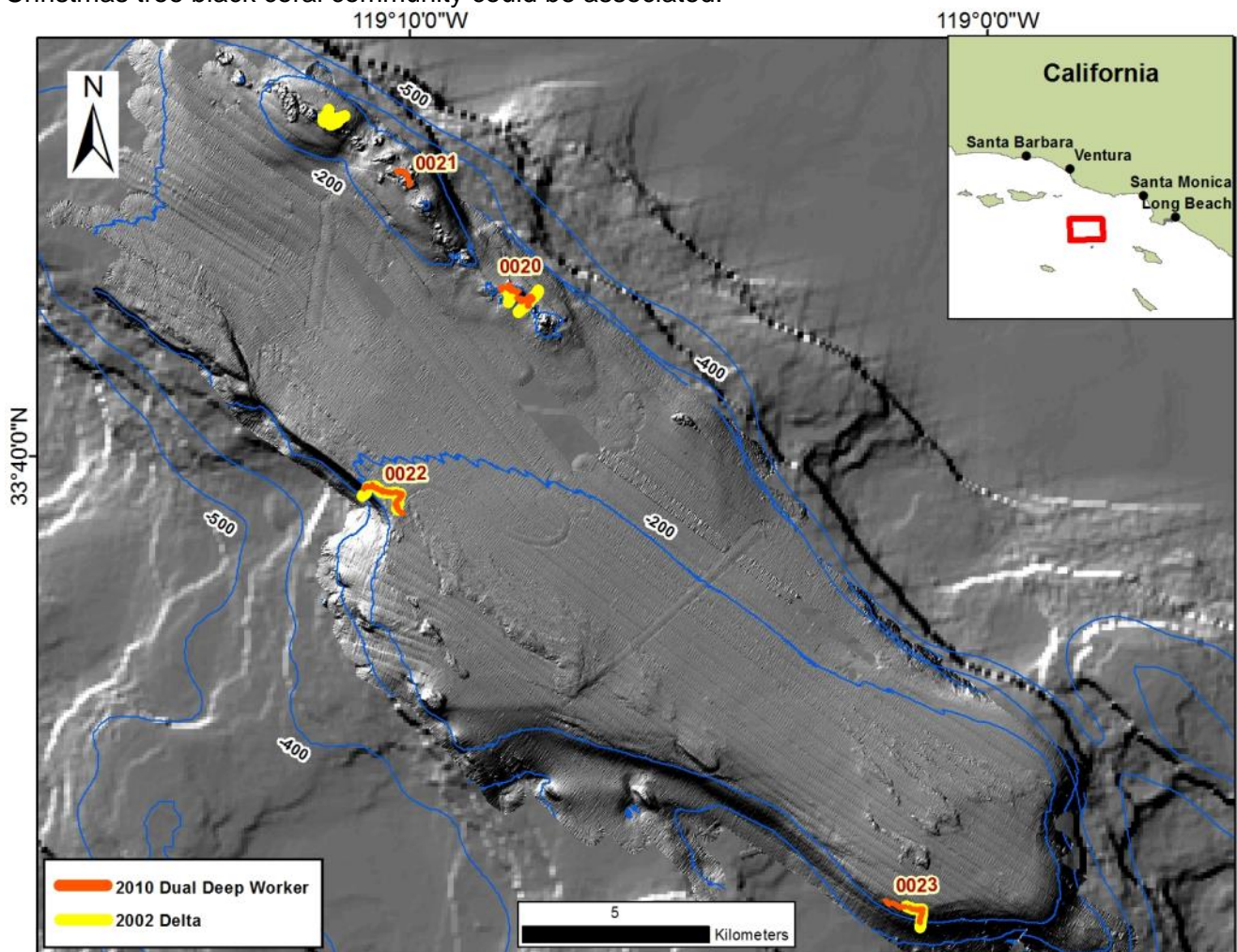
In 2010, the NOAA Deep-Sea Coral Research and Technology Program (DSCRTP) initiated a three-year study to advance our understanding of DSC off the west coast of the U.S. As part of this study, we conducted a cruise during Fall 2010, which focused on the biology and ecology of the Christmas tree black coral and their use by demersal fishes on three deep offshore banks in the SCB (Hidden Reef, Footprint, and Piggy Bank). Our report provides a summary of the methods and results from underwater surveys of these coral colonies and associated habitats, sponges, and fishes. These surveys were a collaborative effort among researchers from the Southwest Fisheries Science Center (SWFSC) and the University of California Santa Barbara.

The objectives of our research were to:

1. Quantify habitat-specific density and size composition of Christmas tree black corals;
2. Determine fish associations with these black corals;
3. Evaluate change in the black corals eight years after an initial baseline survey was conducted;
4. Quantify other corals and sponges occurring at the Hidden Reef study site;
5. Collect corals and sponges to verify identifications on the three study sites.

STUDY SITE

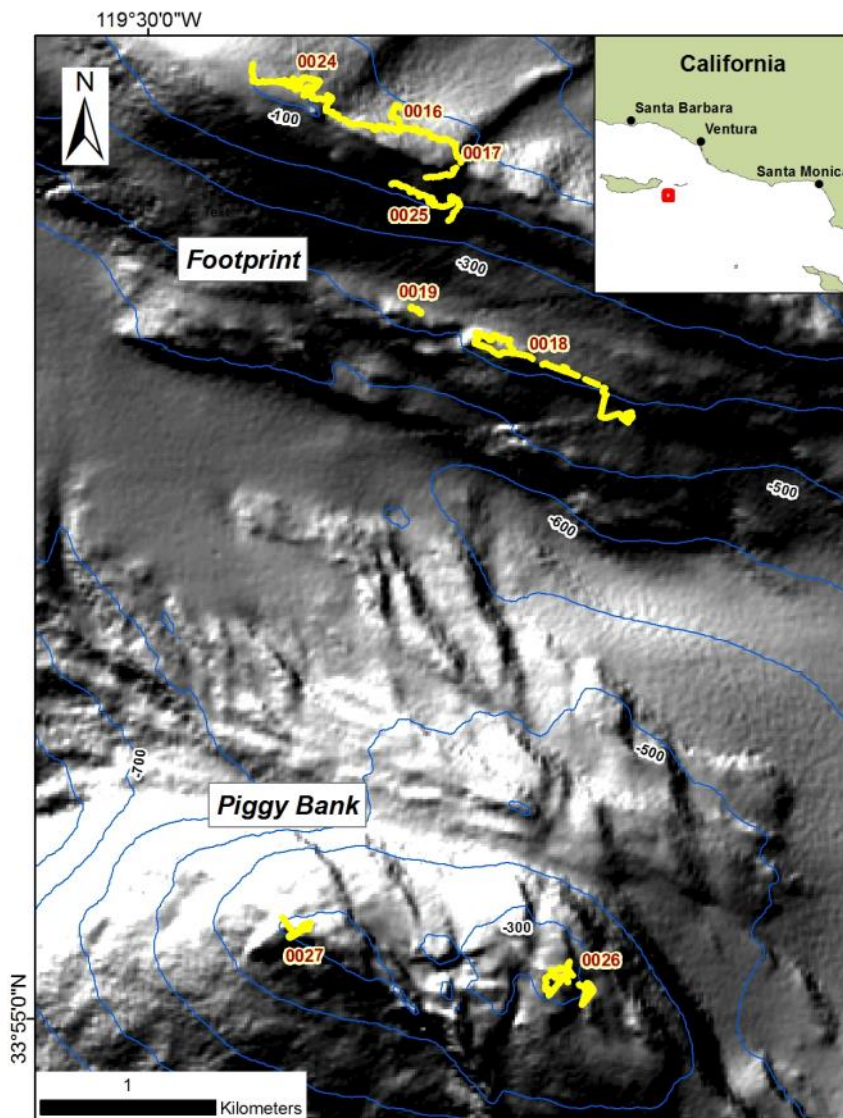
The Hidden Reef study site covers about 290 km² and is located within the Cowcod Conservation Area (CCA), which was closed to bottom-contact fishing gear by the Pacific Fishery Management Council in 2001. This area also was protected in 2006 under Essential Fish Habitat (EFH) regulations (NMFS 2005). Prior to CCA and EFH designation, this area was a longtime focus of intense fishing effort in southern CA. In 2002, we conducted underwater surveys of demersal fishes, structure-forming invertebrates (including Christmas tree black corals), and sea floor habitats (rock, cobble, boulder, and mud) at this study site using the *Delta* submersible. Since these initial surveys, we have mapped the sea floor at this study site using multibeam acoustics (Goldfinger et al. 2007); this has provided us with a much better idea of the likely distribution and amount of complex rock habitat with which the Christmas tree black coral community could be associated.



Hidden Reef study site, located in the Southern California Bight. Dive tracks (overlaid on gray-scale hill-shaded bathymetry) are depicted from comparative surveys of Christmas tree black coral (*Antipathes dendrochristos*) communities using the two-person submersibles *Delta* in 2002 and *Dual DeepWorker* in 2010.

From our earlier survey, the Hidden Reef study area was found to be a “hot spot” of Christmas tree black corals (Tissot et al. 2006), which are of particular interest because they are a large (up to 2.5 m height), relatively new species (Opresko, 2005) that potentially can serve as habitat for fishes and invertebrates and can be vulnerable to human activities. In our current report, we quantify the extent to which these structure-forming corals are associated with fishes and also use the established baseline information from our 2002 surveys to monitor the health of the Christmas tree black corals and associated organisms after eight years of protection within the conservation areas.

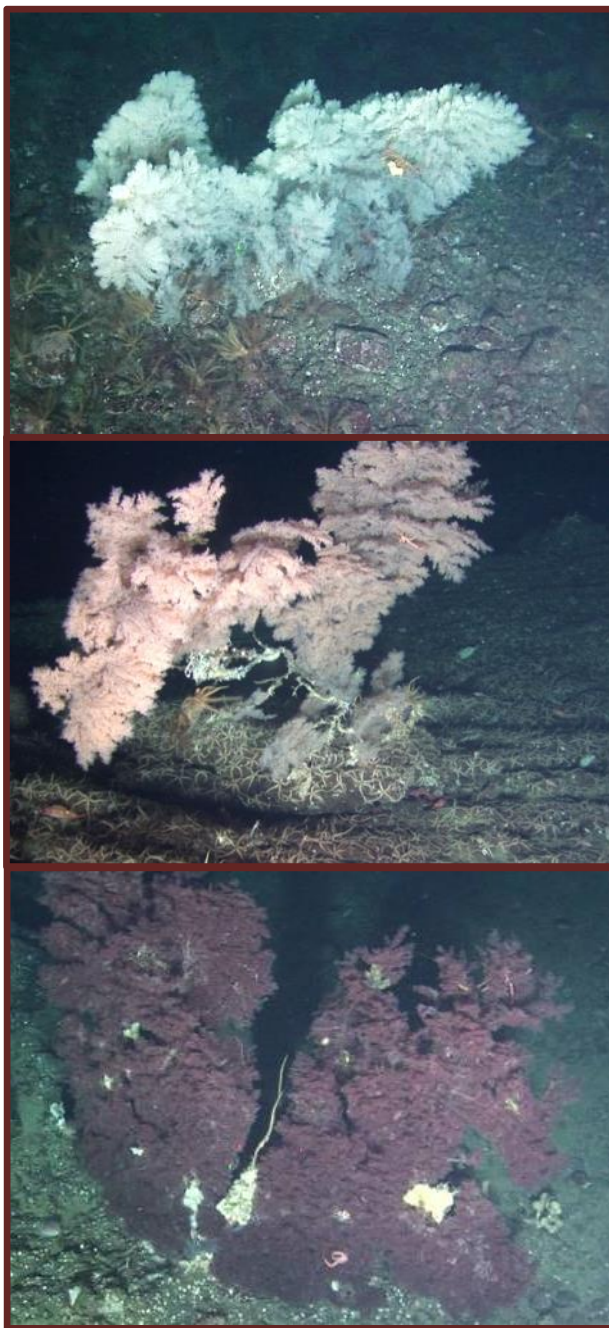
The Footprint and Piggy Bank study sites are located within the Channel Islands National Marine Sanctuary, in the general vicinity of 33°54.84' N and 119°28.35' W in the SCB. The Footprint is about 10 km² in area, ranging in depth from 80 to 500 m. Piggy Bank is about 30 km² in area and ranges in depth from 275 to 900 m. These banks have been designated as EFH by NOAA Fisheries and the Pacific Fisheries Management Council and are within the Footprint Marine Reserve.



The Footprint and Piggy Bank study sites, located in the Southern California Bight. Location is depicted of eight dives from surveys of Christmas tree black coral (*Antipathes dendrochristos*) communities using a two-person submersible *Dual DeepWorker* in Fall 2010.

These areas are especially important because they represent extensive, deep, rocky habitats, which are uncommon within the Sanctuary. They are accessible from nearby ports and protected from adverse sea conditions. The shallowest parts of the Footprint and Piggy Bank (to a depth of 360 m) have been surveyed in previous years using the *Delta* submersible, resulting in archived geo-referenced video tapes and still photographs of DSC (including Christmas tree black corals) and demersal fishes and habitats along quantified dive tracks (Love et al. 2009).

Underwater visual surveys were planned to span from 400 m to the top of each seamount, specifically in regions that had a high probability of comprising rocky substratum types and associated DSC communities. High-resolution maps of bathymetry and backscatter from multibeam acoustic surveys and associated interpreted maps of sea floor substratum types were critical in designing and locating visual surveys prior to our study (Dartnell et al. 2005; P. Dartnell, USGS unpublished data, Goldfinger et al. 2007).



FIELD SURVEY METHODS



Underwater surveys of Christmas tree black corals, associated demersal fishes, habitat, other corals, and sponges were conducted using non-extractive transect methods and direct observations from the *Dual DeepWorker* 2-person submersible (DDW; owned and operated by Nuytco Research Ltd., Vancouver, BC) off of the F/V *Velero IV*, 5 October – 10 October 2010. Video images were collected with a high-definition (HD) digital camera located toward the front and starboard side of DDW and a standard definition (SD) camera at the front and beneath the superstructure of the submersible. The SD camera was positioned to collect images of organisms that were close to the submersible and likely not visible in the HD camera. A scientific observer inside the submersible verbally annotated the HD video footage during each dive. Two parallel red lasers were installed at 20 cm apart on either side of the HD video camera to estimate size of organisms in the images. A green crossing laser was used to estimate distance away from the submersible (which was 2 m when the green and red laser spots were aligned). Digital still and hand-held video cameras were used to document topside activities during the cruise. Dive information (start and end time, location of dives, etc.) also was recorded in a logbook during the cruise.

The DDW was equipped with a Sea-Bird SBE19 CTD with oxygen sensor, which continuously recorded temperature, conductivity, pressure, and dissolved oxygen concentration during the dives. Navigation data, including range and bearing from the ship to the DDW, were collected via a Linkquest Tracklink 1500 USBL system during each dive. These data were integrated with the ship's GPS using Fugro Pelagos WinFrog software. Tracking data were provided to the science team as DAT files in ASCII format.

Visual surveys of Christmas tree black corals and associated habitats, fishes, and macro-invertebrates (including other corals and sponges), were conducted in the Hidden Reef study site along quantitative strip transects using DDW during daytime. Transects were conducted for fifteen minutes at depths from 81 to 259 m at similar locations and sea floor substratum types (e.g., high-relief rock and boulders and low-relief cobble fields) to those of the 2002 transects. All corals, sponges, and fishes within a 2-m-wide strip transect were counted and measured by the observer inside the submersible.

At the Footprint and Piggy Bank study sites, visual surveys of Christmas tree black corals and associated fishes, habitats, and macro-invertebrates were conducted on each dive at depths 72-437 m. The scientific observer inside DDW verbally recorded the dimensions (cm; height and width) of each

Christmas tree coral and the identification and size of all associated fishes. The submersible specifically would slowly pass close to each Christmas tree coral to allow a thorough inspection of associated organisms; the image of each black coral was centered in the video camera to help in later video identification of associated organisms. Large colonies were encircled in order for the observer to determine presence of associated fishes. Because the goal of these dives was to examine Christmas tree black corals and associated fishes, the DDW pilot tried to remain in hard or mixed habitats.

Biological samples were collected using a manipulator arm on DDW, and stored in a box until completion of the dive. Immediately following the dive, these samples were processed, photographed, labeled, and stored in ethanol following protocols outlined in Etnoyer et al. (2006).

POST-DIVE DATA ANALYSES

Navigation data associated with the DDW's USBL tracking system were edited in a series of steps to improve the accuracy of the dive tracks. Duplicate records were identified and removed, and data were filtered to remove those records exceeding maximum speed (0.5 m/s) of the DDW in survey mode. Edited dive tracks were plotted in ArcGIS, and spurious data points were removed based on the type of activities being performed by DDW (e.g., conducting a survey transect, collecting specimens, maneuvering around a large sea floor feature such as a pinnacle) as noted in the dive logbook. The data were linearly interpolated to 3-second intervals, which is the rate that the original data generally were collected. Interpolated data were smoothed using a boxcar running average with an 11-point window.

During the transects, DDW maintained a relatively consistent altitude <2 m off the sea floor and a constant speed of 0.25-0.5 m/s (0.5-1.0 knots), depending on substratum type (i.e., generally slower speed in complex habitats). Quality and resolution of video images from the HD video camera were excellent; these images, along with the audio data recorded by the observer inside the submersible, were used to identify and quantify the Christmas tree black corals, sponges, corals, fishes, and sea floor habitats on each transect. The length of each transect was estimated using ArcMap. The area of each transect was calculated as the product of length and width.

The sea floor was classified by type of substratum, in order of decreasing particle size and vertical relief (as described in Greene et al. 1999): rock ridge (R), boulder (B), cobble (C), flat rock (F), and mud (M). A two-character code was used to quantify patches of uniform substratum type along each transect (as described in Yoklavich et al. 2000). The primary character in the code represented the substratum type that accounted for at least 50% of the patch, and the secondary character represented the substratum type that accounted for at least 20% of the patch (e.g., CM represented a patch of at least 50% cobbles and at least 20% mud). The area of each habitat patch was estimated as the product of the transect width (2 m, measured from the crossing laser dot in the field of view) and the length of the patch, as determined from the geographic position at the beginning and end of each patch.

Temperature, depth, salinity, and dissolved oxygen were derived from raw data at one-second intervals, using the CTD's Sea-Bird Electronics SBEDataProcessing-Win32 software 'filter', 'align', 'derive', and 'bin average' modules. Data were plotted in R.

Corals, sponges, and fishes were identified to the lowest possible taxonomic level and enumerated. Some sponges were classified by general morphology (i.e., upright flat, foliose, mound, branching, barrel, and vase) when species identification was difficult. Densities of corals, sponges, and fishes were estimated by dividing total number of each taxon by the area surveyed. Maximum width and height of each Christmas tree coral and total length of each fish were estimated to nearest 5-cm using the paired

lasers. Physical damage to the Christmas tree corals was recorded. Distance was estimated between the fishes and the Christmas tree corals. Fishes were considered to be associated with the corals if they were less than one body length away or in direct contact with the coral. The condition of each Christmas tree coral was determined to be healthy (<10% of organism is dead), dying (10-50% is dead), or dead (>50% of organism dead). Frequency and type of derelict fishing gear and other marine debris also were documented along the video transects. All collected specimens were sent to experts of the various taxonomic groups for identification.

All data, including navigation, water characteristics, habitat type, and information associated with the corals, sponges, and fishes, were entered into a geo-referenced, relational database in Microsoft Access.

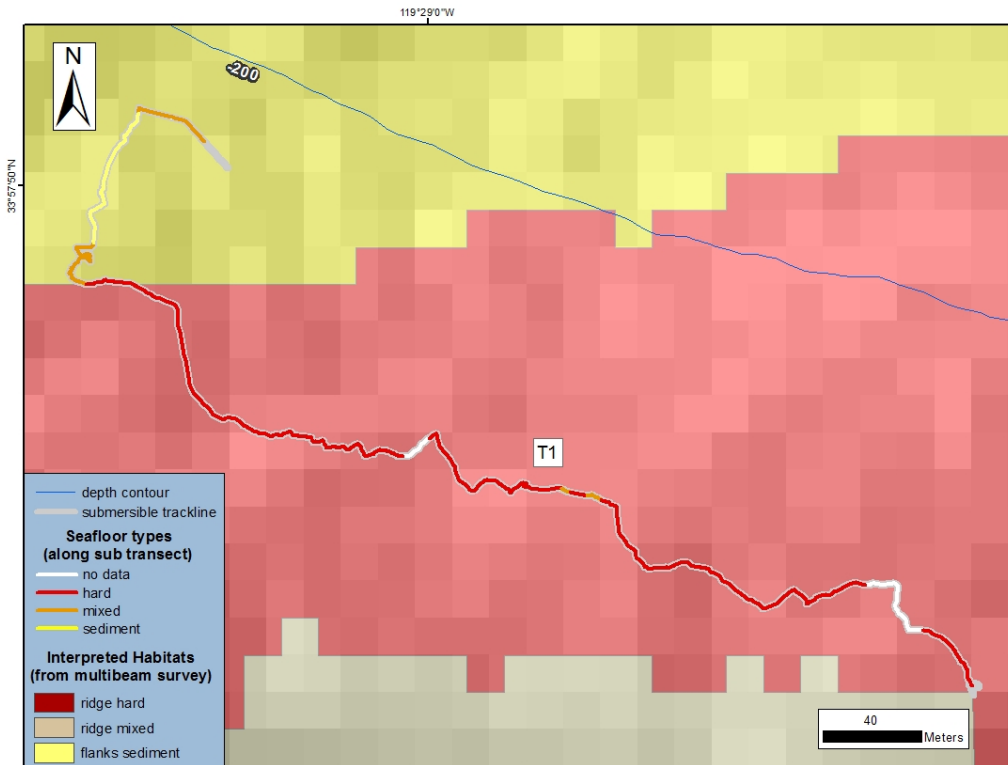


SUMMARY OF DIVES

Over 13 hours of video images were collected during daytime (est. 0800 - 2000) operations on 12 dives on the Hidden Reef, Footprint, and Piggy Bank study sites.

Date	PI	Dive #	Method	Start Time	End Time	Start Lat (N)	Start Long (W)	End Lat (N)	End Long (W)
05 Oct 2010	M. Yoklavich	0016	Submersible	14:49	15:28	33° 57.844'	119° 29.053'	33° 57.729'	119° 28.848'
05 Oct 2010	M. Yoklavich	0017	Submersible	17:01	17:27	33° 57.743'	119° 28.853'	33° 57.629'	119° 28.952'
06 Oct 2010	M. Yoklavich	0018	Submersible	12:19	13:50	33° 56.913'	119° 28.187'	33° 57.103'	119° 28.613'
06 Oct 2010	M. Yoklavich	0019	Submersible	16:46	16:56	33° 57.242'	119° 28.989'	33° 57.242'	119° 28.989'
07 Oct 2010	M. Yoklavich	0020	Submersible	09:47	12:45	33° 42.545'	119° 08.318'	33° 42.319'	119° 07.832'
07 Oct 2010	M. Yoklavich	0021	Submersible	18:02	19:06	33° 44.234'	119° 10.178'	33° 44.039'	119° 09.938'
08 Oct 2010	M. Yoklavich	0022	Submersible	08:35	10:26	33° 39.622'	119° 10.635'	33° 39.277'	119° 09.531'
08 Oct 2010	M. Yoklavich	0023	Submersible	15:52	17:08	33° 33.506'	119° 00.856'	33° 33.815'	119° 01.455'
09 Oct 2010	M. Yoklavich	0024	Submersible	12:47	15:18	33° 57.962'	119° 29.606'	33° 57.770'	119° 29.054'
09 Oct 2010	M. Yoklavich	0025	Submersible	19:09	20:16	33° 57.525'	119° 28.843'	33° 57.606'	119° 29.056'
10 Oct 2010	M. Yoklavich	0026	Submersible	08:27	09:34	33° 55.182'	119° 28.440'	33° 55.128'	119° 28.279'
10 Oct 2010	M. Yoklavich	0027	Submersible	13:01	13:31	33° 55.330'	119° 29.417'	33° 55.307'	119° 29.317'

The following is a summary, by dive, of the densities and sizes of Christmas tree black corals, fishes, and sea floor habitats surveyed during quantitative transects conducted on 11 of these dives (Dive 0019 was aborted). We also present profiles of sea temperature, salinity, and dissolved oxygen with depth during the dives. Health of the Christmas tree black corals is reported, along with incidence of marine debris on each dive. Other corals (in addition to Christmas tree black corals) and sponges were quantified during transects on four dives (Dive 0020-0023).



STATION OVERVIEW

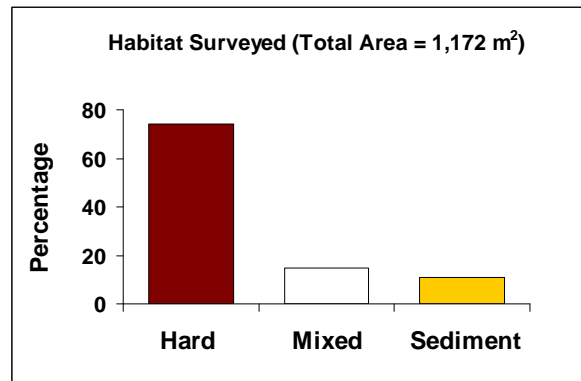
Project	U.S. West Coast Deep Coral Cruise
Chief Scientist	M. Yoklavich
Contact Information	NMFS, SWFSC, mary.yoklavich@noaa.gov
Purpose	Determine fish associations with black corals
Vessel / Vehicle	F/V <i>Velero IV</i> ; <i>Dual DeepWorker</i> submersible
Submersible Pilot	Jeff Heaton
Scientific Observer	Lisa Krigsman
External Digital Video	HD: 52 min; SD: 1 tape
Positioning System	Ship: GPS; Submersible: USBL
CTD Sensors	Yes
O₂ Sensor	Yes
Specimens collected	No
Other	Logbook, Access database
Report Analyst	T. Laidig
Date Compiled	December 2012

DIVE DATA

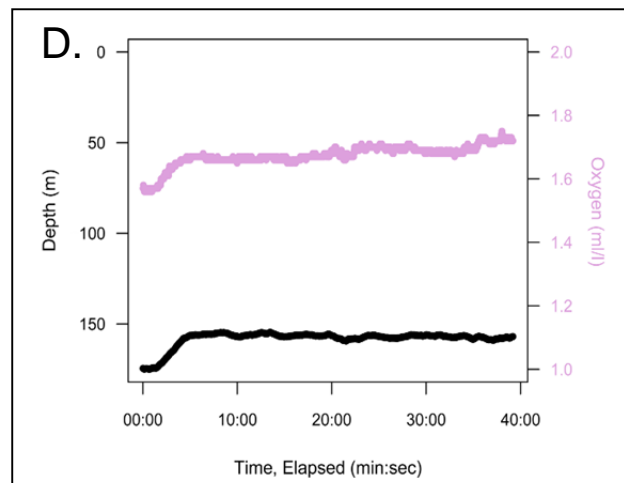
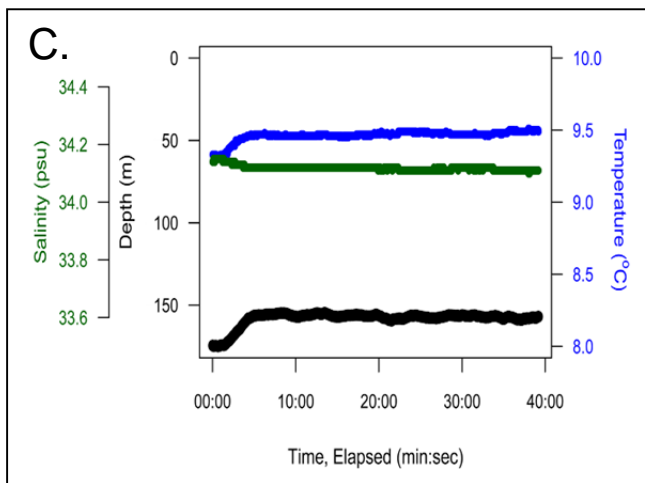
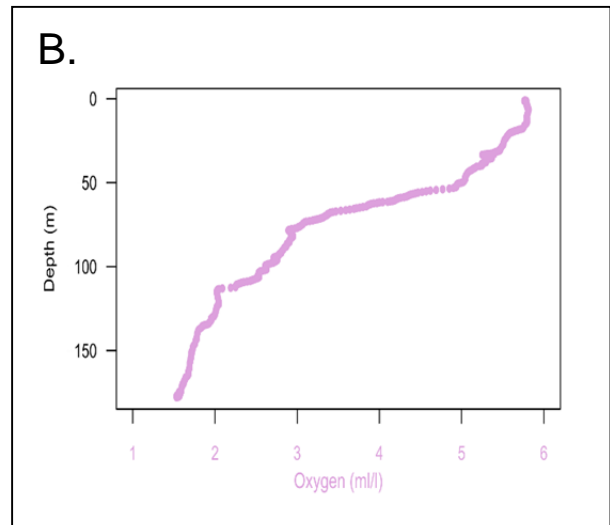
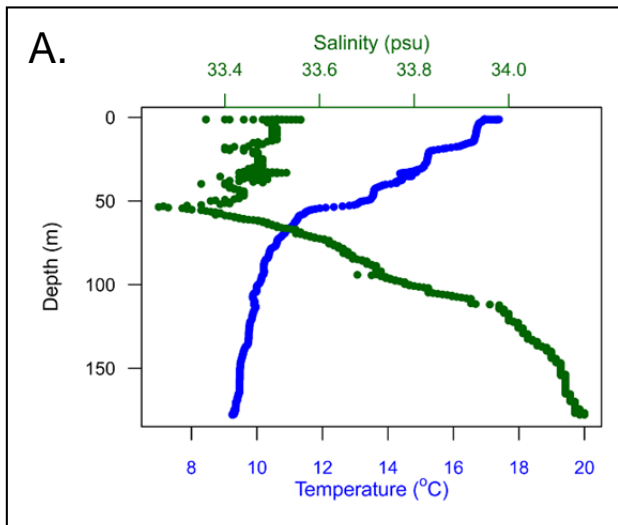
Date	05 Oct 2010	Starting Latitude (N)	33° 57.844'
Minimum Bottom Depth (m)	141	Starting Longitude (W)	119° 29.053'
Maximum Bottom Depth (m)	194	Ending Latitude (N)	33° 57.729'
Start Bottom Time (PDT)	14:49	Ending Longitude (W)	119° 28.848'
End Bottom Time (PDT)	15:28	Surface Current	n/a
Number of Transects	1	Bottom Current	n/a

PHYSICAL ENVIRONMENT

In total, 1,172 m² of sea floor were surveyed in one transect conducted continuously during Dive 0016 on the Footprint. Habitat types were classified as (1) Hard (74% of the total area surveyed), which included large boulders, rock outcrops, and cobbles; (2) Mixed (15% of the total area surveyed), including a combination of mud with boulders, rock, or cobbles; (3) Sediment (11% of the total area surveyed), which consisted entirely of mud.



Data on depth, conductivity, temperature, and oxygen were collected during descent (A and B), and at depth along the track line (C and D). Temperature ranged from 17.5°C at the sea surface to 9.3°C on the sea floor at 177 m depth. Salinity (as estimated from conductivity, temperature, and pressure) ranged from 33.5 psu at the sea surface to 34.2 psu on the sea floor. Dissolved oxygen ranged from 5.8 ml/l at the sea surface to 1.5 ml/l on the sea floor at 177 m depth.



BIOLOGICAL ENVIRONMENT: CHRISTMAS TREES

No Christmas tree black corals occurred on the transect of Dive 0016.

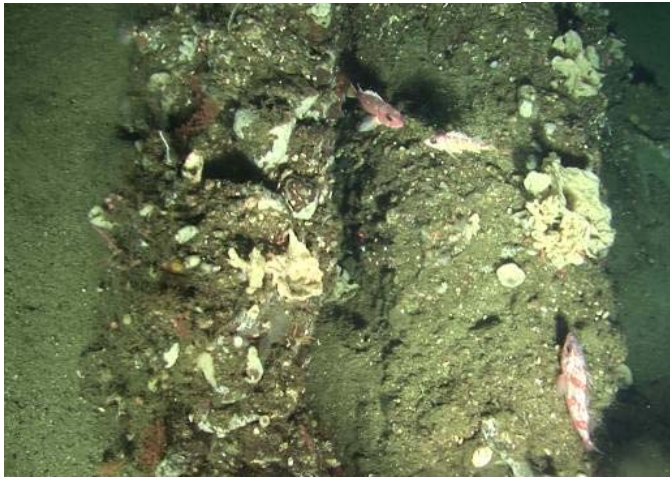
BIOLOGICAL ENVIRONMENT: FISHES

At least 20 taxa of fishes were identified during Dive 0016 along the top of the Footprint Bank. A total of 547 individual fishes were enumerated, and an overall density of 466 fish per 1,000 m² of sea floor was estimated from one continuous transect. At least 13 species of rockfishes (*Sebastes*), dominated by unidentified *Sebastomus*, and bank and shortbelly rockfishes, comprised 96% of fish density. The remainder of the fish assemblage included shortspine combfish, lingcod, poachers, hagfish, and Dover sole.

Scientific name	Common name	Number
Fishes		
<i>Eptatretus</i> spp.	Unidentified hagfish	1
Agonidae	Unidentified poachers	3
<i>Microstomus pacificus</i>	Dover sole	1
<i>Sebastes chlorostictus</i>	Greenspotted rockfish	3
<i>Sebastes constellatus</i>	Starry rockfish	2
<i>Sebastes elongatus</i>	Greenstriped rockfish	2
<i>Sebastes entomelas</i>	Widow rockfish	1
<i>Sebastes goodei</i>	Chilipepper	1
<i>Sebastes jordani</i>	Shortbelly rockfish	38
<i>Sebastes levis</i>	Cowcod	5
<i>Sebastes miniatus</i>	Vermilion rockfish	6
<i>Sebastes ovalis</i>	Speckled rockfish	2
<i>Sebastes paucispinis</i>	Bocaccio	3
<i>Sebastes rubrivinctus</i>	Flag rockfish	2
<i>Sebastes rufus</i>	Bank rockfish	95
<i>Sebastes</i> spp.	Unidentified <i>Sebastomus</i>	358
<i>Sebastes</i> spp.	Young-of-the-year rockfish	1
<i>Sebastes wilsoni</i>	Pygmy rockfish	7
<i>Ophiodon elongatus</i>	Lingcod	2
<i>Zaniolepis frenata</i>	Shortspine combfish	14

IMAGE GALLERY

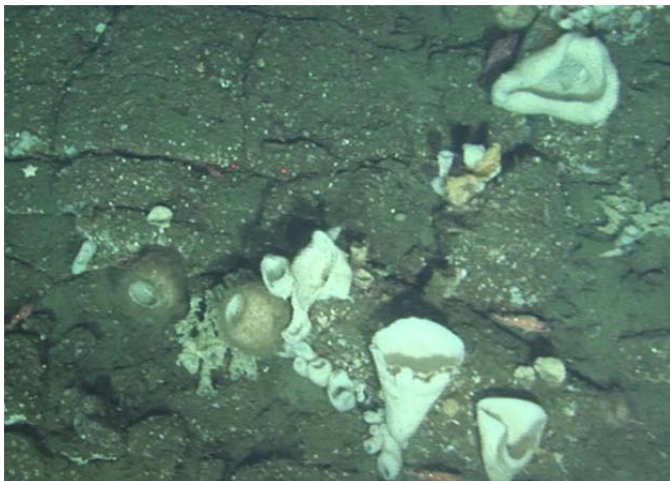
A chilipepper and two greenspotted rockfishes on a rock ridge at 194 m.



A bank rockfish swimming over a sponge-covered rock ridge at 170 m.



Vase and barrel sponges on rock ridge at 170 m.

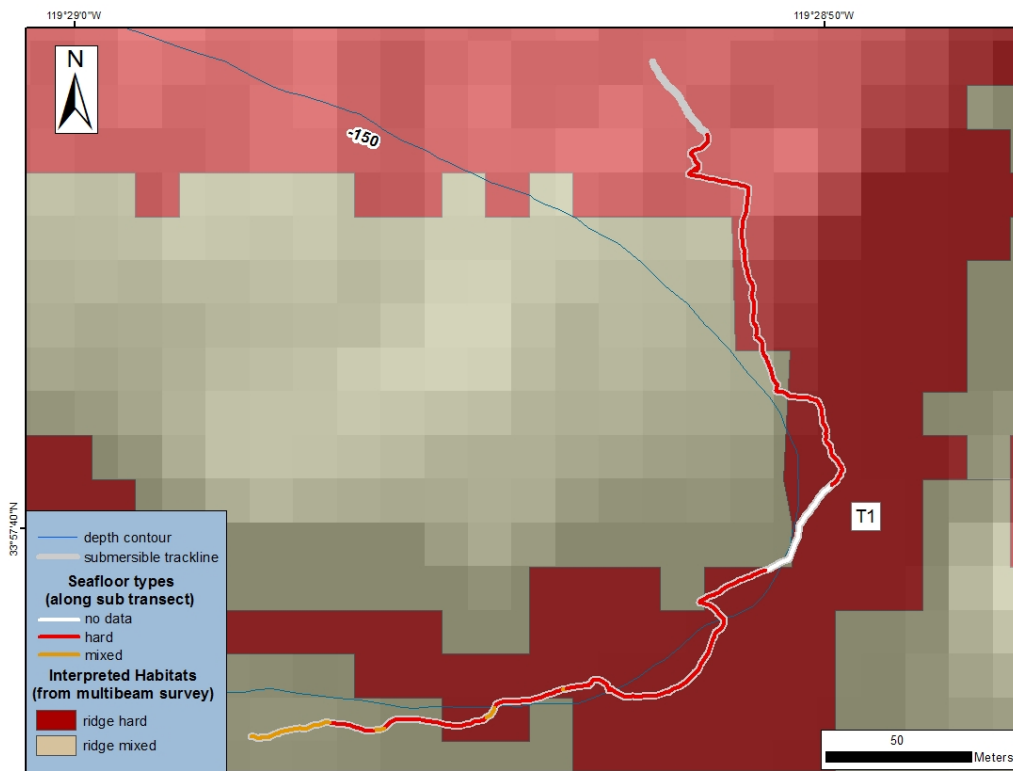


A tan vase sponge (*Sigmadocia* spp.) and other vase sponges at 160 m.



ADDITIONAL COMMENTS

Three man-made debris items (a soda can and two monofilament fishing lines) were documented during Dive 0016. Damage potentially caused by these three items was not observed.



STATION OVERVIEW

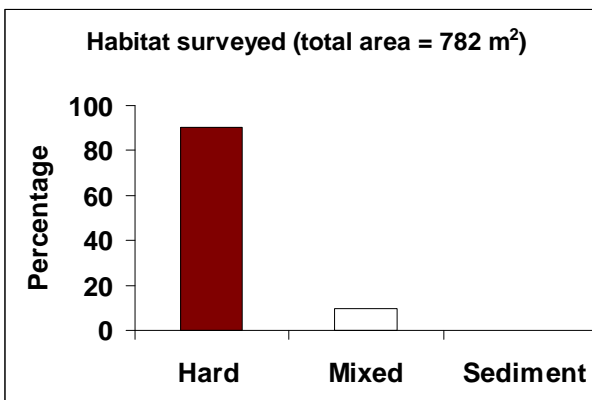
Project	U.S. West Coast Deep Coral Cruise
Chief Scientist	M. Yoklavich
Contact Information	NMFS, SWFSC, mary.yoklavich@noaa.gov
Purpose	Determine fish associations with black corals
Vessel / Vehicle	F/V <i>Velero IV</i> ; <i>Dual DeepWorker</i> submersible
Submersible Pilot	Jeff Heaton
Scientific Observer	Diana Watters
External Digital Video	HD: 28 min; SD: 1 tape
Positioning System	Ship: GPS; Submersible: USBL
CTD Sensors	Yes
O₂ Sensor	Yes
Specimens collected	No
Other	Logbook, Access database
Report Analyst	T. Laidig
Date Compiled	December 2012

DIVE DATA

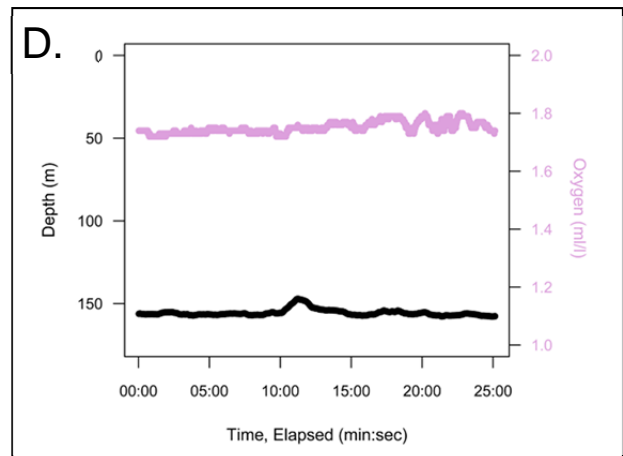
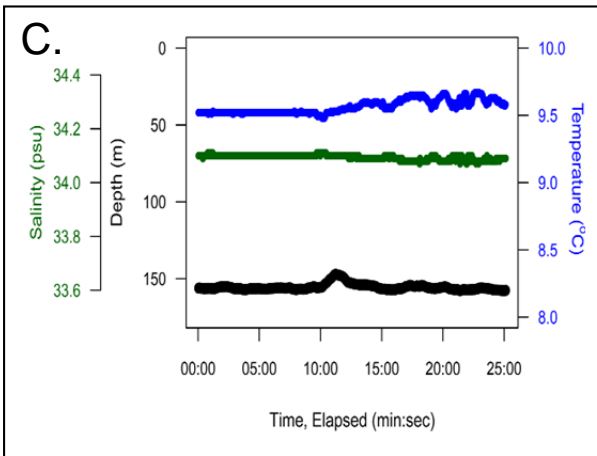
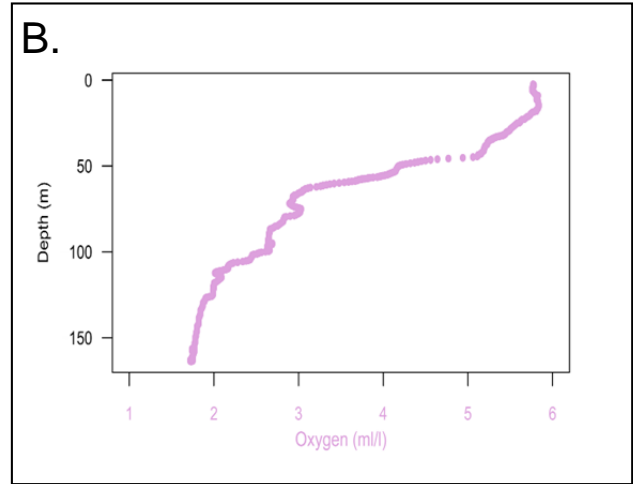
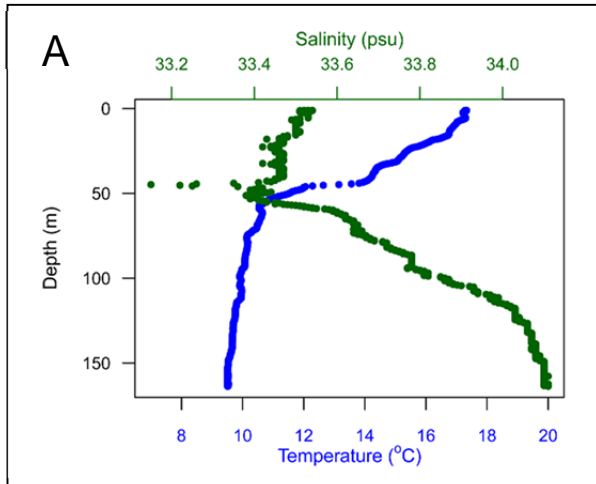
Date	05 Oct 2010	Starting Latitude (N)	33° 57.743'
Minimum Bottom Depth (m)	147	Starting Longitude (W)	119° 28.853'
Maximum Bottom Depth (m)	167	Ending Latitude (N)	33° 57.629'
Start Bottom Time (PDT)	17:01	Ending Longitude (W)	119° 28.952'
End Bottom Time (PDT)	17:27	Surface Current	n/a
Number Transects	1	Bottom Current	n/a

PHYSICAL ENVIRONMENT

In total, 782 m² of sea floor were surveyed during one transect conducted continuously on Dive 0017 on the Footprint. Habitat types were classified as (1) Hard (90% of the total area surveyed), which included large boulders, rock outcrops, and cobbles or (2) Mixed (10% of the total area surveyed), including a combination of mud with boulders, rock, or cobbles. No soft sediment habitat was observed



Data on depth, conductivity, temperature, and oxygen were collected during descent (A and B) and at depth along the track line (C and D) on Dive 0017. Temperature ranged from 17.5°C at the sea surface to 9.5°C on the sea floor at 156 m depth. Salinity (as estimated from conductivity, temperature, and pressure) ranged from 33.5 psu at the sea surface to 34.1 psu on the sea floor. The range in oxygen was from 5.8 ml/l at the sea surface to 1.7 ml/l on the sea floor at 156 m.



BIOLOGICAL ENVIRONMENT: CHRISTMAS TREES

Two Christmas tree black corals, with a density of 2.5 colonies per 1,000 m², occurred on Dive 0017. The colonies were small, averaging 300 cm² in area (range = 200-400 cm²). Both colonies were healthy with no damage, and gray in color. Sponges were associated with both colonies. No fishes were associated with either colony.

BIOLOGICAL ENVIRONMENT: FISHES

At least 12 taxa were identified during Dive 0017 along one continuous transect on the top of the Footprint. A total of 445 individual fishes was enumerated, and an overall density of 569 fish per 1,000 m² of sea floor was estimated. At least 9 species of rockfishes (*Sebastes*), dominated by unidentified *Sebastes* comprised 98% of fish density. The remainder of the fish assemblage included shortspine combfish and spotted ratfish.

No fish were associated with the two Christmas tree black corals on this dive.

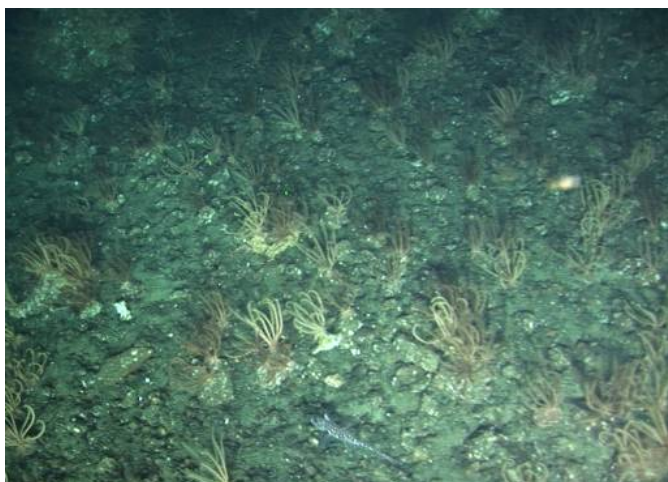
Scientific name	Common name	Number
Fishes		
<i>Sebastes constellatus</i>	Starry rockfish	1
<i>Sebastes hopkinsi</i>	Squarespot rockfish	48
<i>Sebastes jordani</i>	Shortbelly rockfish	24
<i>Sebastes levis</i>	Cowcod	1
<i>Sebastes ovalis</i>	Speckled rockfish	9
<i>Sebastes paucispinis</i>	Bocaccio	9
<i>Sebastes rufus</i>	Bank rockfish	41
<i>Sebastes</i> spp.	Unidentified <i>Sebastes</i>	262
<i>Sebastes wilsoni</i>	Pygmy rockfish	38
<i>Sebastes zacentrus</i>	Sharpchin rockfish	1
<i>Hydrolagus colliei</i>	Spotted ratfish	2
<i>Zaniolepis frenata</i>	Shortspine combfish	9

IMAGE GALLERY

A gold primnoid (*Acanthogorgia* spp.) and sponges on a rock ridge at 158 m.

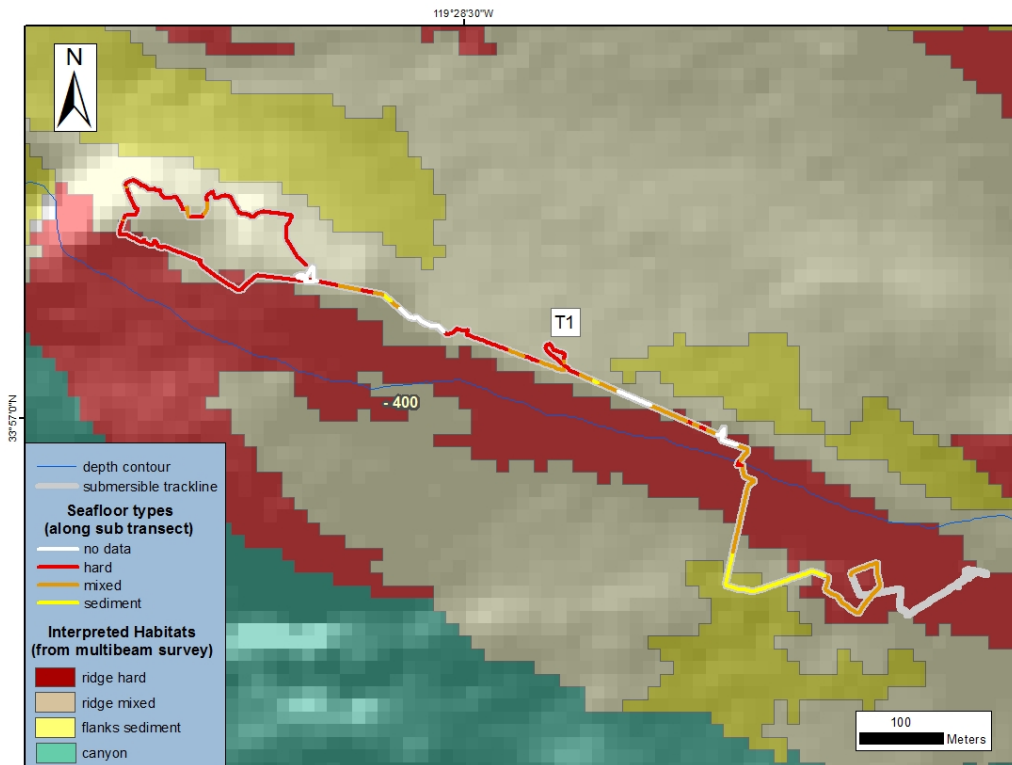


A spotted ratfish swimming through a field of crinoids (*Florometra serratissima*) at 156 m.



ADDITIONAL COMMENTS

Eleven man-made debris items (a beverage bottle and ten monofilament fishing lines) were documented during Dive 0017. Damage potentially caused by these eleven items was not observed.



STATION OVERVIEW

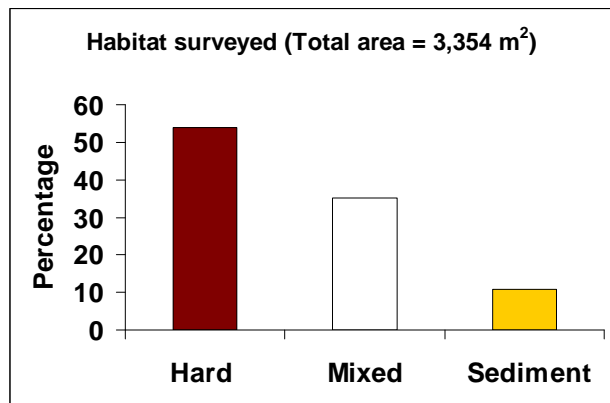
Project	U.S. West Coast Deep Coral Cruise
Chief Scientist	M. Yoklavich
Contact Information	NMFS, SWFSC, mary.yoklavich@noaa.gov
Purpose	Determine fish associations with black corals
Vessel / Vehicle	F/V <i>Velero IV</i> / <i>Dual DeepWorker</i> submersible
Submersible Pilot	Doug Bishop
Scientific Observer	Tom Laidig
External Digital Video	HD: 104 min; SD: 1 tape
Positioning System	Ship: GPS; Submersible: USBL
CTD Sensors	Yes
O₂ Sensor	Yes
Specimens collected	No
Other	Logbook, Access database
Report Analyst	T. Laidig
Date Compiled	December 2012

DIVE DATA

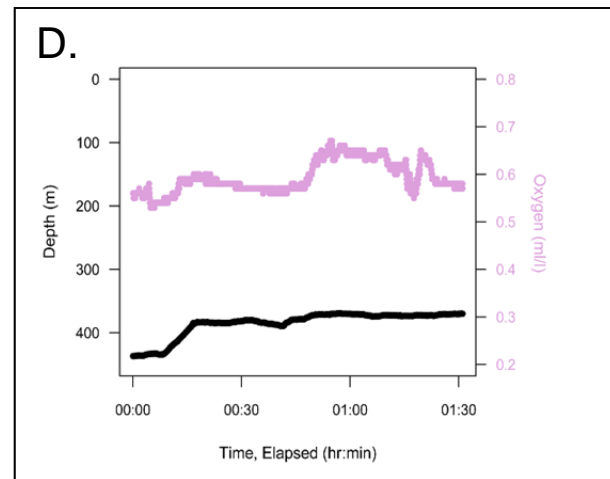
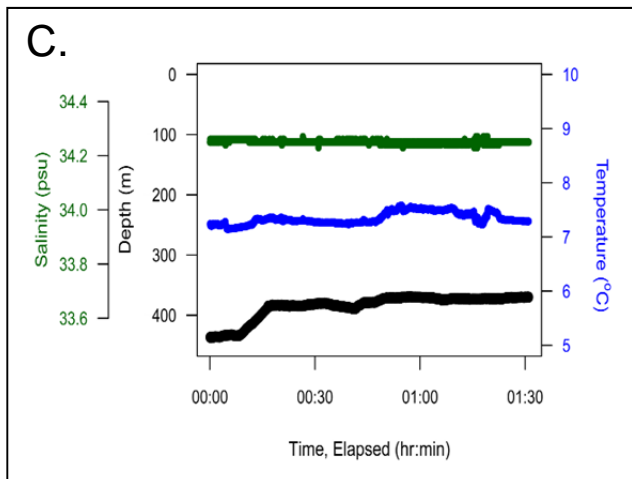
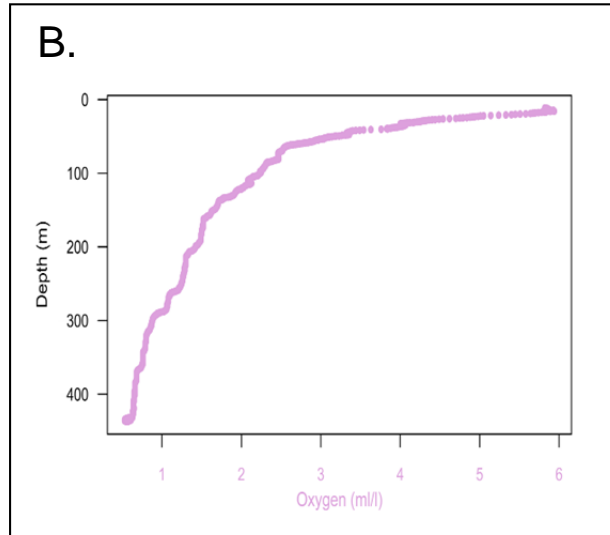
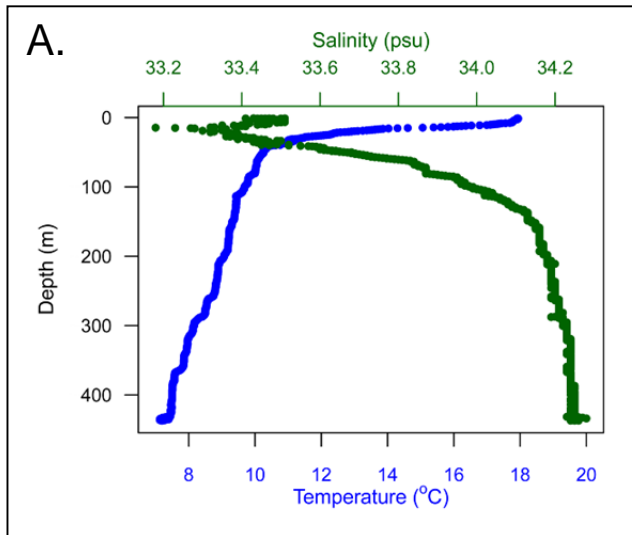
Date	06 Oct 2010	Starting Latitude (N)	33° 56.913'
Minimum Bottom Depth (m)	361	Starting Longitude (W)	119° 28.187'
Maximum Bottom Depth (m)	437	Ending Latitude (N)	33° 57.103'
Start Bottom Time (PDT)	12:19	Ending Longitude (W)	119° 28.613'
End Bottom Time (PDT)	13:50	Surface Current	n/a
Number of Transects	1	Bottom Current	n/a

PHYSICAL ENVIRONMENT

In total, 3,354 m² of sea floor were surveyed in one transect conducted continuously during Dive 0018 on the Footprint. Habitat types were classified as (1) Hard (54% of the total area surveyed), which included large boulders, rock outcrops, and cobbles; (2) Mixed (35% of the total area surveyed), including a combination of mud with boulders, rock, or cobbles; (3) Sediment (11% of the total area surveyed), which consisted entirely of mud.



Data on depth, conductivity, temperature, and oxygen were collected during descent (A and B) and at depth along the track line (C and D) of dive 0018. Temperature ranged from 17.9°C at the sea surface to 7.2°C on the sea floor at 437 m depth. Salinity (as estimated from conductivity, temperature, and pressure) ranged from 33.5 psu at the sea surface to 34.3 psu on the sea floor. The range in oxygen was from 5.9 ml/l at the sea surface to 0.5 ml/l on the sea floor at 437 m.



BIOLOGICAL ENVIRONMENT: CHRISTMAS TREES

Eighty-two Christmas tree black corals, with a density of 24.4 colonies per 1,000 m², occurred on the transect of Dive 0018. The colonies were varied in size, averaging 702 cm² in area (range = 50-10,350 cm²). Fourteen of the colonies had dead or dying sections, and 13 colonies were mostly or entirely dead. Colonies varied from brown when dead to white or red when in good condition. Invertebrates (mostly brittle stars, crabs, and crinoids) were associated with all but five colonies. Four colonies had fish associations.

BIOLOGICAL ENVIRONMENT: FISHES

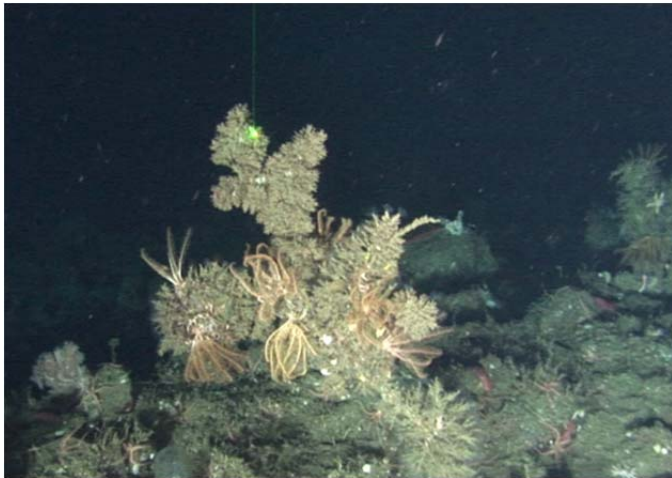
At least 21 taxa of fishes were identified during Dive 0018 along the top of the Footprint. A total of 264 individual fishes were enumerated, and an overall density of 77 fish per 1,000 m² of sea floor was estimated during one continuous transect. At least 4 species of rockfishes (*Sebastes*), dominated by splitnose rockfish comprised 64% of fish density. The remainder of the fish assemblage included thornyheads (14%), flatfishes (10%), poachers (3%), and other taxa.

Two splitnose and one aurora rockfish were observed hiding at the base of three different Christmas tree black corals, while one coral colony had an unidentified cat-shark egg case hanging from a branch. The remaining 78 colonies had no association with fishes.

Scientific name	Common name	Number
Fishes		
<i>Eptatretus</i> spp.	Unidentified hagfishes	3
<i>Lycodes corteziianus</i>	Bigfin eelpout	2
Agonidae	Unidentified poachers	9
<i>Eopsetta jordani</i>	Petrable sole	1
<i>Glyptocephalus zachirus</i>	Rex sole	4
<i>Microstomus pacificus</i>	Dover sole	18
<i>Parophrys vetulus</i>	English sole	1
Pleuronectiformes	Unidentified flatfish	1
<i>Sebastes aurora</i>	Aurora rockfish	5
<i>Sebastes crameri</i>	Darkblotched rockfish	1
<i>Sebastes diploproa</i>	Splitnose rockfish	124
<i>Sebastes melanostomus</i>	Blackgill rockfish	25
<i>Sebastes</i> spp.	Unidentified rockfishes	12
<i>Sebastes</i> spp.	Unidentified Sebastomus	2
<i>Sebastolobus alascanus</i>	Shortspine thornyhead	3
<i>Sebastolobus</i> spp.	Unidentified thornyheads	33
Cottidae	Unidentified sculpins	5
<i>Icelinus</i> spp.	Icelinid sculpins	6
<i>Merluccius productus</i>	Pacific hake	3
Myctophidae	Unidentified lanternfishes	3
<i>Raja rhina</i>	Longnose skate	3

IMAGE GALLERY

A dead Christmas tree black coral covered in epifauna at 380 m depth.



A large barrel sponge with an Icelinid sculpin next to a small white Christmas tree black coral at 387 m depth.



A large fingered goblet vase sponge (*Heterochone calyx*) at 376 m depth.



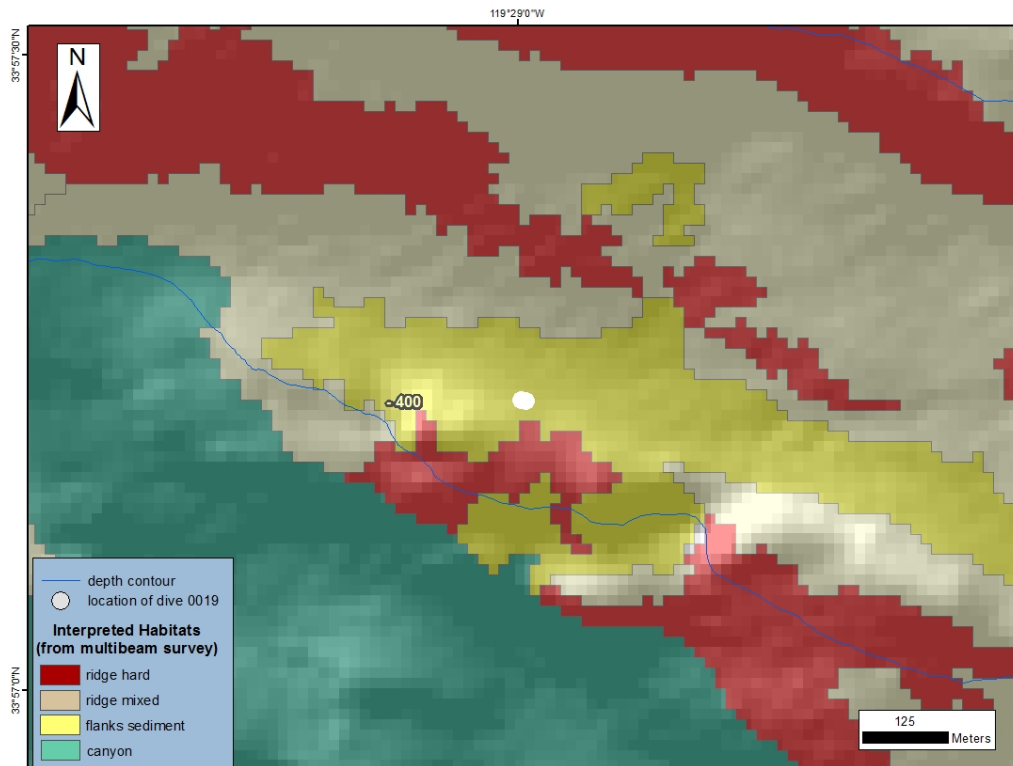
A red Christmas tree black coral at 380 m depth.



ADDITIONAL COMMENTS

Two man-made debris items (both monofilament fishing lines) occurred during Dive 0018. Damage potentially caused by these two items was not observed.

STATION OVERVIEW



Project	U.S. West Coast Deep Coral Cruise
Chief Scientist	M. Yoklavich
Contact Information	NMFS, SWFSC, mary.yoklavich@noaa.gov
Purpose	Determine fish associations with black corals
Vessel / Vehicle	F/V <i>Velero IV</i> ; <i>Dual DeepWorker</i> submersible
Submersible Pilot	Doug Bishop
Scientific Observer	Milton Love
External Digital Video	HD: 0 min; SD: 0 tape
Positioning System	Ship: GPS; Submersible: USBL
CTD Sensors	Yes
O₂ Sensor	Yes
Specimens collected	No
Other	Logbook, Access database
Report Analyst	T. Laidig
Date Compiled	December 2012

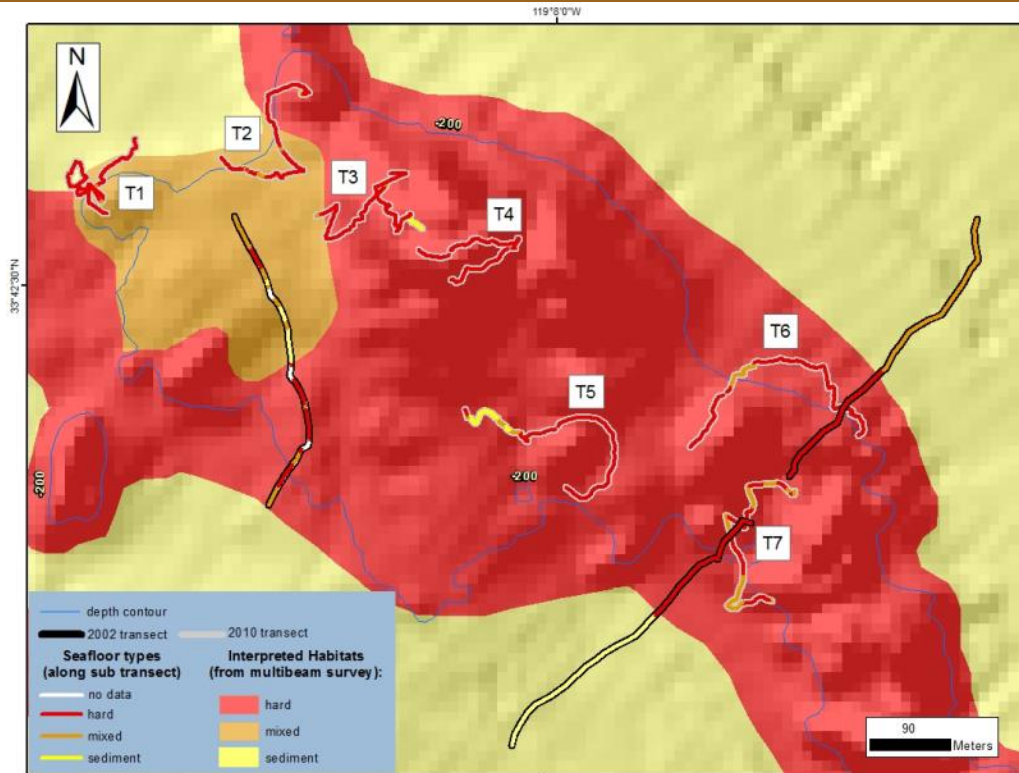
DIVE NUMBER: DDW 0019

STUDY AREA: Piggy Bank

DIVE DATA

Date	06 Oct 2010	Starting Latitude (N)	33° 57.242'
Minimum Bottom Depth (m)	385	Starting Longitude (W)	119° 28.989'
Maximum Bottom Depth (m)	385	Ending Latitude (N)	33° 57.242'
Start Bottom Time (PDT)	16:46	Ending Longitude (W)	119° 28.989'
End Bottom Time (PDT)	16:56	Surface Current	n/a
Number 15-min Transects	0	Bottom Current	n/a

Navigation failed (no tracking signal transmitted from DDW) upon reaching the sea floor at a depth of 385 m, and Dive 0019 was aborted after testing the navigation system for 10 minutes. The scientific observer noted a small (20 cm in height) dead Christmas tree black coral on sea floor, and a thick layer of squid in water column at about 330 m water depth.



STATION OVERVIEW

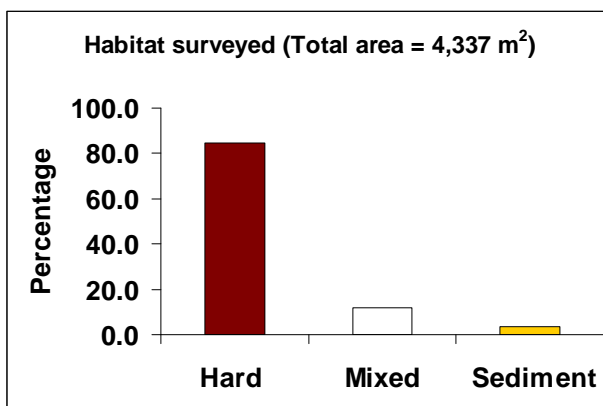
Project	U.S. West Coast Deep Coral Cruise
Chief Scientist	M. Yoklavich
Contact Information	NMFS, SWFSC, mary.yoklavich@noaa.gov
Purpose	<ol style="list-style-type: none"> 1) Estimate black coral density 2) Determine fish associations with black corals 3) Evaluate change in black coral community
Vessel / Vehicle	<i>F/V Velero IV</i> ; <i>Dual DeepWorker</i> submersible
Submersible Pilot	Jeff Heaton
Scientific Observer	Tom Laidig
External Digital Video	HD: 193 min; SD: 1 tape
Positioning System	Ship: GPS; Submersible: USBL
CTD Sensors	Yes
O₂ Sensor	Yes
Specimens collected	Yes
Other	Logbook, Access database
Report Analyst	T. Laidig
Date Compiled	December 2012

DIVE DATA

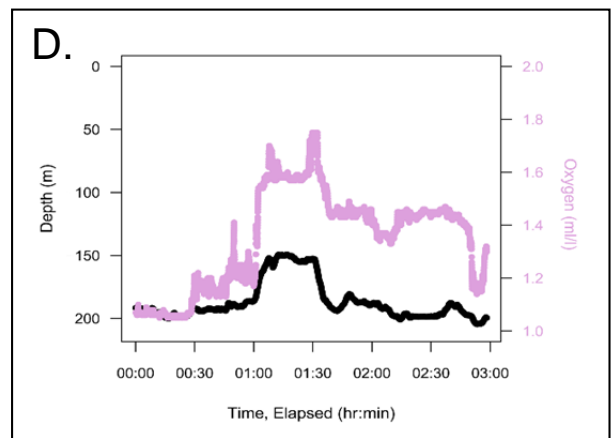
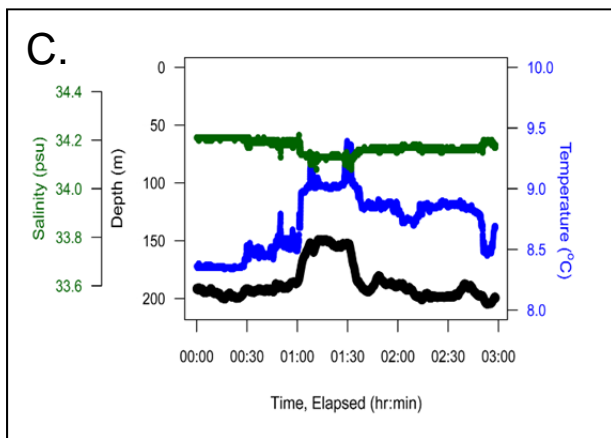
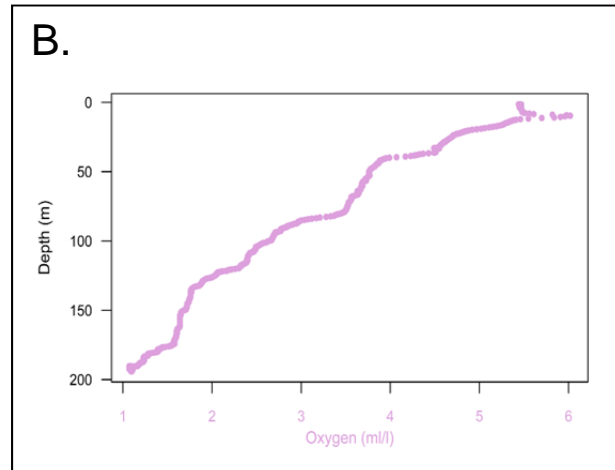
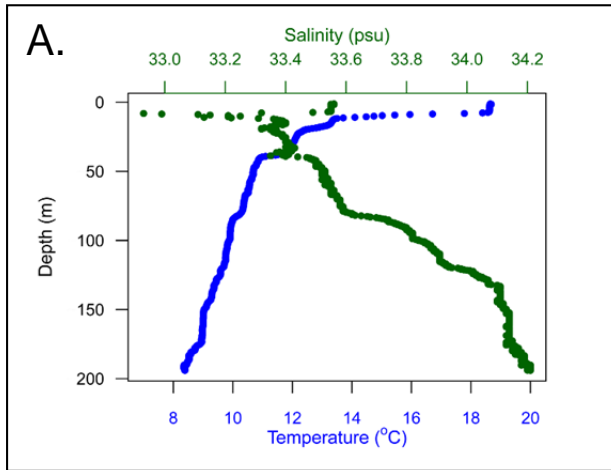
Date	07 Oct 2010	Starting Latitude (N)	33° 42.545'
Minimum Bottom Depth (m)	128	Starting Longitude (W)	119° 08.318'
Maximum Bottom Depth (m)	211	Ending Latitude (N)	33° 42.319'
Start Bottom Time (PDT)	09:47	Ending Longitude (W)	119° 7.832'
End Bottom Time (PDT)	12:45	Surface Current	n/a
Number 15-min Transects	7	Bottom Current	n/a

PHYSICAL ENVIRONMENT

In total, 4,337 m² of sea floor were surveyed during seven 15-minute transects on Dive 0020 at Hidden Reef. Habitat types were classified as (1) Hard (84% of the total area surveyed), which included large boulders, rock outcrops, and cobbles; (2) Mixed (12% of the total area surveyed), including a combination of mud with boulders, rock, or cobbles; (3) Sediment (4% of the total area surveyed), which consisted entirely of mud.



Data on depth, conductivity, temperature, and oxygen were collected during descent (A and B) and at depth along the track line (C and D) of Dive 0020. Temperature ranged from 18.7°C at the sea surface to 8.3°C on the sea floor at 205 m depth. Salinity (as estimated from conductivity, temperature, and pressure) ranged from 33.6 psu at the sea surface to 34.2 psu on the sea floor. Dissolved oxygen ranged from 5.2 ml/l at the sea surface (6.0 ml/l at the thermocline) to 1.1 ml/l on the sea floor at 205 m.



BIOLOGICAL ENVIRONMENT: CHRISTMAS TREES

A total of 100 Christmas tree black corals, with a density of 23.1 colonies per 1,000 m², occurred during the 7 transects on Dive 0020. The colonies generally were large, averaging 2,110 cm² in area (range = 50-40,000 cm²); some colonies were over 1 m in height. Fourteen colonies contained dead or dying sections, four colonies were mostly or completely dead, and one colony was knocked over. Most colonies were white or red. Invertebrates (crinoids, brittle stars, and crabs) were associated with all but 30 colonies; 10 colonies were associated with fishes.

BIOLOGICAL ENVIRONMENT: CORALS

A total of 643 individual corals, comprising at least 16 taxa, was enumerated from seven 15-minute transects conducted during Dive 0020 on Hidden Reef. An overall density of 148 corals per 1,000 m² of sea floor was estimated. Cup corals (including *Desmophyllum dianthus*) and *Lophelia pertusa* accounted for 52% of the coral density. The remaining coral density comprised fan-like gorgonians (22%, including *Plumarella longispina*, *Acanthogorgia* spp., *Paragorgia* spp., and *Parastenella ramosa*), the Christmas tree black coral (16%), unidentified zoanthids (7%), the mushroom coral (2%, *Anthomastus ritteri*), and 1% or less for stick-like gorgonians (including both *Swiftia* spp. and *Euplexaura* spp., which could not be distinguished reliably from video footage alone), sea pens, and soft coral. All of these corals, with the exception of sea pens, occurred on either hard or mixed habitats.

Scientific name	Common name	Number
Corals		
<i>Acanthogorgia</i> spp.	Gold coral	12
<i>Paragorgia</i> spp.	Sea fan (white with red polyps)	4
<i>Parastenella ramosa</i>	Primnoid	2
<i>Plumarella longispina</i>	Primnoid	124
Plexauridae #1	Sea fans (red w/ white polyps)	4
Plexauridae #2	Sea fan (red w/ yellow polyps)	1
<i>Swiftia</i> sp.	Red sea fan	1
<i>Antipathes dendrochristos</i>	Christmas tree black coral	100
<i>Desmophyllum dianthus</i>	Cockscomb cup coral	44
<i>Lophelia pertusa</i>	White cup coral	183
Scleractinia	Unidentified cup corals	105
<i>Anthomastus ritteri</i>	Mushroom coral	12
Zoantharia	Unidentified zoanthid corals	45
<i>Anthoptilum grandiflorum</i>	Feather boa sea pen	1
Pennatulacea #1	Sea pen (thin)	1
<i>Clavularia</i> spp.	Soft coral	4

One pale pink primnoid specimen was collected on Dive 0020, and identified by Stephen Cairns (National Museum of Natural History, Smithsonian Institution, Washington DC) as *Plumarella longispina*.

BIOLOGICAL ENVIRONMENT: SPONGES

A total of 1,352 individual sponges from at least 16 different taxa was enumerated from 7 15-minute transects conducted during Dive 0020 on Hidden Reef. An overall density of 312 sponges per 1,000 m² of sea floor was estimated. Vase sponges (*Heterochone calyx*, *Sigmadocia* spp., *Staurocalyptus* spp. and others) were most abundant (26% of the total density), followed by foliose (22%, *Farrea occa*, *Thenea muricata* spp., and others), barrel (18%), branching (16%, *Rhizaxinella gadus* and others), upright flat (8%), and shelf (5%), and mound sponges (2%). The category 'Other' represented 3% of total sponge density and included *Asbestopluma* spp. among other sponges. Most of the sponges occurred on hard and mixed habitats.

Scientific name	Common name	Number
Sponges		
Porifera #3	Unidentified barrel sponges	245
<i>Heterochone calyx</i>	Fingered goblet vase sponge	2
Porifera #5	Unidentified vase sponges	270
<i>Sigmadocia</i> spp.	Tan vase/trumpet sponge	76
<i>Staurocalyptus</i> spp.	Picasso sponge	1
Porifera #4	Unidentified shelf sponges	70
Porifera #2	Unidentified upright flat sponges	111
<i>Farrea occa</i>	Lace (or cloud) foliose sponge	7
Porifera #1	Unidentified foliose sponges	220
Porifera #8	Unidentified tube sponges	37
<i>Thenea muricata</i>	Foliose sponge (clear)	37
Porifera #6	Unidentified mound sponges	22
Porifera #7	Unidentified branching sponges	88
<i>Rhizaxinella gadus</i>	Club sponge	131
<i>Asbestopluma</i> spp. #1	Predatory pipecleaner sponge	23
Porifera #12	Unidentified sponges	12

Two Demospongia specimens were collected during Dive 0020, which William Austin (Khoyatan Marine Laboratory, Sidney, BC) identified as the club sponge (*Rhizaxinella gadus*) and the tan vase sponge (*Sigmadocia* spp.).

BIOLOGICAL ENVIRONMENT: FISHES

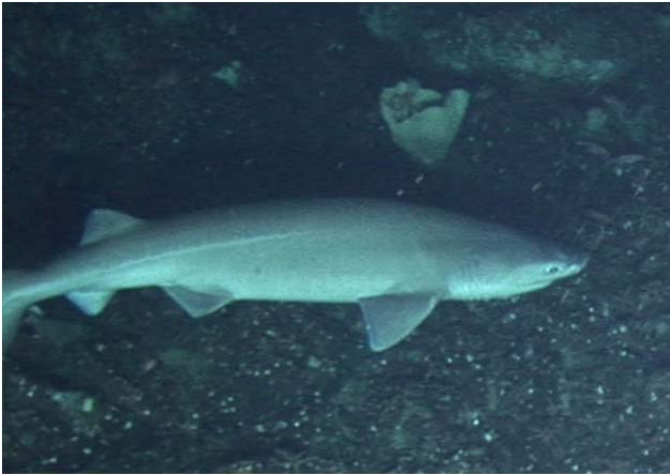
At least 27 fish taxa were identified during Dive 0020 on Hidden Reef. A total of 1,544 individual fishes was enumerated, and an overall density of 356 fish per 1,000 m² of sea floor was estimated from seven 15-minute transects. At least 15 species of rockfishes (*Sebastes*), dominated by unidentified *Sebastes*, comprised 97% of fish density. The remainder of the fish assemblage included shortspine combfish, flatfishes, poachers, sculpins, and other taxa. One sixgill shark was seen off-transect during the collection of a specimen.

Scientific name	Common name	Number
Fishes		
Agonidae	Unidentified poachers	2
<i>Citharichthys</i> spp.	Unidentified sanddabs	2
<i>Microstomus pacificus</i>	Dover sole	1
<i>Sebastes chlorostictus</i>	Greenspotted rockfish	1
<i>Sebastes elongatus</i>	Greenstriped rockfish	30
<i>Sebastes ensifer</i>	Swordspine rockfish	1
<i>Sebastes entomelas</i>	Widow rockfish	2
<i>Sebastes goodei</i>	Chilipepper	1
<i>Sebastes hopkinsi</i>	Squarespot rockfish	58
<i>Sebastes jordani</i>	Shortbelly rockfish	20
<i>Sebastes levis</i>	Cowcod	20
<i>Sebastes ovalis</i>	Speckled rockfish	20
<i>Sebastes paucispinis</i>	Bocaccio	6
<i>Sebastes rufinanus</i>	Dwarf-red rockfish	1
<i>Sebastes rufus</i>	Bank rockfish	67
<i>Sebastes simulator</i>	Pinkrose rockfish	2
<i>Sebastes</i> spp.	Unidentified rockfishes	53
<i>Sebastes</i> spp.	Unidentified <i>Sebastes</i>	897
<i>Sebastes</i> spp.	Young-of-the-year rockfishes	230
<i>Sebastes wilsoni</i>	Pygmy rockfish	91
<i>Sebastes zacentrus</i>	Sharpchin rockfish	1
Cottidae	Unidentified sculpins	3
<i>Hydrolagus colliei</i>	Spotted ratfish	1
<i>Ophiodon elongatus</i>	Lingcod	1
Osteichthyes	Unidentified fish	1
Scyliorhinidae	Unidentified cat shark egg cases	2
<i>Zaniolepis frenata</i>	Shortspine combfish	30

Seventy-one fishes were associated with 10 Christmas tree black corals (out of 100 black corals recorded during this dive). At least 10 different species of fishes were associated with these colonies, and most of these fishes (76%) were small, unidentified rockfishes (*Sebastes*, length 10 cm or less). Unidentified cat shark egg case hung from branches of one coral colony. Other species associated with these 10 colonies were cowcod, bank, widow, and shortbelly rockfishes.

IMAGE GALLERY

A sixgill shark (*Hexanchus griseus*) at 181 m depth.



A white Christmas tree black coral with small rockfish (*Sebastes* spp.) at 195 m depth.



A pink Christmas tree black coral at 141 m.

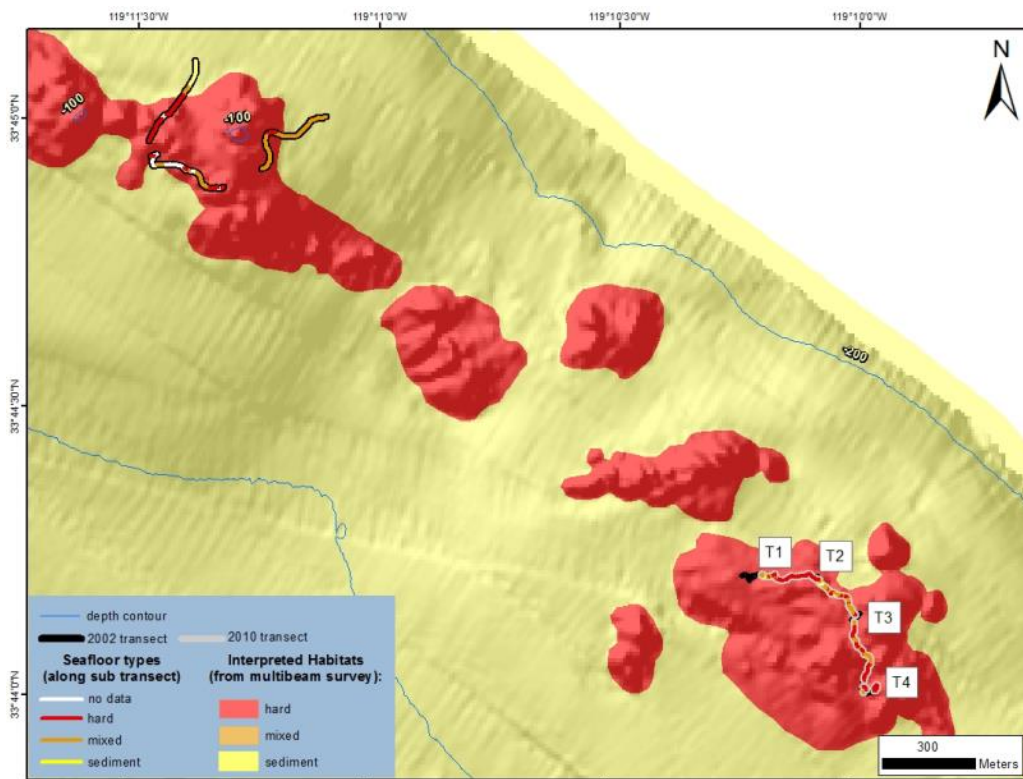


A Cowcod (*Sebastes levis*) on a rock ridge at 183 m depth.



ADDITIONAL COMMENTS

Two man-made debris items (a monofilament fishing line and a thick line or cable) were documented during Dive 0020. The thick line was draped across rocky outcrops and covered with invertebrates including feather stars (crinoid, *Florometra serratissima*) and encrusting and vase sponges. Damage potentially caused by these two items was not observed.



STATION OVERVIEW

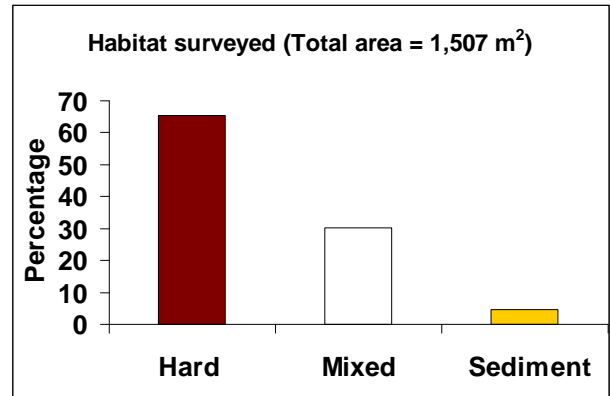
Project	U.S. West Coast Deep Coral Cruise
Chief Scientist	M. Yoklavich
Contact Information	NMFS, SWFSC, mary.yoklavich@noaa.gov
Purpose	<ol style="list-style-type: none"> 1) Estimate black coral density 2) Determine fish associations with black corals 3) Evaluate change in black coral community
Vessel / Vehicle	F/V <i>Velero IV</i> ; <i>Dual DeepWorker</i> submersible
Submersible Pilot	Jeff Heaton
Scientific Observer	Mary Yoklavich
External Digital Video	HD: 68 min; SD: 1 tape
Positioning System	Ship: GPS; Submersible: USBL
CTD Sensors	Yes
O₂ Sensor	Yes
Specimens collected	No
Other	Logbook, Access database
Report Analyst	T. Laidig
Date Compiled	December 2012

DIVE DATA

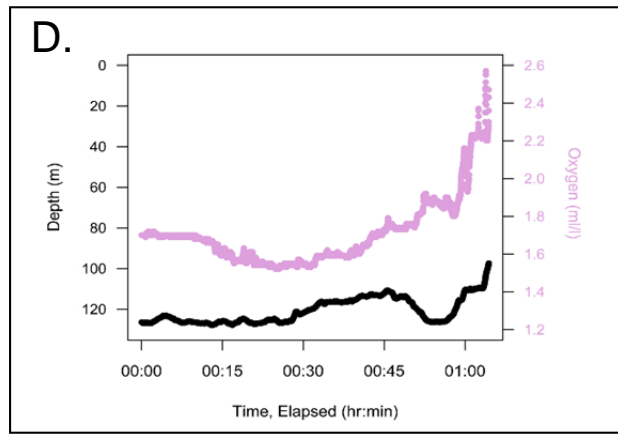
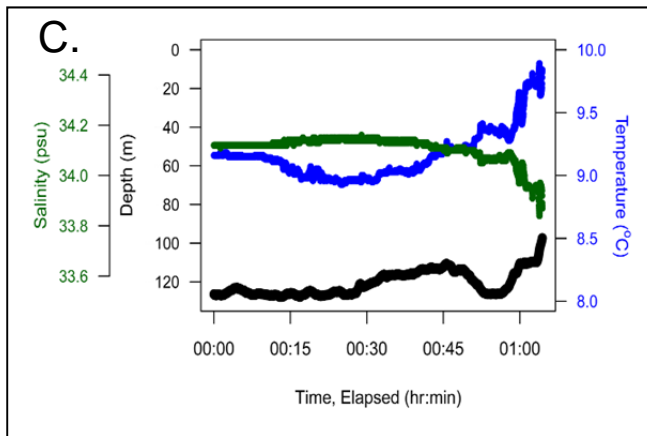
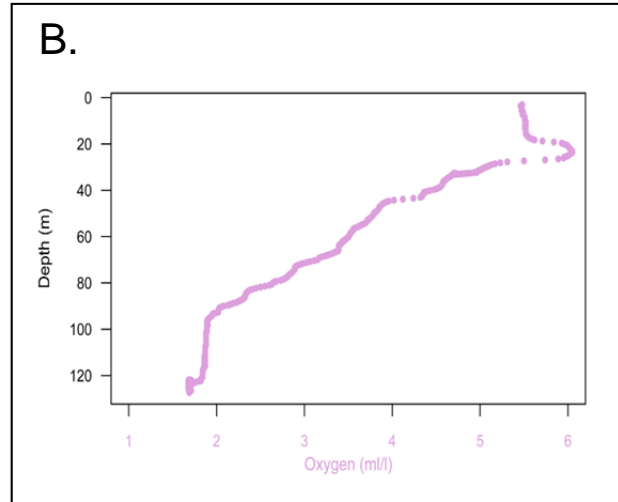
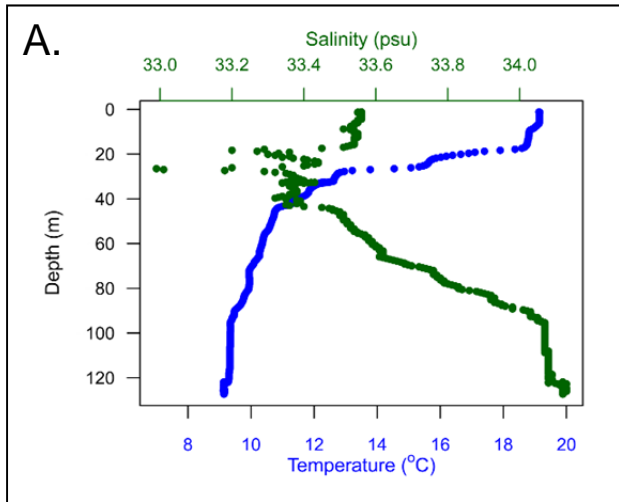
Date	07 Oct 2010	Starting Latitude (N)	33° 44.234'
Minimum Bottom Depth (m)	81	Starting Longitude (W)	119° 10.178'
Maximum Bottom Depth (m)	141	Ending Latitude (N)	33° 44.039'
Start Bottom Time (PDT)	18:02	Ending Longitude (W)	119° 09.938'
End Bottom Time (PDT)	19:06	Surface Current	n/a
Number 15-min Transects	4	Bottom Current	n/a

PHYSICAL ENVIRONMENT

In total, 1,507 m² of sea floor were surveyed in four 15-minute transects conducted during Dive 0021 on Hidden Reef. Habitat types were classified as (1) Hard (65% of the total area surveyed), which included large boulders, rock outcrops, and cobbles; (2) Mixed (30% of the total area surveyed), including a combination of mud with boulders, rock, or cobbles; (3) Sediment (5% of the total area surveyed), which consisted entirely of mud.



Data on depth, conductivity, temperature, and oxygen were collected during descent (A and B) and at depth along the track line (C and D) on Dive 0021. Temperature ranged from 19.2°C at the sea surface to 8.9°C on the sea floor at 128 m depth. Salinity (as estimated from conductivity, temperature, and pressure) ranged from 33.6 psu at the sea surface to 34.2 psu on the sea floor. Dissolved oxygen ranged from 5.8 ml/l at the sea surface (6.0 ml/ at the thermocline) to 1.6 ml/l on the sea floor at 128 m.



DIVE NUMBER: DDW 0021

STUDY AREA: Hidden Reef

BIOLOGICAL ENVIRONMENT: CHRISTMAS TREES

Four white or pink Christmas tree black corals, with a density of 2.7 trees per 1,000 m², occurred during the 4 transects on Dive 0021. The colonies generally were large, averaging 8,317 cm² in area (range = 200 -16,500 cm²); some colonies were over 1 m in height. One colony had visible damage (a broken branch), and two colonies had dead or dying sections. No colonies were entirely (or even mostly) dead. Invertebrates (crinoids, brittle stars, and crabs) were associated with all but the smallest colony. Two colonies were associated with fishes.

BIOLOGICAL ENVIRONMENT: CORALS

The Christmas tree black coral was the only coral species occurring on Dive 0021 on Hidden Reef.

BIOLOGICAL ENVIRONMENT: SPONGES

A total of 194 individual sponges from at least 11 different taxa was enumerated from 4 15-minute transects conducted during Dive on Hidden Reef. An overall density of 129 sponges per 1,000 m² of sea floor was estimated. Barrel sponges were the most abundant (43% of the total density), followed by vase sponges (35%, *Sigmadocia* spp. and others), foliose (6%, *Thenea muricata* spp. and others), upright flat (5%), branching (1%, *Rhizaxinella gadus* and others), mound (1%), and shelf sponges (1%). The category 'Other' represented 10% of total sponge density and included at least one taxa of unidentified sponge. Most of the sponges occurred on hard and mixed habitats.

Scientific name	Common name	Number
Sponges		
Porifera #3	Unidentified barrel sponges	83
Porifera #5	Unidentified vase sponges	66
<i>Sigmadocia</i> spp.	Tan vase/trumpet sponge	1
Porifera #4	Unidentified shelf sponge	1
Porifera #2	Unidentified upright flat sponges	9
Porifera #1	Unidentified foliose sponge	1
<i>Thenea muricata</i>	Foliose sponge (clear)	11
Porifera #6	Unidentified mound sponge	1
Porifera #7	Unidentified branching sponge	1
<i>Rhizaxinella gadus</i>	Club sponge	1
Porifera #12	Unidentified sponges	19

BIOLOGICAL ENVIRONMENT: FISHES

At least 22 taxa of fishes were identified during Dive 0021 on Hidden Reef. A total of 1,443 individual fishes was enumerated, and an overall density of 957 fish per 1,000 m² of sea floor was estimated from 4 15-minute transects. At least 15 species of rockfishes (*Sebastes*) dominated by unidentified *Sebastes*, and young-of-the-year, squarespot, and pygmy rockfishes comprised 98% of fish density. The remainder of the fish assemblage included shortspine combfish, flatfishes, and blackeye gobies.

Scientific name	Common name	Number
Fishes		
<i>Microstomus pacificus</i>	Dover sole	1
Pleuronectiformes	Unidentified flatfish	1
<i>Sebastes chlorostictus</i>	Greenspotted rockfish	1
<i>Sebastes constellatus</i>	Starry rockfish	5
<i>Sebastes elongatus</i>	Greenstriped rockfish	7
<i>Sebastes ensifer</i>	Swordspine rockfish	5
<i>Sebastes entomelas</i>	Widow rockfish	3
<i>Sebastes hopkinsi</i>	Squarespot rockfish	186
<i>Sebastes jordani</i>	Shortbelly rockfish	1
<i>Sebastes levis</i>	Cowcod	12
<i>Sebastes miniatus</i>	Vermilion rockfish	4
<i>Sebastes ovalis</i>	Speckled rockfish	38
<i>Sebastes paucispinis</i>	Bocaccio	15
<i>Sebastes rubrivinctus</i>	Flag rockfish	2
<i>Sebastes rufus</i>	Bank rockfish	63
<i>Sebastes semicinctus</i>	Halfbanded rockfish	6
<i>Sebastes</i> spp.	Unidentified rockfishes	27
<i>Sebastes</i> spp.	Unidentified <i>Sebastes</i>	233
<i>Sebastes</i> spp.	Young-of-the-year rockfishes	698
<i>Sebastes wilsoni</i>	Pygmy rockfish	108
<i>Rhinogobiops nicholsii</i>	Blackeye goby	3
<i>Zaniolepis frenata</i>	Shortspine combfish	24

Five fishes (one cowcod and four squarespot rockfish) were associated with 2 of the 4 Christmas tree black corals that occurred on these transects. Fishes were not associated with the remaining two coral colonies.

IMAGE GALLERY

Flag (*Sebastes rubrivinctus*) and bank rockfishes (*Sebastes rufus*) near field of crinoids (*Florometra serratissima*) at 132 m depth.



A cowcod (*Sebastes levis*) under a white Christmas tree black coral at 113 m depth.

Greenspotted rockfish (*Sebastes chlorostictus*) over rocky habitat at 112 m depth.

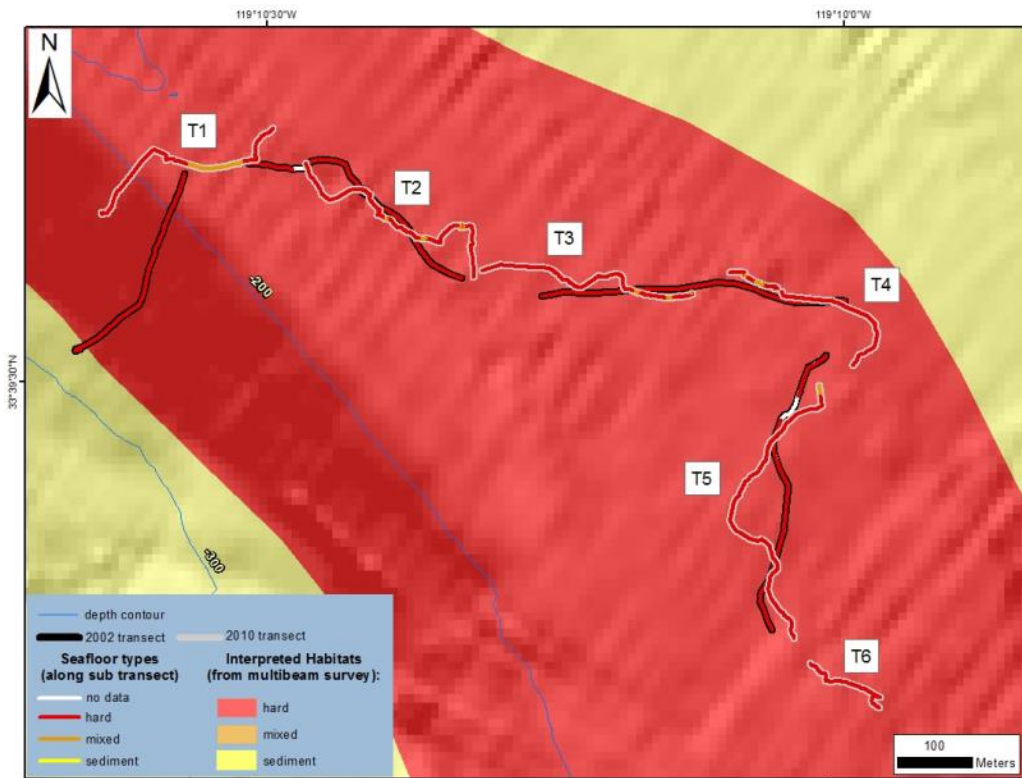


A white Christmas tree black coral at 113 m depth.



ADDITIONAL COMMENTS

No man-made debris items were observed during the 4 15-minute transects conducted on Dive 0021.



STATION OVERVIEW

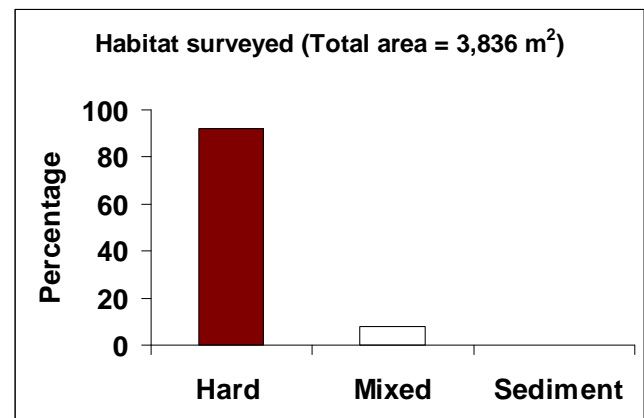
Project	U.S. West Coast Deep Coral Cruise
Chief Scientist	M. Yoklavich
Contact Information	NMFS, SWFSC, mary.yoklavich@noaa.gov
Purpose	<ol style="list-style-type: none"> 1) Estimate black coral density 2) Determine fish associations with black corals 3) Evaluate change in black coral community
Vessel / Vehicle	<i>F/V Velero IV</i> ; <i>Dual DeepWorker</i> submersible
Submersible Pilot	Doug Bishop
Scientific Observer	Linda Snook
External Digital Video	HD: 121 min; SD: 1 tape
Positioning System	Ship: GPS; Submersible: USBL
CTD Sensors	Yes
O₂ Sensor	Yes
Specimens collected	No
Other	Logbook, Access database
Report Analyst	T. Laidig
Date Compiled	December 2012

DIVE DATA

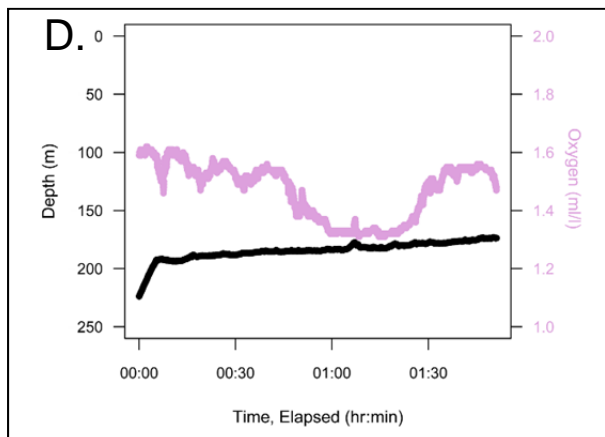
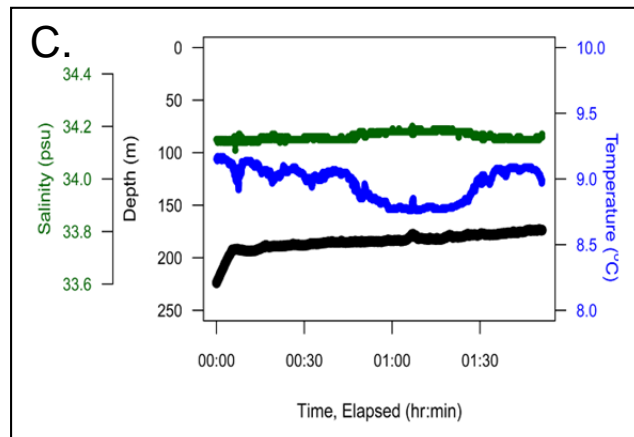
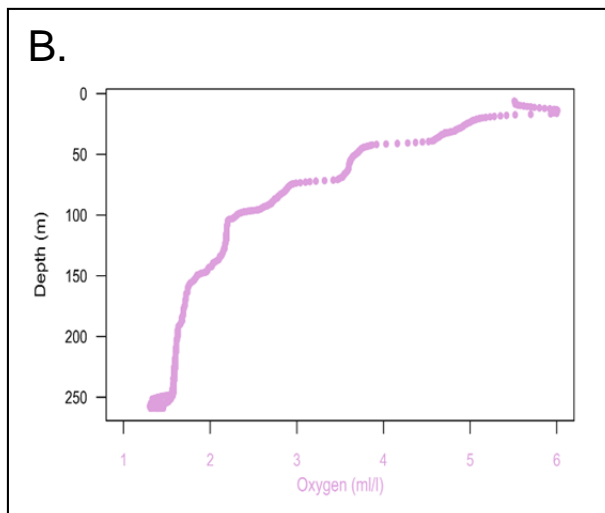
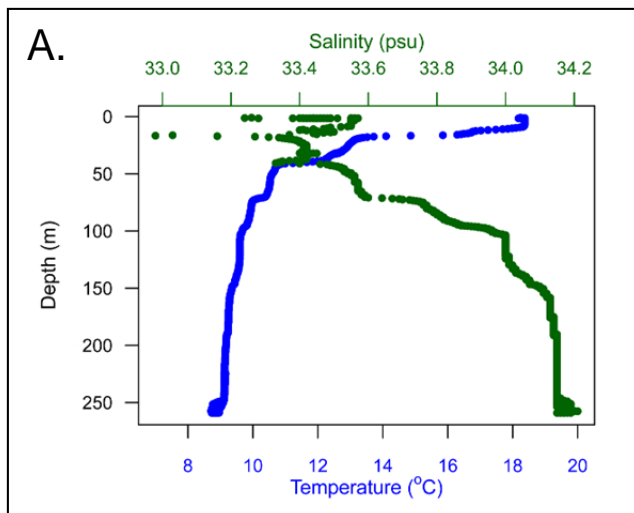
Date	08 Oct 2010	Starting Latitude (N)	33° 39.622'
Minimum Bottom Depth (m)	158	Starting Longitude (W)	119° 10.635'
Maximum Bottom Depth (m)	259	Ending Latitude (N)	33° 39.277'
Start Bottom Time (PDT)	08:35	Ending Longitude (W)	119° 09.531'
End Bottom Time (PDT)	10:26	Surface Current	n/a
Number 15-min Transects	6	Bottom Current	n/a

PHYSICAL ENVIRONMENT

In total, 3,836 m² of sea floor were surveyed in six transects conducted during Dive 0022 on Hidden Reef. Habitat types were classified as (1) Hard (92% of the total area surveyed), which included large boulders, rock outcrops, and cobbles or (2) Mixed (8% of the total area surveyed), including a combination of mud with boulders, rock, or cobbles. No soft sediment occurred on these transects.



Data on depth, conductivity, temperature, and dissolved oxygen were collected during descent (A and B) and at depth along the track line (C and D) of Dive 0022. Temperature ranged from 18.4°C at the sea surface to 8.7°C on the sea floor at 259 m depth. Salinity (as estimated from conductivity, temperature, and pressure) ranged from 33.6 psu at the sea surface to 34.2 psu on the sea floor. Dissolved oxygen ranged from 5.5 ml/l at the sea surface (6.0 ml/l at the thermocline) to 1.3 ml/l on the sea floor at 259 m.



BIOLOGICAL ENVIRONMENT: CHRISTMAS TREES

A total of 22 Christmas tree black corals, with a density of 5.7 colonies per 1,000 m², occurred on six 15-minute transects during Dive 0022. These were medium-sized colonies, averaging 1,057 cm² in area (range = 50-6,000 cm²). Colonies were white or red and upright. Two colonies had dead or dying sections and none were dead or mostly dead. Ten colonies had associated invertebrates (mostly crinoids, brittle stars, and crabs), and fishes were associated only with the two largest colonies.

BIOLOGICAL ENVIRONMENT: CORALS

A total of 414 corals, comprising at least 5 taxa, were enumerated from six 15-min transects conducted during Dive 0022. There was an overall density of 108 corals per 1,000 m² of sea floor. Fan-like gorgonians accounted for 93% and Christmas tree black corals 5% of all corals. The stick-like gorgonians (including *Swiftia* spp. and *Euplexaura* spp., based on expert examination of photographs and specimens) accounted for 1% of corals. All corals occurred on either hard or mixed habitats.

Scientific name	Common name	Number
Corals		
<i>Acanthogorgia</i> spp.	Gold coral	8
<i>Parastenella ramosa</i>	Primnoid	1
<i>Plumarella longispina</i>	Primnoid	378
Plexauridae #3	Sea fan (red w/ unknown polyps)	5
<i>Antipathes dendrochristos</i>	Christmas tree black coral	22

BIOLOGICAL ENVIRONMENT: SPONGES

A total of 845 individual sponges from at least 16 taxa were enumerated from six 15-min transects conducted during Dive 0022. Overall density was 220 sponges per 1,000 m² of sea floor. Branching sponges were most abundant (34% of the total density, *Rhizaxinella gadus* and others), followed by vase sponges (19%, *Heterochone calyx*, *Sigmatocia* spp., *Staurocalyptus* spp.), barrel sponges (18%), upright flat (6%), foliose (4%, *Farrea occa*), mound (2%), and shelf sponges (2%). *Asbestopluma* spp. and unidentified sponges represented 16% of total sponge density. Most of the sponges occurred on hard and mixed habitats.

Scientific name	Common name	Number
Sponges		
Porifera #3	Unidentified barrel sponges	150
<i>Heterochone calyx</i>	Fingered goblet vase sponge	1
Porifera #5	Unidentified vase sponges	141
<i>Sigmatocia</i> spp.	Tan vase/trumpet sponge	21
<i>Staurocalyptus</i> spp.	Picasso sponge	1
Porifera #4	Unidentified shelf sponges	14
Porifera #2	Unidentified upright flat sponges	47
<i>Farrea occa</i>	Lace (or cloud) foliose sponge	6
Porifera #1	Unidentified foliose sponges	23
Porifera #8	Unidentified tube sponge	1
Porifera #6	Unidentified mound sponges	15
Porifera #9	Unidentified puffball mound sponges	2
Porifera #7	Unidentified branching sponges	281
<i>Rhizaxinella gadus</i>	Club sponge	3
<i>Asbestopluma</i> spp. #1	Predatory pipecleaner sponge	127
Porifera #12	Unidentified sponges	12

BIOLOGICAL ENVIRONMENT: FISHES

At least 26 taxa of fishes were identified during Dive 0022 on Hidden Reef. A total of 1,397 individual fishes was enumerated, and an overall density of 363 fish per 1,000 m² of sea floor was estimated from four 15-minute transects. At least 14 species of rockfishes (*Sebastes*), dominated by unidentified Sebastomus and bank rockfish, comprised 95% of fish density. The remainder of the fish assemblage included shortspine combfish, hagfish, and unidentified cat shark egg cases, among other species.

Scientific name	Common name	Number
Fishes		
<i>Eptatretus</i> spp.	Unidentified hagfishes	5
Agonidae	Unidentified poacher	1
<i>Sebastes chlorostictus</i>	Greenspotted rockfish	2
<i>Sebastes crameri</i>	Darkblotched rockfish	1
<i>Sebastes elongatus</i>	Greenstriped rockfish	35
<i>Sebastes ensifer</i>	Swordspine rockfish	62
<i>Sebastes gillii</i>	Bronzespotted rockfish	1
<i>Sebastes goodei</i>	Chilipepper	10
<i>Sebastes jordani</i>	Shortbelly rockfish	51
<i>Sebastes levis</i>	Cowcod	16
<i>Sebastes ovalis</i>	Speckled rockfish	1
<i>Sebastes paucispinis</i>	Bocaccio	12
<i>Sebastes rosenblatti</i>	Greenblotched rockfish	1
<i>Sebastes rubrivinctus</i>	Flag rockfish	7
<i>Sebastes rufus</i>	Bank rockfish	139
<i>Sebastes</i> spp.	Unidentified rockfishes	2
<i>Sebastes</i> spp.	Unidentified Sebastomus	986
<i>Sebastes</i> spp.	Young-of-the-year rockfish	1
<i>Sebastes wilsoni</i>	Pygmy rockfish	5
Cottidae	Unidentified sculpins	2
<i>Hydrolagus colliei</i>	Spotted ratfish	1
<i>Icelinus</i> spp.	Icelinid sculpin	1
<i>Ophiodon elongatus</i>	Lingcod	1
<i>Plectobranchnus evides</i>	Bluebarred prickleback	2
Scyliorhinidae	Unidentified cat shark egg cases	6
<i>Zaniolepis frenata</i>	Shortspine combfish	46

Two small unidentified rockfishes were associated with one Christmas tree black coral, while seven unidentified cat shark egg cases were hanging from the branches of two coral colonies. Fishes were not associated with the remaining 20 colonies on this dive.

IMAGE GALLERY

A multi-armed seastar (*Rathbunaster californicus*) on boulders at 169 m.



A rare bronzespotted rockfish (*Sebastes gillii*) resting between boulders at 168 m depth.



A red Christmas tree black coral with associated invertebrates on boulders at 184 m depth.

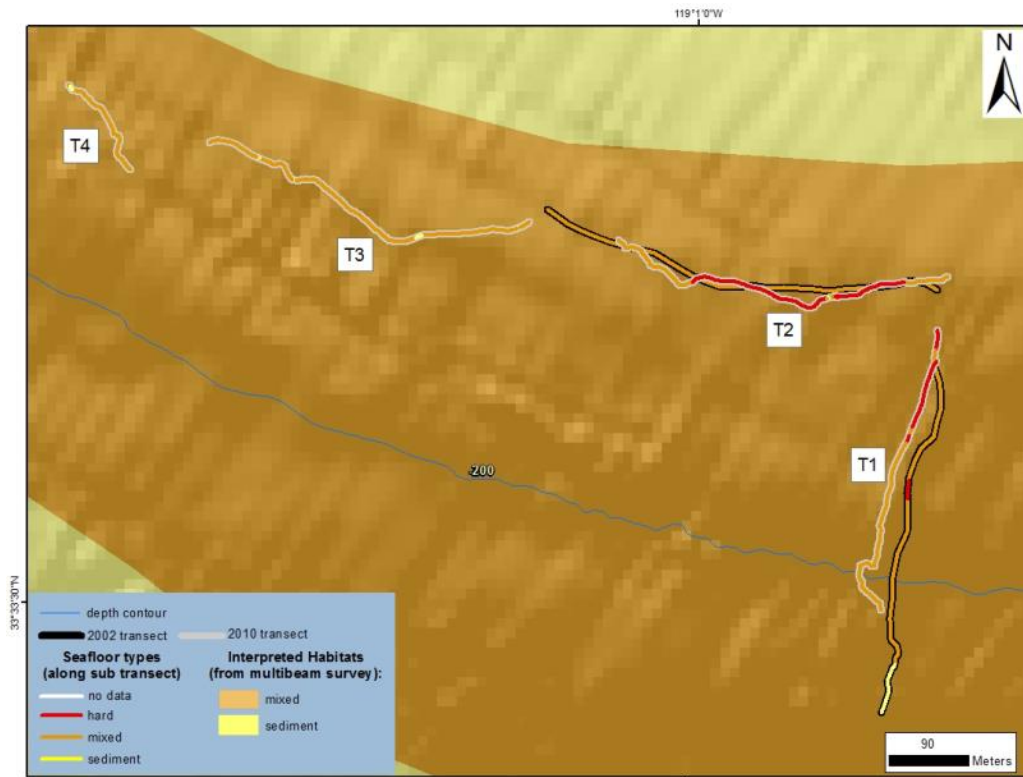


A barrel sponge on a boulder and cobble sea floor at 184 m depth.



ADDITIONAL COMMENTS

Four man-made debris items (a wine bottle, a beer can, a fishing weight, and a monofilament fishing line) were observed during Dive 0022. Damage potentially caused by these four items was not observed.



STATION OVERVIEW

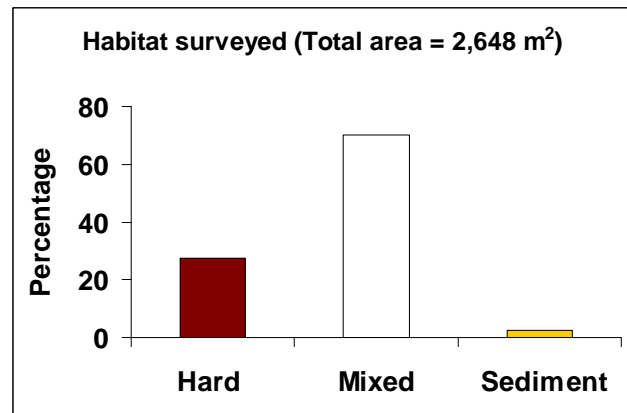
Project	U.S. West Coast Deep Coral Cruise
Chief Scientist	M. Yoklavich
Contact Information	NMFS, SWFSC, mary.yoklavich@noaa.gov
Purpose	<ol style="list-style-type: none"> 1) Estimate black coral density 2) Determine fish associations with black corals 3) Evaluate change in black coral community
Vessel / Vehicle	F/V <i>Velero IV</i> ; <i>Dual DeepWorker</i> submersible
Submersible Pilot	Doug Bishop
Scientific Observer	Mary Nishimoto
External Digital Video	HD: 93 min; SD: 1 tape
Positioning System	Ship: GPS; Submersible: USBL
CTD Sensors	Yes
O₂ Sensor	Yes
Specimens collected	Yes
Other	Logbook, Access database
Report Analyst	T. Laidig
Date Compiled	December 2012

DIVE DATA

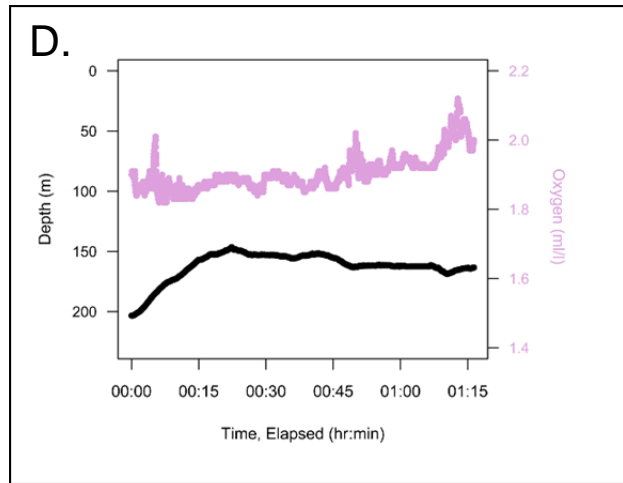
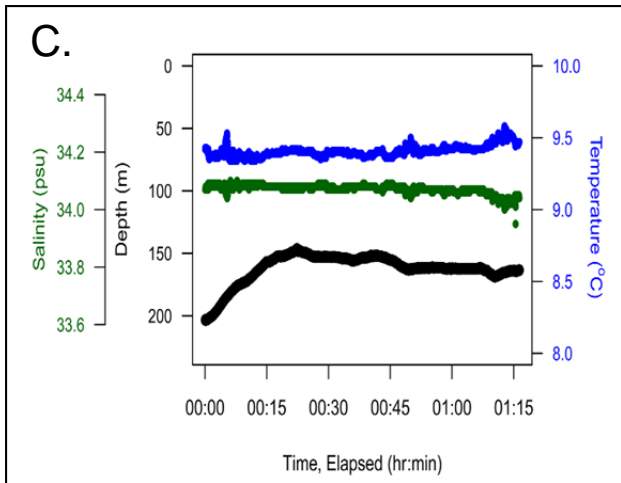
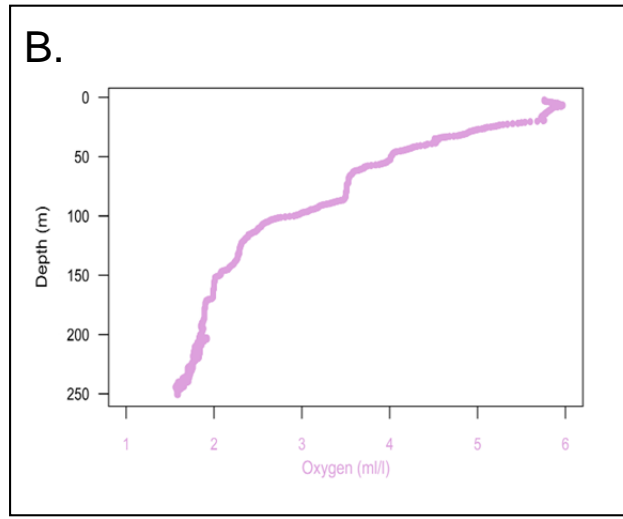
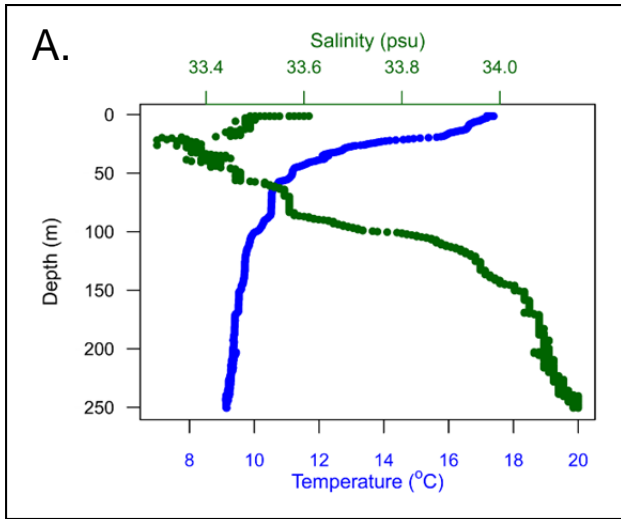
Date	08 Oct 2010	Starting Latitude (N)	33° 33.506'
Minimum Bottom Depth (m)	135	Starting Longitude (W)	119° 00.856'
Maximum Bottom Depth (m)	251	Ending Latitude (N)	33° 33.815'
Start Bottom Time (PDT)	15:52	Ending Longitude (W)	119° 01.455'
End Bottom Time (PDT)	17:08	Surface Current	n/a
Number 15-min Transects	4	Bottom Current	n/a

PHYSICAL ENVIRONMENT

In total, 2,648 m² of sea floor was surveyed in four transects conducted during Dive 0023 using the *Dual DeepWorker* from the F/V *Velero IV* on Hidden Reef. Habitat types were classified as (1) Hard (28% of the total area surveyed), which included large boulders, rock outcrops, and cobbles; (2) Mixed (70% of the total area surveyed), including a combination of mud with boulders, rock, or cobbles; (3) Sediment (2% of the total area surveyed), which consisted entirely of mud.



Data on depth, conductivity, temperature, and dissolved oxygen were collected during descent (A and B) and at depth along the track line (C and D) on Dive 0023. Temperature ranged from 17.4°C at the sea surface to 9.1°C on the sea floor at 251 m depth. Salinity (as estimated from conductivity, temperature, and pressure) ranged from 33.6 psu at the sea surface to 34.2 psu on the sea floor. Dissolved oxygen ranged from 5.8 ml/l at the sea surface (6.0 ml/l at the thermocline) to 1.6 ml/l on the sea floor at 251 m.



BIOLOGICAL ENVIRONMENT: CHRISTMAS TREES

A total of 14 Christmas tree black corals, with a density of 5.3 colonies per 1,000 m², occurred on four 15-min transects on Dive 0023. These were small colonies, averaging 269 cm² in area (range = 50-600 cm²); there were no large colonies (>1 m in height). All colonies were upright, either white or red, and only 1 colony was dead or mostly dead. Four trees had associated invertebrates (crinoids and crabs), and no fishes were associated with any Christmas tree black corals.

BIOLOGICAL ENVIRONMENT: CORALS

At least 7 taxa representing 350 corals were recorded on 4 15-min transects during Dive 0023. Overall density was 132 corals per 1,000 m² of sea floor. Fan-like gorgonians (including *Paragorgia stephencairnsi*, *Parastenella ramosa*, and *Plumarella longispina*) accounted for 94% of the coral density. Christmas tree black corals accounted for 4% of all corals and 8 unidentified taxa accounted for 2% of corals. All corals occurred on either hard or mixed habitats.

Scientific name	Common name	Number
Corals		
Hexacorallia/Octocorallia	Unidentified corals	8
Gorgonacea	Unidentified sea fan	1
<i>Paragorgia</i> spp.	Sea fan (white with red polyps)	1
<i>Paragorgia stephencairnsi</i>	Primnoid	5
<i>Parastenella ramosa</i>	Primnoid	3
<i>Plumarella longispina</i>	Primnoid	318
<i>Antipathes dendrochristos</i>	Christmas tree black coral	14

One coral specimen was collected, and identified by Stephen Cairns (National Museum of Natural History, Smithsonian Institution, Washington DC) as the golden primnoid (*Acanthogorgia* spp.).

BIOLOGICAL ENVIRONMENT: SPONGES

At least 14 taxa of 909 individual sponges were enumerated from 4 15-min transects during Dive 0023. Overall density was 343 sponges per 1,000 m² of sea floor. Upright flat sponges comprised 49% of total density, followed by vase (29%, *Sigmadocia* spp. and others), barrel sponges (6%), foliose (5%, *Thenea occa* and others), mound (5%), shelf (3%), and branching sponges (<1%, *Rhizaxinella gadus* and others). *Asbestopluma* spp. and unidentified sponges were 2% of total density. Most of the sponges occurred on hard and mixed habitats.

Scientific name	Common name	Number
Sponges		
Porifera #3	Unidentified barrel sponges	58
Porifera #5	Unidentified vase sponges	266
<i>Sigmadocia</i> spp.	Tan vase/trumpet sponge	2
Porifera #4	Unidentified shelf sponges	31
Porifera #2	Unidentified upright flat sponges	444
Porifera #1	Unidentified foliose sponges	9
Porifera #8	Unidentified tube sponges	3
<i>Thenea muricata</i>	Foliose sponge (clear)	35
Porifera #6	Unidentified mound sponges	42
Porifera #9	Unidentified puffball mound sponges	2
Porifera #7	Unidentified branching sponge	1
<i>Rhizaxinella gadus</i>	Club sponge	1
<i>Asbestopluma</i> spp. #1	Predatory pipecleaner sponge	5
Porifera #12	Unidentified sponges	10

BIOLOGICAL ENVIRONMENT: FISHES

At least 20 taxa of fishes were identified during Dive on Hidden Reef. A total of 759 individual fishes were enumerated, and an overall density of 287 fish per 1,000 m² of sea floor was estimated from four 15-minute transects. At least 7 species of rockfishes (*Sebastes*), dominated by unidentified *Sebastes* and halfbanded rockfish, comprised 84% of fish density. The remainder of the fish assemblage included shortspine combfish, flatfishes, and skates, among other taxa.

Scientific name	Common name	Number
Fishes		
Agonidae	Unidentified poacher	1
<i>Parophrys vetulus</i>	English sole	2
Pleuronectiformes	Unidentified flatfishes	3
<i>Sebastes elongatus</i>	Greenstriped rockfish	17
<i>Sebastes ensifer</i>	Swordspine rockfish	2
<i>Sebastes jordani</i>	Shortbelly rockfish	11
<i>Sebastes levis</i>	Cowcod	3
<i>Sebastes rufus</i>	Bank rockfish	1
<i>Sebastes semicinctus</i>	Halfbanded rockfish	263
<i>Sebastes</i> spp.	Unidentified rockfishes	2
<i>Sebastes</i> spp.	Unidentified <i>Sebastes</i>	310
<i>Sebastes</i> spp.	Young-of-the-year rockfishes	16
<i>Sebastes wilsoni</i>	Pygmy rockfish	15
<i>Chilara taylori</i>	Spotted cusk-eel	1
Cottidae	Unidentified sculpin	1
<i>Icelinus</i> spp.	Icelinid sculpin	1
<i>Raja rhina</i>	Longnose skate	1
Rajidae	Unidentified skate egg case	1
Rajidae	Unidentified skate	1
<i>Zaniolepis frenata</i>	Shortspine combfish	107

No fishes were associated with any of the 14 Christmas tree black corals observed during this dive.

IMAGE GALLERY

A crab on a mud and cobble sea floor at 175 m depth



A barrel sponge on a cobble and mud habitat at 178 m.



Vase and barrel sponges on cobble and mud sea floor at 158 m depth.

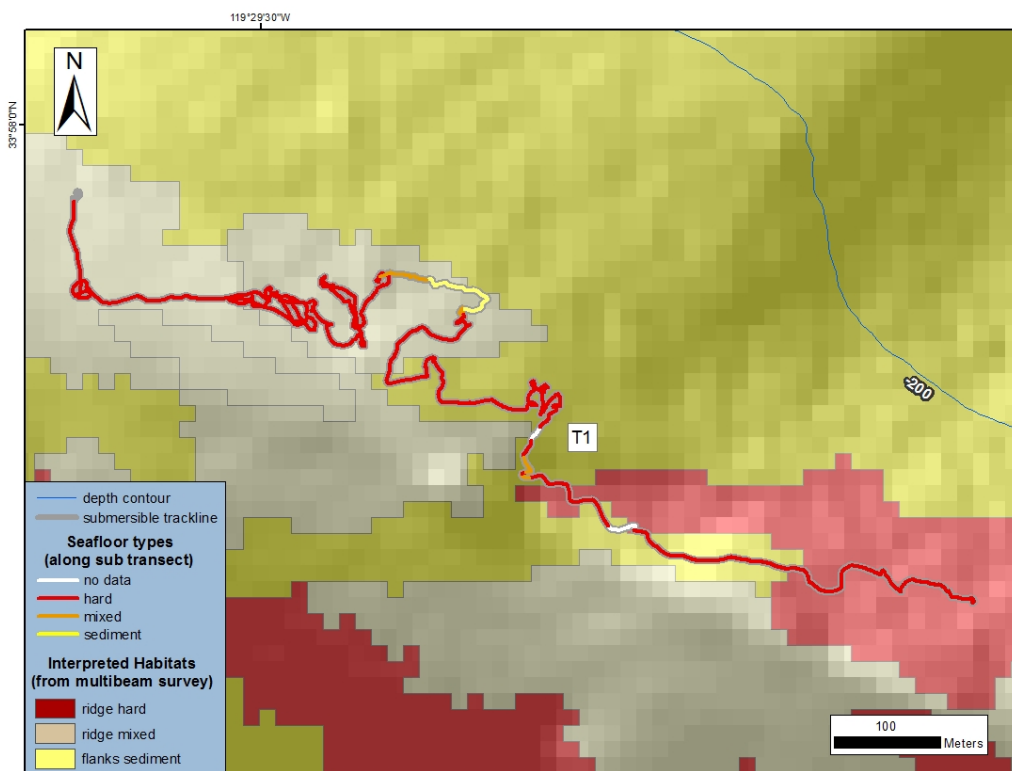


Collecting a gold primnoid (*Acanthogorgia* spp.) at 153 m depth.



ADDITIONAL COMMENTS

One man-made debris items (a green beverage bottle) was observed during Dive 0023. Damage potentially caused by this item was not observed.



STATION OVERVIEW

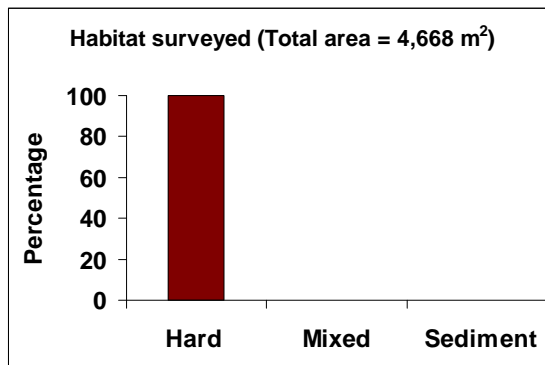
Project	U.S. West Coast Deep Coral Cruise
Chief Scientist	M. Yoklavich
Contact Information	NMFS, SWFSC, mary.yoklavich@noaa.gov
Purpose	Determine fish associations with black corals
Vessel / Vehicle	F/V <i>Velero IV</i> ; <i>Dual DeepWorker</i> submersible
Submersible Pilot	Jeff Heaton
Scientific Observer	Tom Laidig
External Digital Video	HD: 155 min; SD: 1 tape
Positioning System	Ship: GPS; Submersible: USBL
CTD Sensors	Yes
O₂ Sensor	Yes
Specimens collected	No
Other	Logbook, Access database
Report Analyst	T. Laidig
Date Compiled	December 2012

DIVE DATA

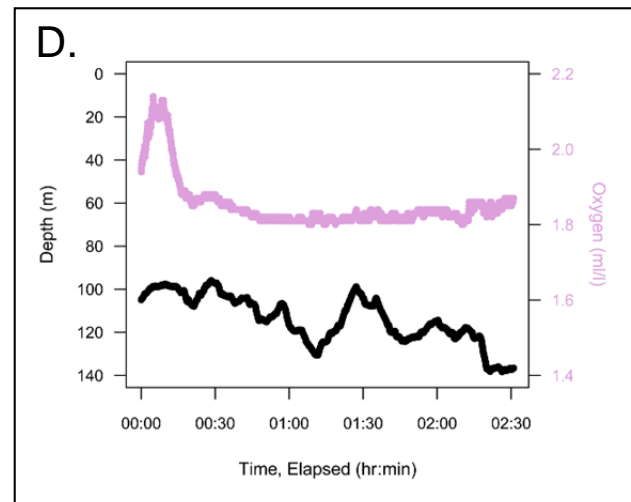
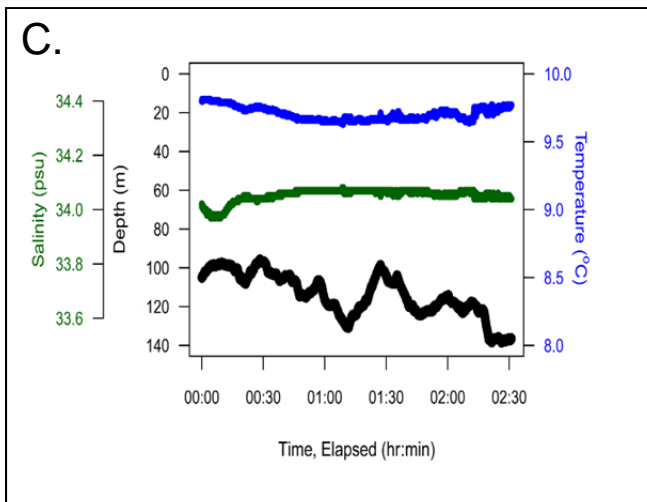
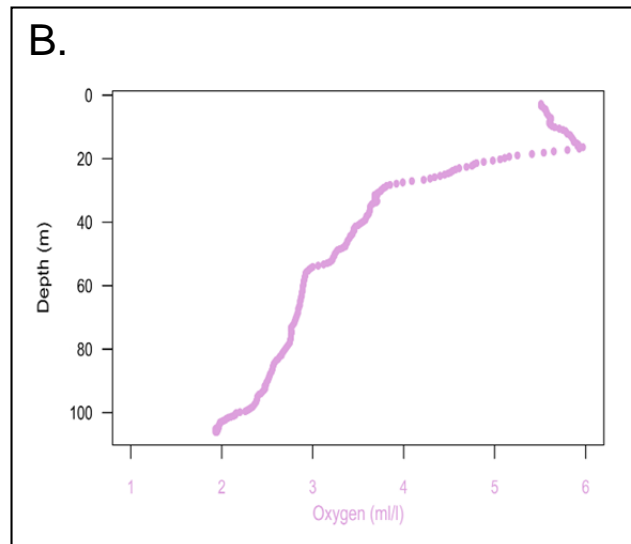
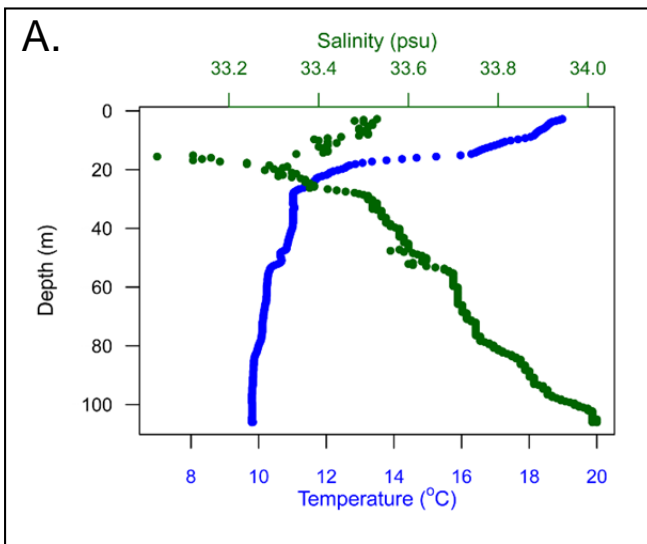
Date	09 Oct 2010	Starting Latitude (N)	33° 57.962'
Minimum Bottom Depth (m)	72	Starting Longitude (W)	119° 29.606'
Maximum Bottom Depth (m)	147	Ending Latitude (N)	33° 57.770'
Start Bottom Time (PDT)	12:47	Ending Longitude (W)	119° 29.054'
End Bottom Time (PDT)	15:18	Surface Current	n/a
Number of Transects	1	Bottom Current	n/a

PHYSICAL ENVIRONMENT

In total, 4,668 m² of sea floor were surveyed in one transect conducted during Dive 0024 on the Footprint study site. Habitat types were classified as Hard (100% of area surveyed), which included large boulders, rock outcrops, and cobbles. No Mixed or Soft Sediment habitat types were surveyed.



Data on depth, conductivity, temperature, and dissolved oxygen were collected during descent (A and B) and at depth along the track line (C and D) on Dive 0024. Temperature ranged from 19.2°C at the sea surface to 9.8°C on the sea floor at 106 m depth. Salinity (as estimated from conductivity, temperature, and pressure) ranged from 33.5 psu at the sea surface to 34.1 psu on the sea floor. Dissolved oxygen ranged from 5.5 ml/l at the surface (6.0 ml/l at the thermocline) to 1.8 ml/l on the sea floor at 106 m.



BIOLOGICAL ENVIRONMENT: CHRISTMAS TREES

A total of 4 Christmas tree black corals, with a density of 0.9 colonies per 1,000 m², occurred on transect during Dive 0024. These colonies varied in size, averaging 3,800 cm² in area (range = 200-12,000 cm²); 1 colony was >1 m in height and width. Colonies were white or red. One colony had dead or dying sections. All but one colony had associated invertebrates (crinoids, crabs, anemones, and sponges). Fishes were associated with only the largest colony.

BIOLOGICAL ENVIRONMENT: FISHES

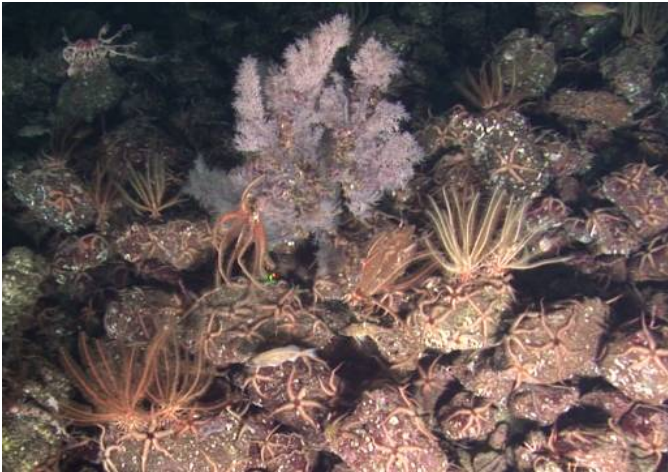
At least 22 taxa of fishes were identified on the top of the Footprint during Dive 0024. A total of 11,229 individual fishes was enumerated, and an overall density of 2,406 fish per 1,000 m² of sea floor was estimated during one continuous transect. At least 13 species of rockfishes (*Sebastes*), dominated by unidentified *Sebastes* and squarespot, shortbelly, and pygmy rockfishes, comprised 99% of fish density. The remainder of the fish assemblage included shortspine combfish, unidentified sanddabs, lingcod, and other taxa.

Scientific name	Common name	Number
Fishes		
<i>Citharichthys</i> spp.	Unidentified sanddabs	15
<i>Sebastes chlorostictus</i>	Greenspotted rockfish	5
<i>Sebastes constellatus</i>	Starry rockfish	22
<i>Sebastes elongatus</i>	Greenstriped rockfish	1
<i>Sebastes entomelas</i>	Widow rockfish	4
<i>Sebastes hopkinsi</i>	Squarespot rockfish	4983
<i>Sebastes jordani</i>	Shortbelly rockfish	1115
<i>Sebastes levis</i>	Cowcod	26
<i>Sebastes miniatus</i>	Vermilion rockfish	6
<i>Sebastes ovalis</i>	Speckled rockfish	37
<i>Sebastes paucispinis</i>	Bocaccio	53
<i>Sebastes rubrivinctus</i>	Flag rockfish	10
<i>Sebastes semicinctus</i>	Halfbanded rockfish	408
<i>Sebastes</i> spp.	Unidentified rockfishes	327
<i>Sebastes</i> spp.	Unidentified <i>Sebastes</i>	2455
<i>Sebastes</i> spp.	Young-of-the-year rockfishes	23
<i>Sebastes wilsoni</i>	Pygmy rockfish	1687
<i>Hydrolagus colliei</i>	Spotted ratfish	1
<i>Ophiodon elongatus</i>	Lingcod	12
<i>Rhinogobiops nicholsii</i>	Blackeye goby	3
<i>Torpedo californica</i>	Pacific electric ray	1
<i>Zaniolepis frenata</i>	Shortspine combfish	35

Two squarespot and one unidentified rockfishes were associated with 1 Christmas tree black coral colony. Fishes were not associated with the other 3 coral colonies.

IMAGE GALLERY

A Christmas tree black coral in a boulder and cobble field at 110 m depth.



A Christmas tree black coral on a boulder at 120 m.



A sponge garden on a rock ridge at 124 m.

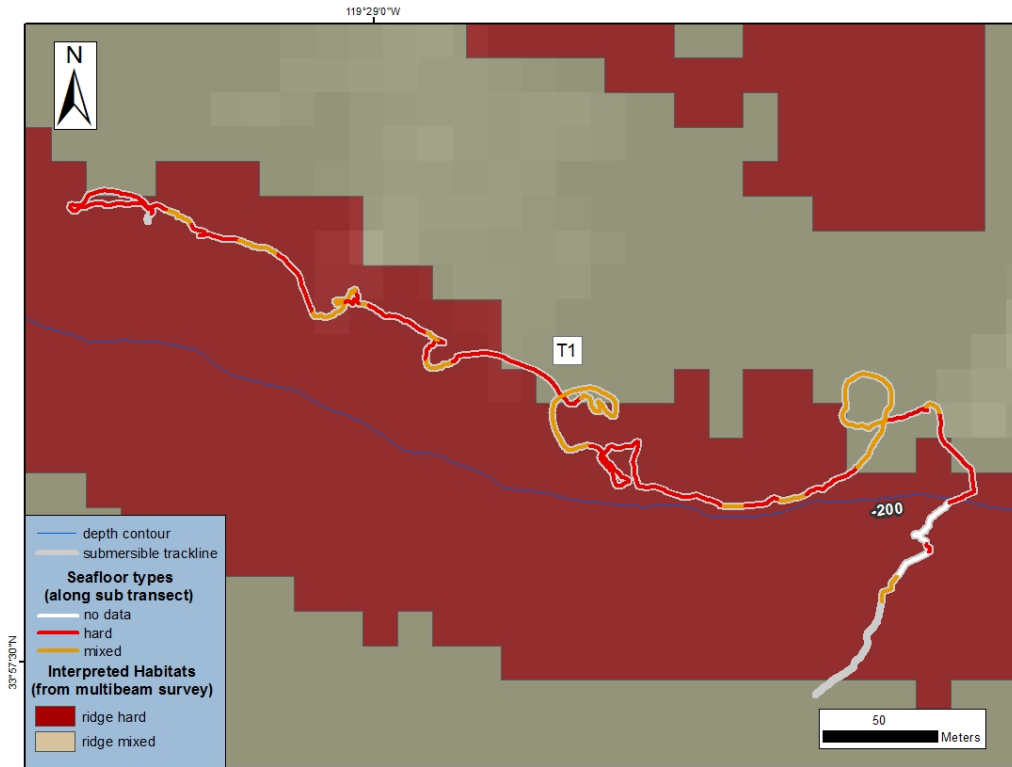


Boulder and cobble habitat at 100 m depth.



ADDITIONAL COMMENTS

Five man-made debris items (two beer cans, a fishing weight, a monofilament fishing line, and an unidentified line) were observed during Dive 0024. Damage potentially caused by these five items was not observed.



STATION OVERVIEW

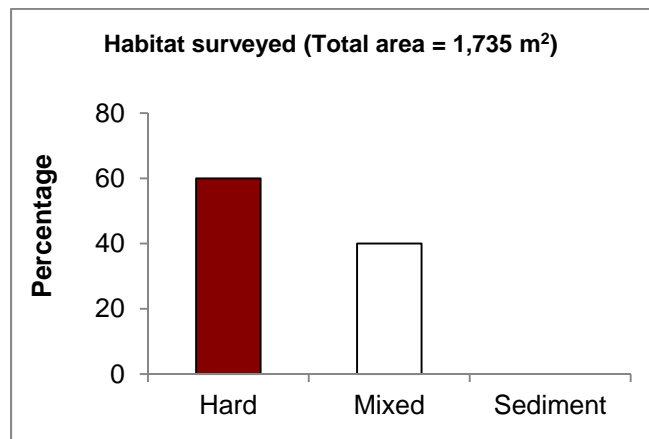
Project	U.S. West Coast Deep Coral Cruise
Chief Scientist	M. Yoklavich
Contact Information	NMFS, SWFSC, mary.yoklavich@noaa.gov
Purpose	Determine fish associations with black corals
Vessel / Vehicle	F/V <i>Velero IV</i> ; <i>Dual DeepWorker</i> submersible
Submersible Pilot	Jeff Heaton
Scientific Observer	Lisa Krigsman
External Digital Video	HD: 71 min; SD: 1 tape
Positioning System	Ship: GPS; Submersible: USBL
CTD Sensors	Yes
O₂ Sensor	Yes
Specimens collected	No
Other	Logbook, Access database
Report Analyst	T. Laidig
Date Compiled	December 2012

DIVE DATA

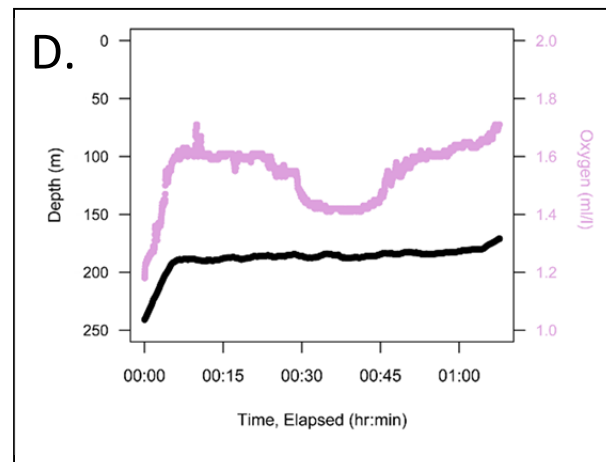
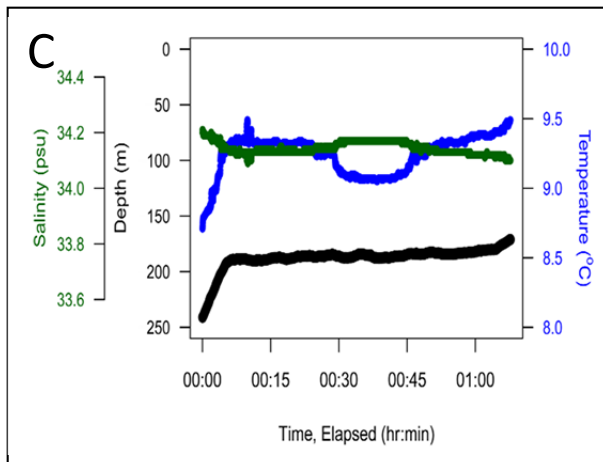
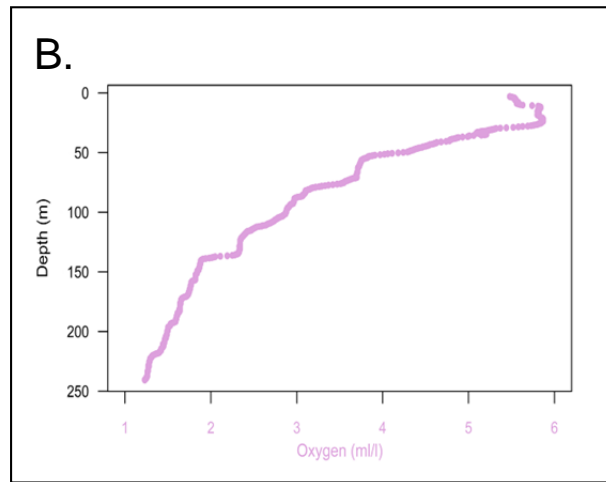
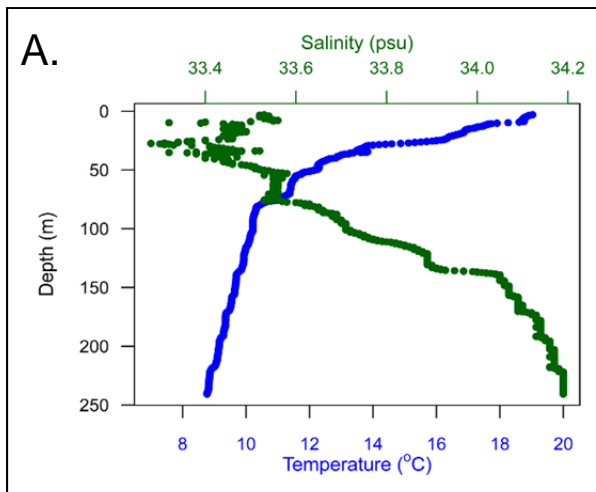
Date	09 Oct 2010	Starting Latitude (N)	33° 57.525'
Minimum Bottom Depth (m)	161	Starting Longitude (W)	119° 28.843'
Maximum Bottom Depth (m)	271	Ending Latitude (N)	33° 57.606'
Start Bottom Time (PDT)	19:09	Ending Longitude (W)	119° 29.056'
End Bottom Time (PDT)	20:16	Surface Current	n/a
Number of Transects	1	Bottom Current	n/a

PHYSICAL ENVIRONMENT

In total, 1,735 m² of sea floor were surveyed during one transect conducted on Dive 0025 on the Footprint. Habitat types were classified as (1) Hard (60% of the total area surveyed), which included large boulders, rock outcrops, and cobbles; (2) Mixed (40% of the total area surveyed), including a combination of mud with boulders, rock, or cobbles. No Soft Sediment habitat was observed.



Data on depth, conductivity, temperature, and dissolved oxygen were collected during descent (A and B) and at depth along the track line (C and D) on Dive 0025. Temperature ranged from 19.0°C at the sea surface to 8.8°C on the sea floor at 241 m depth. Salinity (as estimated from conductivity, temperature, and pressure) ranged from 33.6 at the sea surface to 34.2 psu on the sea floor. Dissolved oxygen ranged from 5.5 ml/l at the sea surface (5.9 ml/l at the thermocline) to 1.2 ml/l on the sea floor at 241 m.



BIOLOGICAL ENVIRONMENT: CHRISTMAS TREES

A total of 26 Christmas tree black corals, with a density of 15 colonies per 1,000 m², occurred on transect during Dive 0025. Colonies were small, averaging 209 cm² in area (range = 25-450 cm²); there were no colonies >1 m in height. Colonies were white, gray, or red. All colonies were healthy and upright. All colonies had associated invertebrates (crinoids, crabs, and brittle stars); no fishes were associated with these corals.

BIOLOGICAL ENVIRONMENT: FISHES

At least 13 taxa of fishes were identified on the top of the Footprint during Dive 0025. A total of 167 individual fishes was enumerated, and an overall density of 96 fishes per 1,000 m² of sea floor was estimated during one continuous transect. At least 6 species of rockfishes (*Sebastes*), dominated by unidentified *Sebastomus* and bank rockfish, comprised 95% of the density. The remainder of the fish assemblage comprised Dover sole, spotted ratfish, and other taxa.

Scientific name	Common name	Number
Fishes		
<i>Microstomus pacificus</i>	Dover sole	2
<i>Sebastes elongatus</i>	Greenstriped rockfish	1
<i>Sebastes helvomaculatus</i>	Rosethorn rockfish	1
<i>Sebastes levis</i>	Cowcod	3
<i>Sebastes paucispinis</i>	Bocaccio	3
<i>Sebastes rubrivinctus</i>	Flag rockfish	1
<i>Sebastes rufus</i>	Bank rockfish	10
<i>Sebastes</i> spp.	Unidentified rockfishes	4
<i>Sebastes</i> spp.	Unidentified <i>Sebastomus</i>	136
<i>Hydrolagus colliei</i>	Spotted ratfish	3
<i>Icelinus</i> spp.	Icelinid sculpin	1
<i>Ophiodon elongatus</i>	Lingcod	1
<i>Zaniolepis frenata</i>	Shortspine combfish	1

No fishes were associated with the Christmas tree black corals on this dive.

IMAGE GALLERY

A Christmas tree black coral and a gold primnoid (*Acanthogorgia* spp.) on a rock ridge at 186 m depth.



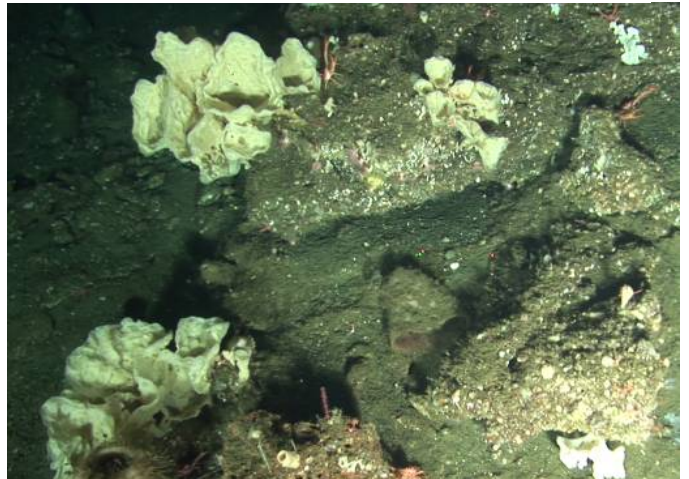
A cowcod (*Sebastes levis*) and many sponges at 177 m depth.



A vase sponge (*Sigmatocia* spp.) on a rock ridge at 187 m depth.

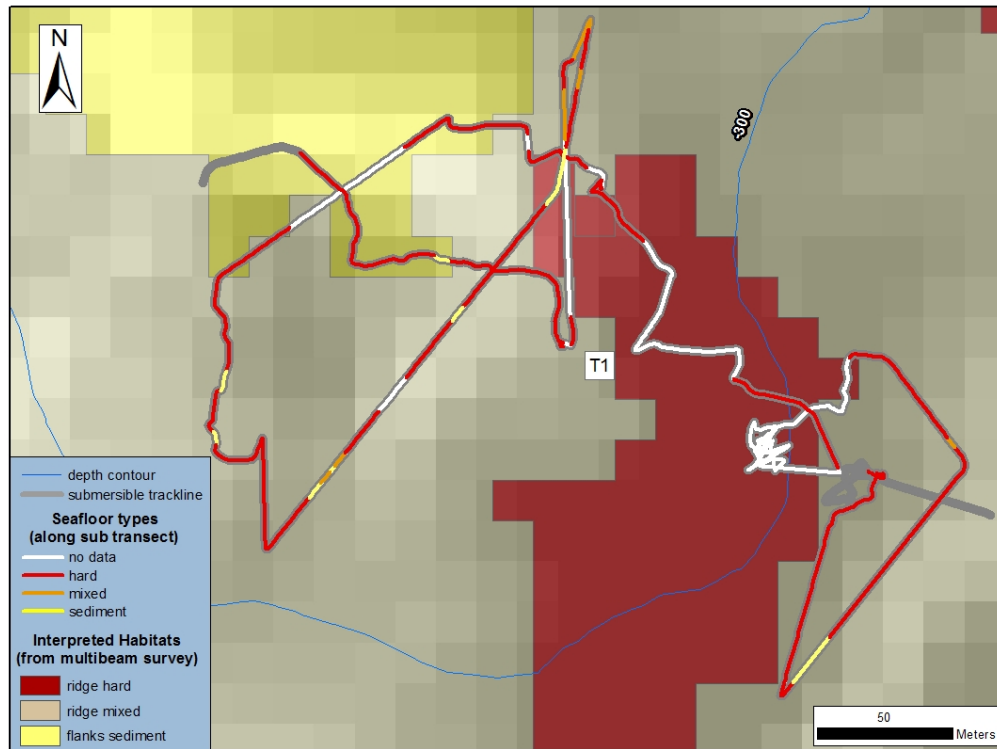


Two foliose sponges on rock and boulder habitat at 193 m depth.



ADDITIONAL COMMENTS

Eight man-made debris items (six monofilament fishing lines, a brown beverage bottle, and a hand fishing net) were observed during Dive 0025. Damage potentially caused by these eight items was not observed.



STATION OVERVIEW

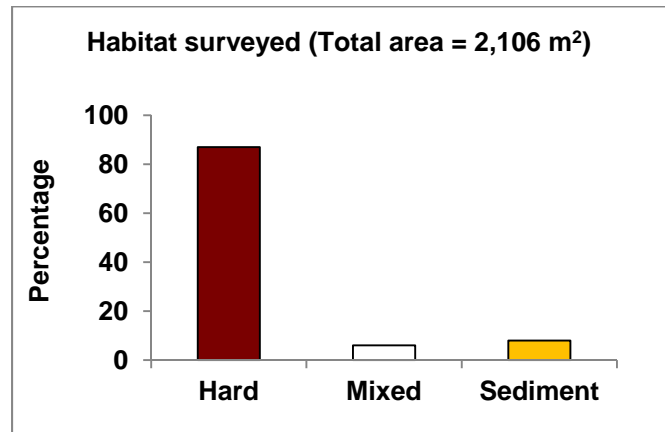
Project	U.S. West Coast Deep Coral Cruise
Chief Scientist	M. Yoklavich
Contact Information	NMFS, SWFSC, mary.yoklavich@noaa.gov
Purpose	Determine fish associations with black corals
Vessel / Vehicle	F/V <i>Velero IV</i> ; <i>Dual DeepWorker</i> submersible
Submersible Pilot	Doup Bishop
Scientific Observer	Mary Yoklavich
External Digital Video	HD: 72 min; SD: 1 tape
Positioning System	Ship: GPS; Submersible: USBL
CTD Sensors	Yes
O₂ Sensor	Yes
Specimens collected	Yes
Other	Logbook, Access database
Report Analyst	T. Laidig
Date Compiled	December 2012

DIVE DATA

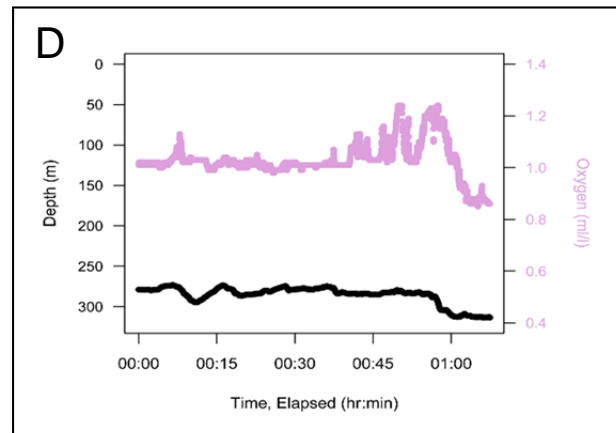
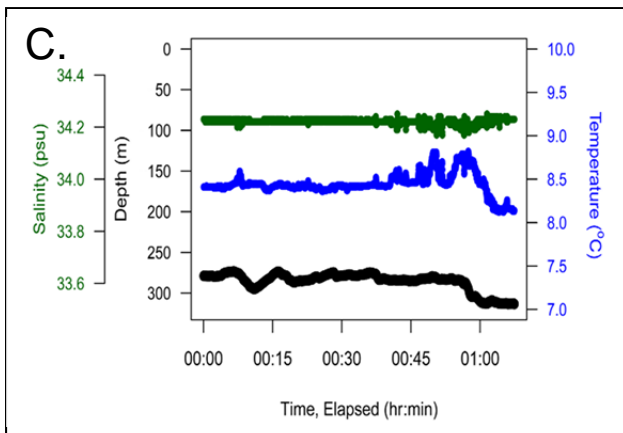
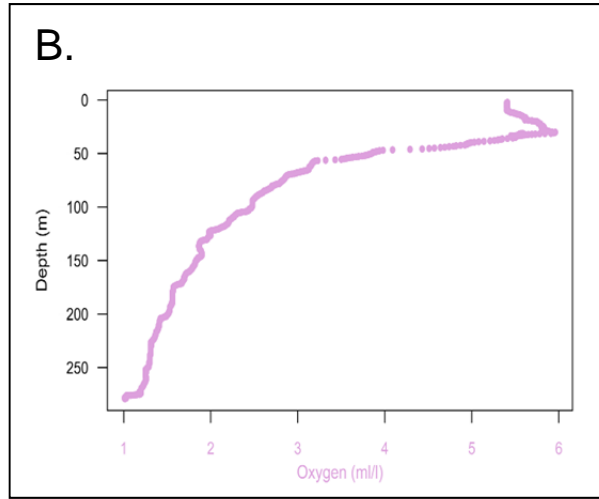
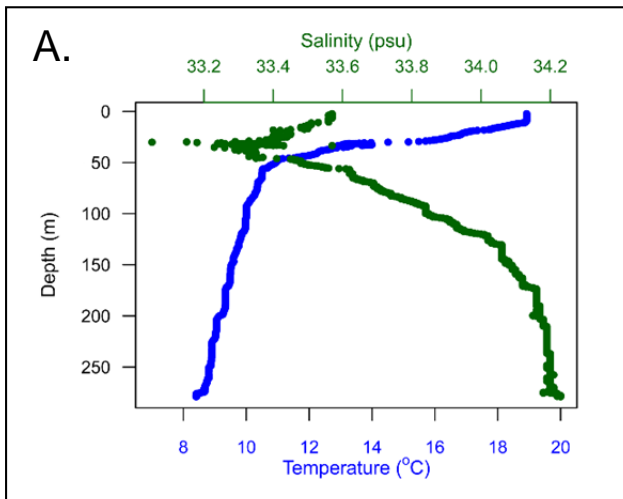
Date	10 Oct 2010	Starting Latitude (N)	33° 55.182'
Minimum Bottom Depth (m)	263	Starting Longitude (W)	119° 28.440'
Maximum Bottom Depth (m)	308	Ending Latitude (N)	33° 55.128'
Start Bottom Time (PDT)	08:27	Ending Longitude (W)	119° 28.279'
End Bottom Time (PDT)	09:34	Surface Current	n/a
Number of Transects	1	Bottom Current	n/a

PHYSICAL ENVIRONMENT

A total 2,106 m² of sea floor was surveyed in one continuous transect conducted during Dive 0026 on the Piggy Bank. Habitat types were classified as (1) Hard (87% of the total area surveyed), which included large boulders, rock outcrops, and cobbles; (2) Mixed (6% of the total area surveyed), including a combination of mud with boulders, rock, or cobbles; (3) Soft Sediment (7% of the total area surveyed) comprised entirely of mud



Data on depth, conductivity, temperature, and dissolved oxygen were collected during descent (A and B) and at depth along the track line (C and D) on Dive 0026. Temperature ranged from 19.1°C at the sea surface to 8.4°C on the sea floor at 279 m depth. Salinity (as estimated from conductivity, temperature, and pressure) ranged from 33.6 psu at the sea surface to 34.3 psu on the sea floor. Dissolved oxygen ranged from 5.4 ml/l at the sea surface (6.0 ml/l at the thermocline) to 0.9 ml/l on the sea floor at 279 m.



DIVE NUMBER: DDW 0026

STUDY AREA: Piggy Bank

BIOLOGICAL ENVIRONMENT: CHRISTMAS TREES

A total of 6 Christmas tree black corals, with a density of 2.8 colonies per 1,000 m², occurred on transect during Dive 0026. Colonies generally were large, averaging 1,900 cm² in area (range = 750-4,500 cm²); 1 colony was >1 m in width. Colonies were white, gray, or red, and all were upright. No colony had any sign of dead or dying sections. All colonies had associated invertebrates (mostly crinoids, crabs, and brittle stars); only one colony was associated with a fish.

Three coral specimens were collected during Dive 0026; Stephen Cairns (National Museum of Natural History, Smithsonian Institution, Washington DC) identified the pale pink primnoid (*Plumarella longispina*) and the bubblegum coral (*Paragorgia arborea*), and Sandra Brooke received specimens of *Lophelia pertusa* for genetic and reproductive studies.

BIOLOGICAL ENVIRONMENT: FISHES

At least 14 taxa of fishes were identified on the top of the Piggy Bank during Dive 0026. A total of 431 individual fishes was enumerated, and an overall density of 205 fishes per 1,000 m² of sea floor was estimated from one continuous transect. At least 7 species of rockfishes (*Sebastes*), dominated by unidentified *Sebastomus*, and bank and shortbelly rockfishes, comprised 96% of the density. The remainder of the fish assemblage included unidentified cat shark egg cases, flatfishes, poachers, spotted ratfish, and bluebarred pricklebacks.

	Scientific name	Common name	Number
Fishes			
	Agonidae	Unidentified poachers	6
	<i>Microstomus pacificus</i>	Dover sole	2
	Pleuronectiformes	Unidentified flatfish	1
	<i>Sebastes aurora</i>	Aurora rockfish	1
	<i>Sebastes constellatus</i>	Starry rockfish	1
	<i>Sebastes diploproa</i>	Splitnose rockfish	2
	<i>Sebastes helvomaculatus</i>	Rosethorn rockfish	1
	<i>Sebastes jordani</i>	Shortbelly rockfish	38
	<i>Sebastes rufus</i>	Bank rockfish	285
	<i>Sebastes</i> spp.	Unidentified rockfish	1
	<i>Sebastes</i> spp.	Unidentified <i>Sebastomus</i>	85
	<i>Hydrolagus colliei</i>	Spotted ratfish	1
	<i>Plectobranchnus evides</i>	Bluebarred prickleback	1
	Scyliorhinidae	Unidentified cat shark egg cases	6

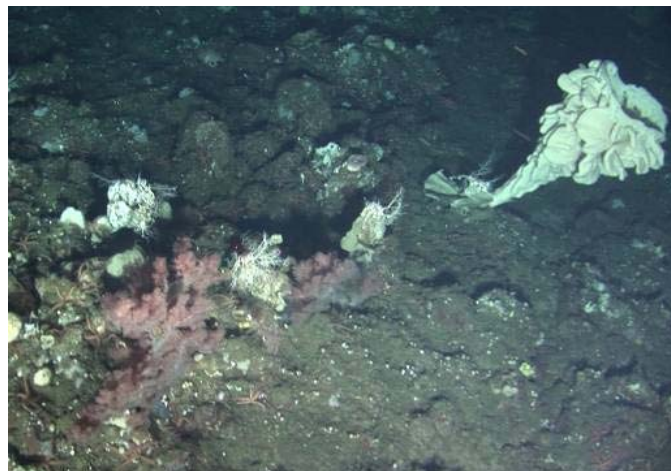
One unidentified *Sebastomus* rockfish was associated with one Christmas tree black coral observed on this dive. The remaining 5 coral colonies were not associated with fishes.

IMAGE GALLERY

A bubblegum coral (*Paragorgia arborea*) on rock ridge at 283 m depth.



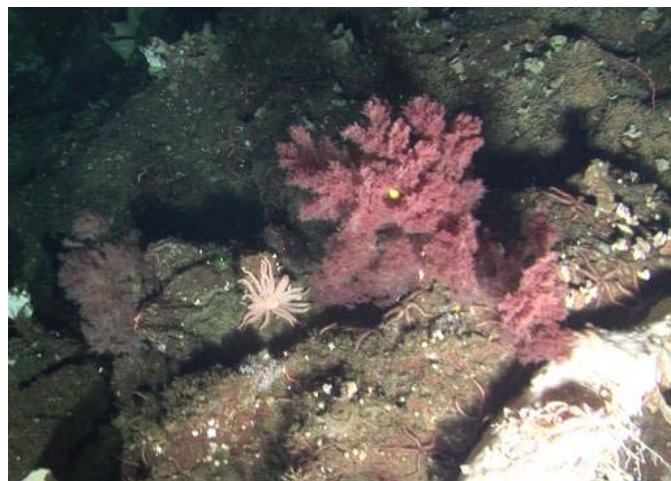
A Christmas tree black coral and a fingered goblet vase sponge (*Heterochone calyx*) on rock ridge at 289 m depth.



Two vase sponges on cobble and boulder habitat at 303 m depth.

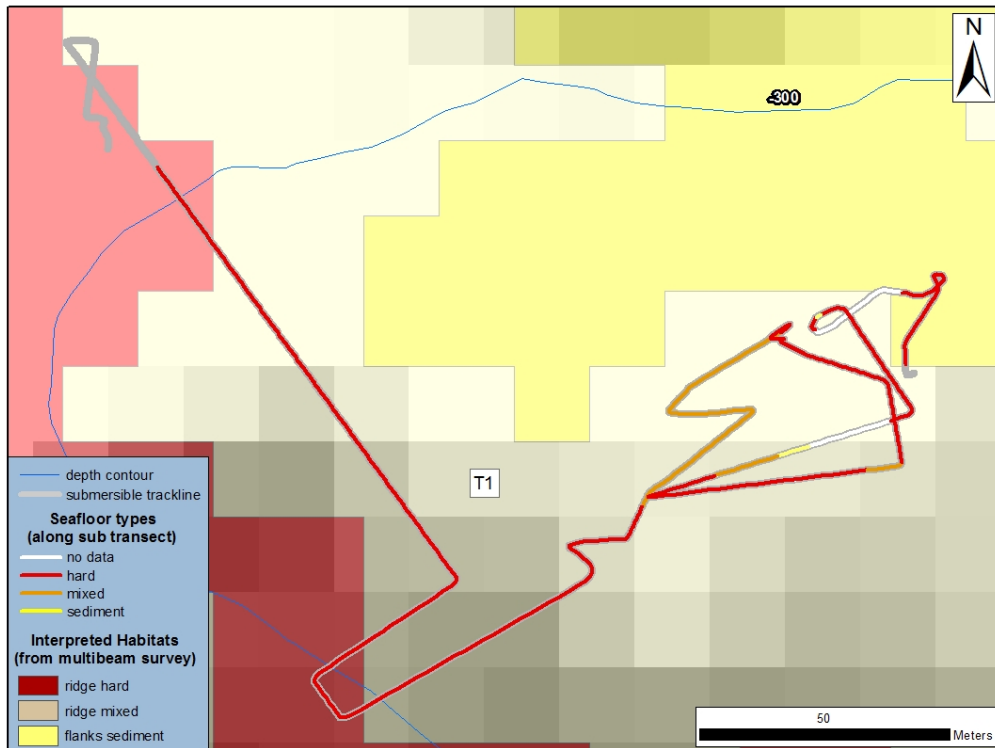


Two Christmas tree black corals on rocky ridge at 285 m depth.



ADDITIONAL COMMENTS

No man-made debris items were observed during Dive 0026.



STATION OVERVIEW

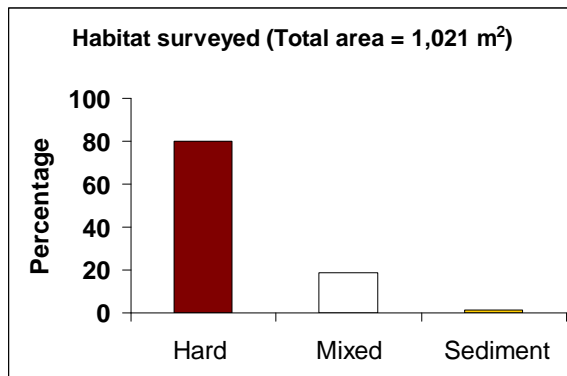
Project	U.S. West Coast Deep Coral Cruise
Chief Scientist	M. Yoklavich
Contact Information	NMFS, SWFSC, mary.yoklavich@noaa.gov
Purpose	Determine fish associations with black corals
Vessel / Vehicle	F/V <i>Velero IV</i> ; <i>Dual DeepWorker</i> submersible
Submersible Pilot	Doug Bishop
Scientific Observer	Mary Nishimoto
External Digital Video	HD: 33 min; SD: 1 tape
Positioning System	Ship: GPS; Submersible: USBL
CTD Sensors	Yes
O₂ Sensor	Yes
Specimens collected	No
Other	Logbook, Access database
Report Analyst	T. Laidig
Date Compiled	December 2012

DIVE DATA

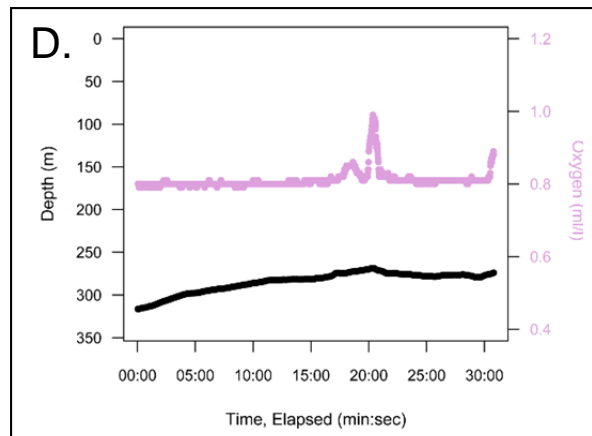
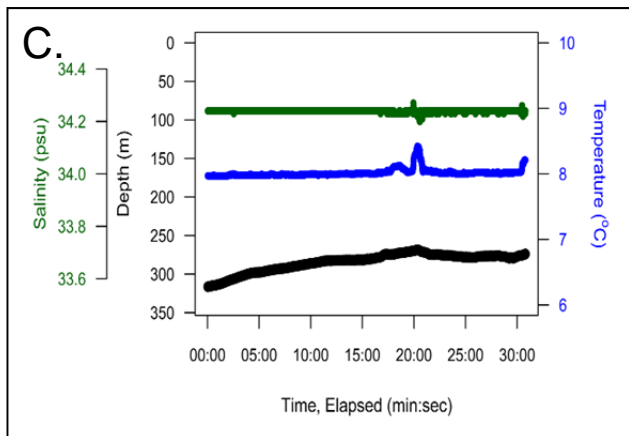
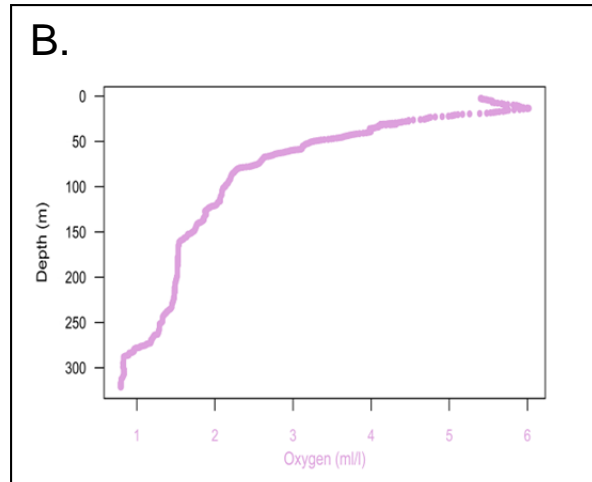
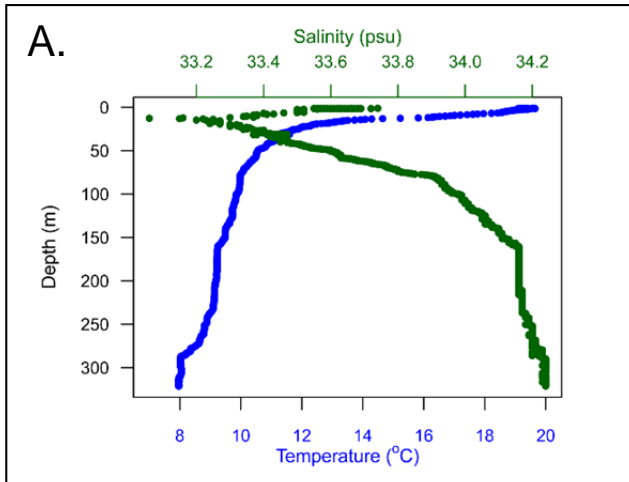
Date	10 Oct 2010	Starting Latitude (N)	33° 55.330'
Minimum Bottom Depth (m)	258	Starting Longitude (W)	119° 29.417'
Maximum Bottom Depth (m)	322	Ending Latitude (N)	33° 55.307'
Start Bottom Time (PDT)	13:01	Ending Longitude (W)	119° 29.317'
End Bottom Time (PDT)	13:31	Surface Current	n/a
Number of Transects	1	Bottom Current	n/a

PHYSICAL ENVIRONMENT

In total, 1,021 m² of sea floor were surveyed on one continuous transect on the Piggy Bank during Dive 0027. Habitat types were classified as (1) Hard (80% of the total area surveyed), which included large boulders, rock outcrops, and cobbles; (2) Mixed (18% of the total area surveyed), including a combination of mud with boulders, rock, or cobbles; (3) Soft Sediment (2% of the total area surveyed) comprising mud.



Data on depth, conductivity, temperature, and dissolved oxygen were conducted during descent (A and B) and at depth along the track line (C and D) on Dive 0027. Temperature ranged from 19.7°C at the sea surface to 8.0°C on the sea floor at 321 m depth. Salinity (as estimated from conductivity, temperature, and pressure) ranged from 33.7 psu at the sea surface to 34.3 psu on the sea floor. Dissolved oxygen ranged from 5.4 ml/l at the sea surface (6.0 ml/l at the thermocline) to 0.8 on the sea floor at 321 m.



BIOLOGICAL ENVIRONMENT: CHRISTMAS TREES

A total of 12 Christmas tree black corals, with a density of 11.8 colonies per 1,000 m², occurred on transect during Dive 0027. The colonies were small to medium, averaging 542 cm² in area (range = 25-1,650 cm²). Colonies were white, gray, pink, or red, and all were upright. One colony had a dead or dying section, but none appeared mostly dead. All colonies had associated invertebrates (crinoids, crabs, and brittle stars), but only 1 colony was associated with a fish taxon.

BIOLOGICAL ENVIRONMENT: FISHES

At least 10 taxa of fishes were identified on the top of Piggy Bank during Dive 0027. A total of 131 individual fishes was enumerated, and an overall density of 127 fish per 1,000 m² of sea floor was estimated during one continuous transect. At least 3 species of rockfishes (*Sebastes*), dominated by unidentified *Sebastomus* and bank, comprised 90% of fish density. The remainder of the fish assemblage included Dover sole, poachers, hagfish, thornyheads, Icelinid sculpins, and unidentified cat shark egg cases.

	Scientific name	Common name	Number
Fishes			
	<i>Eptatretus</i> spp.	Unidentified hagfish	1
	Agonidae	Unidentified poacher	1
	<i>Microstomus pacificus</i>	Dover sole	6
	<i>Sebastes diploproa</i>	Splitnose rockfish	9
	<i>Sebastes rufus</i>	Bank rockfish	58
	<i>Sebastes simulator</i>	Pinkrose rockfish	1
	<i>Sebastes</i> spp.	Unidentified <i>Sebastomus</i>	50
	<i>Sebastolobus</i> spp.	Unidentified thornyhead	1
	<i>Icelinus</i> spp.	Icelinid sculpins	2
	Scyliorhinidae	Unidentified cat shark egg cases	2

One unidentified cat shark egg case was hanging in one coral colony. Fishes were not associated with the remaining 11 colonies.

IMAGE GALLERY

A multi-armed seastar (*Rathbunaster californicus*) and a Sebastomus rockfish (*Sebastes* spp.) on a boulder and cobble habitat at 300 m depth.



A Christmas tree black coral and basketstars (*Gorgonocephalus eucnemis*) on a boulder and cobble habitat at 294 m depth.



A Christmas tree black coral and basketstar (*Gorgonocephalus eucnemis*) on boulder and cobble habitat at 290 m depth.



A bubblegum coral (*Paragorgia arborea*) and a rosethorn rockfish (*Sebastes helvomagulatus*) in a field of *Lophelia pertusa* at 262 m depth.



ADDITIONAL COMMENTS

Five man-made debris items (monofilament fishing lines) were observed during Dive 0027. Damage potentially caused by these five items was not observed.

OVERALL SUMMARY:

We identified at least 20 taxa of corals, 17 taxa of sponges, and 56 taxa of fishes from the quantitative transects on 11 dives (dive 0019 was aborted) conducted on Hidden Reef (21 15-min transects), Footprint (5 longer transects), and Piggy Bank (2 longer transects). We collected 8 specimens, including 4 corals and 2 sponges, which have been identified by various experts.

A total of 1,543 corals, 3,300 sponges, and 18,357 fishes were enumerated during this study. Densities ranged from 3 to 148 corals/1,000 m², 129 to 343 sponges/1,000 m², and 79 to 2,406 fishes/1,000 m². Densest corals were Christmas tree black coral, the primnoid *Plumarella longispina*, and *Lophelia pertusa*. Highest densities of sponges were vase, barrel, branching, and upright flat groups. The highest densities of fishes were unidentified *Sebastomus*, squarespot, pygmy, and shortbelly rockfishes.

We classified 27,166 m² of sea floor substrata. The original two-character-code substratum types were aggregated into three general categories for this analysis: the 'Hard' category included rock ridge, boulder, cobble, and flat rock in various proportions and comprised 75% of the survey; 'Mixed' category included varying amounts of mud with rock ridge, boulder, cobble, or flat rock and comprised 20% of the survey; and 'Soft Sediment' was represented entirely by mud and comprised 5% of the survey.



A rock ridge (classified as Hard substratum).



Boulders and cobbles (classified as Hard substratum).



Mud and cobble (classified as Mixed substratum).



A mud sea floor (classified as Soft Sediment).

Coral and sponge taxa observed from video surveys conducted with a submersible on the three banks in southern California, 5 – 10 October 2010.

Scientific Name	Common Name	Taxon	Scientific Name	Common Name	Taxon
<i>Acanthogorgia</i> spp.	Gold coral	Coral	Porifera #3	Unidentified barrel sponges	Sponge
<i>Paragorgia</i> spp.	Sea fan (white with red polyps)	Coral	<i>Heterochone calyx</i>	Fingered goblet vase sponge	Sponge
<i>Paragorgia arborea</i>	Bubblegum coral	Coral	Porifera #5	Unidentified vase sponges	Sponge
<i>Paragorgia stephencairnsi</i>	Primnoid	Coral	<i>Sigmatocia</i> spp.	Tan vase/trumpet sponge	Sponge
<i>Parastenella ramosa</i>	Primnoid	Coral	<i>Staurocalyptus</i> spp.	Picasso sponge	Sponge
<i>Plumarella longispina</i>	Primnoid	Coral	Porifera #4	Unidentified shelf sponges	Sponge
Plexauridae #1	Sea fan (red w/ white polyps)	Coral	Porifera #2	Unidentified upright flat sponges	Sponge
Plexauridae #2	Sea fan (red w/ yellow polyps)	Coral	<i>Farrea occa</i>	Lace (or cloud) foliose sponge	Sponge
Plexauridae #3	Sea fan (red w/ unknown polyps)	Coral	Porifera #1	Unidentified foliose sponges	Sponge
<i>Swiftia</i> sp.	Red sea fan	Coral	Porifera #8	Unidentified tube sponges	Sponge
<i>Antipathes dendrochristos</i>	Christmas tree black coral	Coral	Porifera #6	Unidentified mound sponges	Sponge
<i>Desmophyllum dianthus</i>	Cockscomb cup coral	Coral	Porifera #9	Unidentified puffball mound sponges	Sponge
<i>Lophelia pertusa</i>	White cup coral	Coral	Porifera #7	Unidentified branching sponges	Sponge
Scleractinia	Unidentified cup corals	Coral	<i>Rhizaxinella gadus</i>	Club sponge	Sponge
<i>Anthomastus ritteri</i>	Mushroom coral	Coral	<i>Asbestopluma</i> spp. #1	Predatory pipecleaner sponge	Sponge
Zoantharia	Unidentified zoanthid corals	Coral	Porifera #12	Unidentified sponges	Sponge
<i>Anthoptilum grandiflorum</i>	Feather boa sea pen	Coral	<i>Thenea muricata</i>	Foliose sponge (clear)	Sponge
Pennatulacea #1	Sea pen (thin)	Coral			
<i>Clavularia</i> spp.	Soft coral	Coral			
Hexacorallia/Octocorallia	Unidentified corals	Coral			

Fish taxa observed from video surveys conducted with a submersible on the three banks in southern California, 5 – 10 October 2010.

Scientific name

Eptatretus spp.
Lycodes cortezianus
 Agonidae
Citharichthys spp.
Eopsetta jordani
Glyptocephalus zachirus
Microstomus pacificus
Parophrys vetulus
 Pleuronectiformes
Sebastes aurora
Sebastes chlorostictus
Sebastes constellatus
Sebastes crameri
Sebastes diploproa
Sebastes elongatus
Sebastes ensifer
Sebastes entomelas
Sebastes gillii
Sebastes goodei
Sebastes helvomaculatus
Sebastes hopkinsi
Sebastes jordani
Sebastes levis
Sebastes melanostomus
Sebastes miniatus
Sebastes ovalis
Sebastes paucispinis
Sebastes rosenblatti

Common name

Unidentified hagfishes
 Bigfin eelpout
 Unidentified poachers
 Unidentified sanddabs
 Petrale sole
 Rex sole
 Dover sole
 English sole
 Unidentified flatfishes
 Aurora rockfish
 Greenspotted rockfish
 Starry rockfish
 Darkblotched rockfish
 Splitnose rockfish
 Greenstriped rockfish
 Swordspine rockfish
 Widow rockfish
 Bronzespotted rockfish
 Chilipepper
 Rosethorn rockfish
 Squarespot rockfish
 Shortbelly rockfish
 Cowcod
 Blackgill rockfish
 Vermilion rockfish
 Speckled rockfish
 Bocaccio
 Greenblotched rockfish

Scientific name

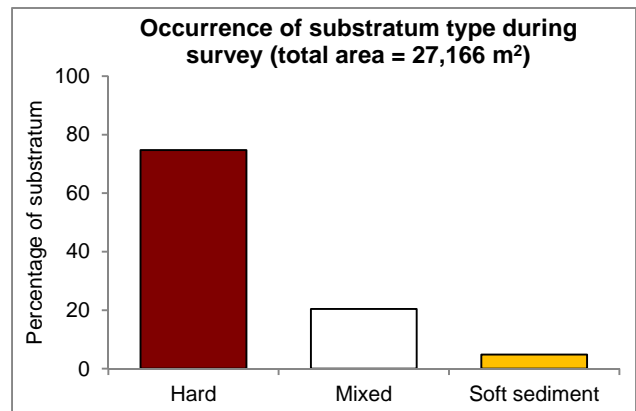
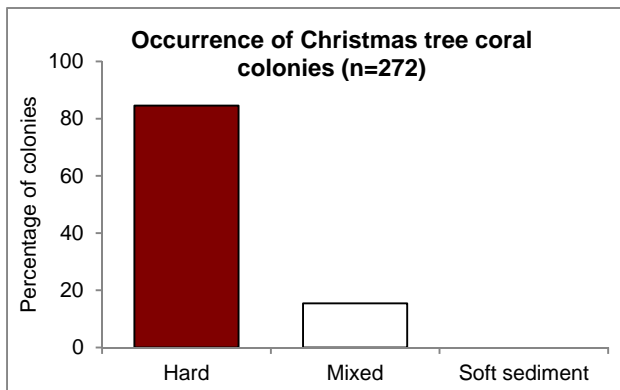
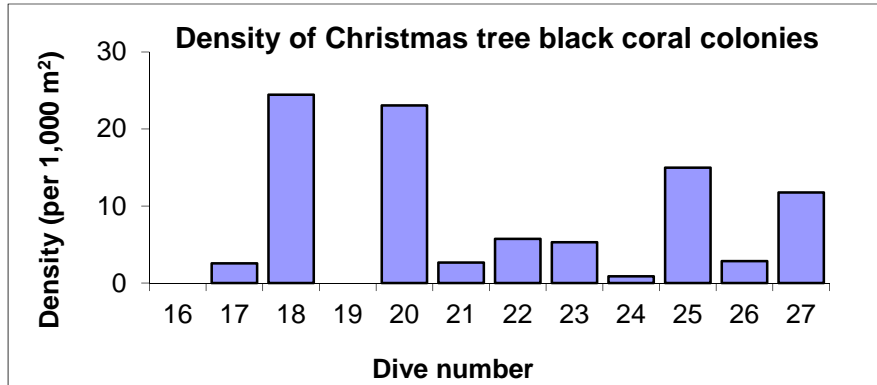
Sebastes rubrivinctus
Sebastes rufinanus
Sebastes rufus
Sebastes semicinctus
Sebastes simulator
Sebastes spp.
Sebastes spp.
Sebastes spp.
Sebastes wilsoni
Sebastes zacentrus
Sebastolobus alascanus
Sebastolobus spp.
Chilara taylori
 Cottidae
Hydrolagus colliei
Icelinus spp.
Merluccius productus
 Myctophidae
Ophiodon elongatus
 Osteichthyes
Plectobranchnus evides
Raja rhina
 Rajidae
 Rajidae
Rhinogobiops nicholsii
 Scyliorhinidae
Torpedo californica
Zaniolepis frenata

Common name

Flag rockfish
 Dwarf-red rockfish
 Bank rockfish
 Halfbanded rockfish
 Pinkrose rockfish
 Unidentified rockfishes
 Unidentified Sebastomus
 Young-of-the-year rockfishes
 Pygmy rockfish
 Sharpchin rockfish
 Shortspine thornyhead
 Unidentified thornyheads
 Spotted cusk-eel
 Unidentified sculpins
 Spotted ratfish
 Icelinid sculpins
 Pacific hake
 Unidentified lanternfishes
 Lingcod
 Unidentified fishes
 Bluebarred prickleback
 Longnose skate
 Unidentified skate egg cases
 Unidentified skates
 Blackeye goby
 Unidentified cat shark egg cases
 Pacific electric ray
 Shortspine combfish

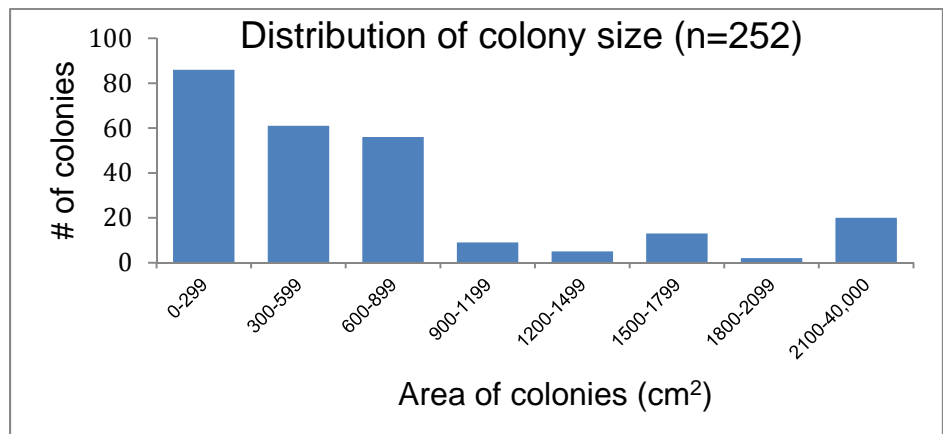
SUMMARY: DENSITY, SIZE, AND CONDITION OF CHRISTMAS TREE BLACK CORALS

A total of 272 Christmas tree black corals were observed on surveys conducted with the *Dual DeepWorker* manned submersible during October 2010. We estimated an overall density of 10 coral colonies per 1,000 m² of sea floor (densities ranged from 0 to 24.4 colonies per 1,000 m² on Dive 0016 and Dive 0018, respectively. Dive 0019 was aborted, and no surveys were conducted.

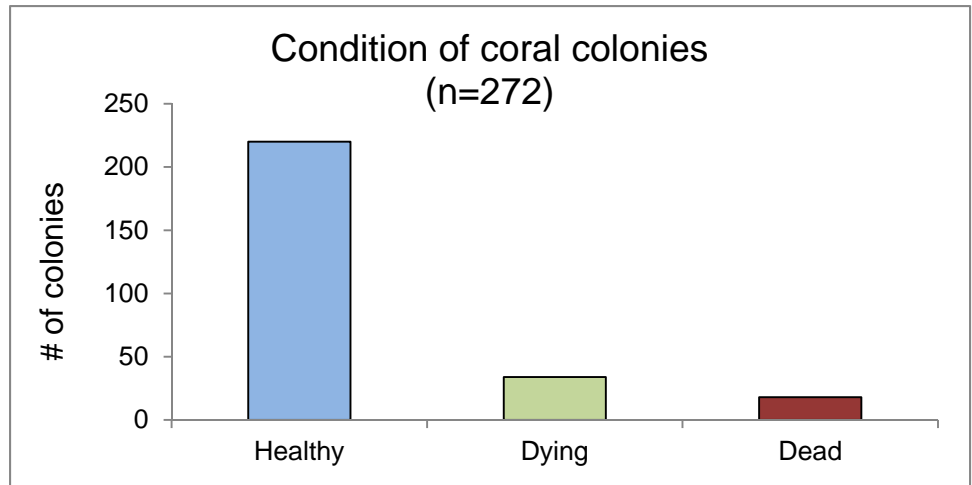


Christmas tree black corals occurred only on Hard (85% of colonies on rocks, boulders, and cobbles) and Mixed (15% of colonies on mud with rock, boulders, or cobbles) substrata. Frequency of occurrence of the colonies in these substratum types was similar to the proportions of sea floor substratum types in our survey (75% classified as Hard, 15% Mixed, 5% Soft Sediment). We estimated 11.3 colonies/1,000 m² on hard and 7.6 colonies/1000 m² on mixed substrata.

Size was estimated for 252 Christmas tree black corals. Area of the colonies varied from 25 to 40,000 cm²; height ranged from 5 to 200 cm. Almost 75% of the colonies were <900 cm² in area; large corals (>2,100 cm²) comprised 13% of all colonies.



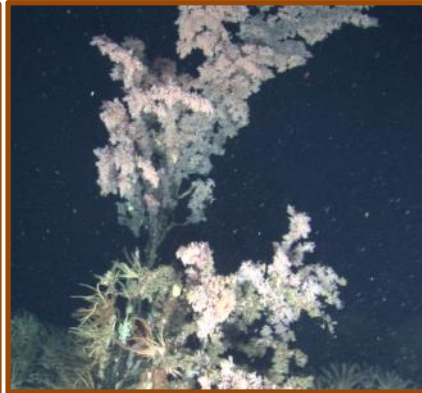
Christmas tree black corals generally were healthy, with little or no obvious damage. Only 19% of the colonies were dying or entirely dead. One broken and dead colony (base and stem about 0.5 m in height) was assumed to be the remains of a large colony (0.7 m in height; 1.4 m in width) surveyed several years earlier at the same location.



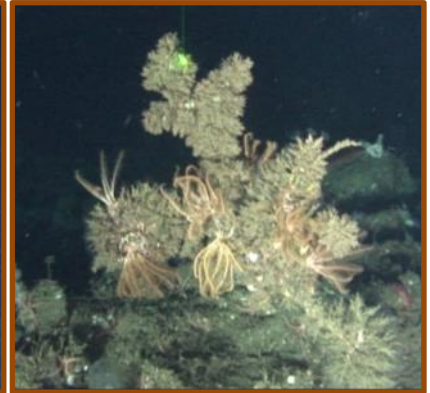
During this survey, we noted a greater number of invertebrates (e.g., crinoids, sponges, tunicates, zoanths, bivalves, brittle stars) on dead Christmas tree corals than on healthy colonies (see also Yoklavich et al. 2011). We surmise that healthy corals protect themselves from such colonization.



Healthy Christmas tree coral colony, with crinoids on surrounding rock.

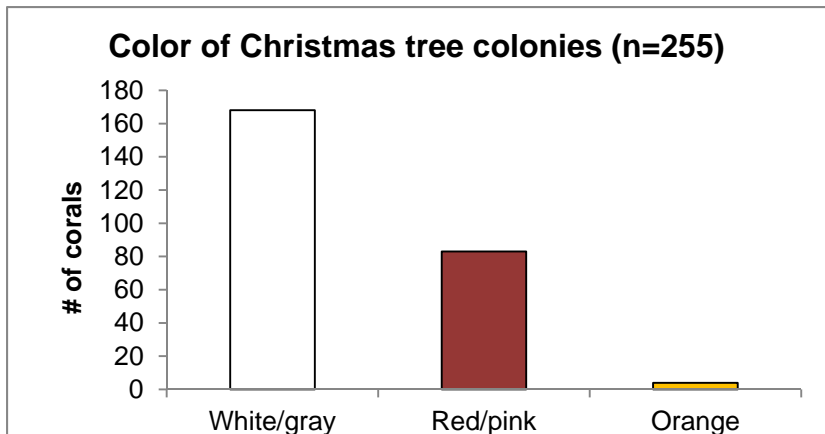


Dying Christmas tree coral, with crinoids on dead sections of colony.



Dead Christmas tree coral covered in crinoids and zoanths.

Healthy Christmas tree black coral colonies were either white or gray (66%), red or pink (32%), or orange (2%). All four of the orange colonies occurred on Dive 0020.

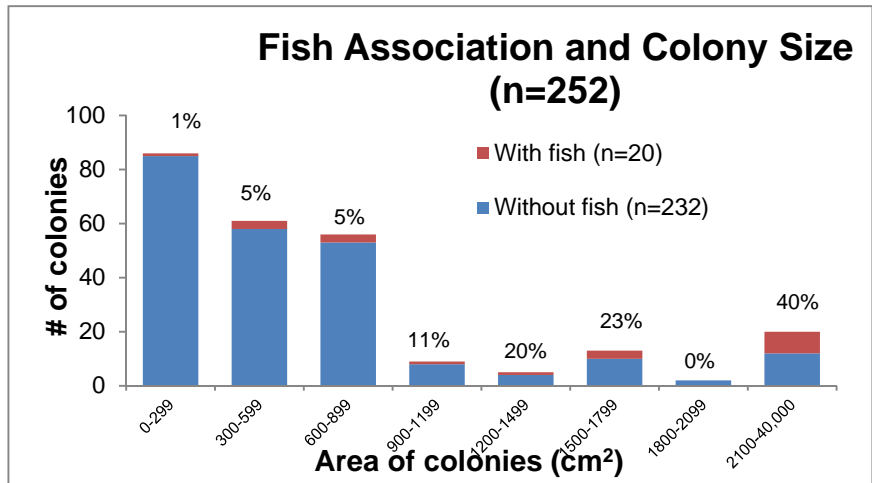


ASSOCIATIONS OF FISHES WITH CHRISTMAS TREE BLACK CORALS

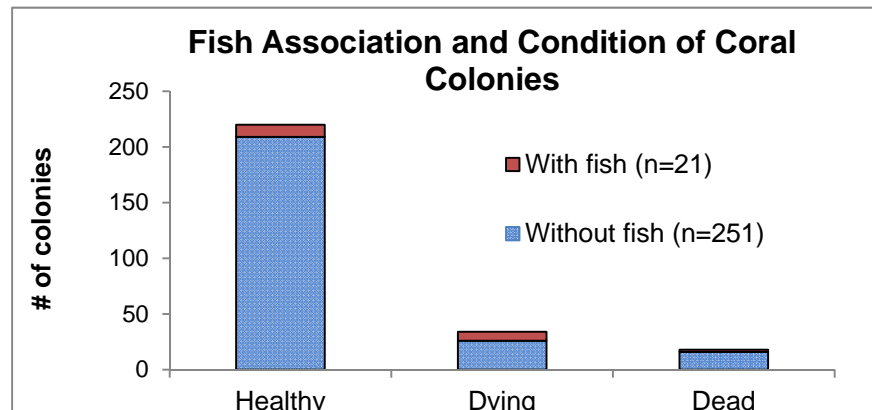
Fishes were associated with 21 Christmas tree black corals (<8% of the 272 individual colonies observed during this survey). We defined 'associated' to be < 1 fish body length away from or in direct contact with the coral colony. A total of 94 fishes (<1% of the 18,357 fishes counted on the survey) from 12 taxa were considered to be associated with the 21 coral colonies. Young rockfish (<10 cm) and cat shark egg cases were most frequently associated with these corals. Fishes associated with the colonies were 5-45 cm in total length.

Fish Taxa	Total number on/near colonies (n= 94 fishes)	Total number on survey (n= 18,357 fishes)
Young rockfishes (10 cm)	55	1,397
Cat shark egg cases	13	16
Squarespot rockfish	7	5,275
Bank rockfish	4	759
Unidentified Sebastomus	6	5,774
Cowcod	2	86
Halfbanded rockfish	1	677
Splitnose rockfish	2	135
Widow rockfish	1	10
Aurora rockfish	1	6
Sharpchin rockfish	1	2
Shortbelly rockfish	1	1,298
Pygmy rockfish	0	1,951
Others	0	971

Fishes typically associated with the largest colonies; there were fishes near/on 8 colonies (40%) in the largest size category. Only 1-5% of the corals in the three smallest size categories were associated with fishes.

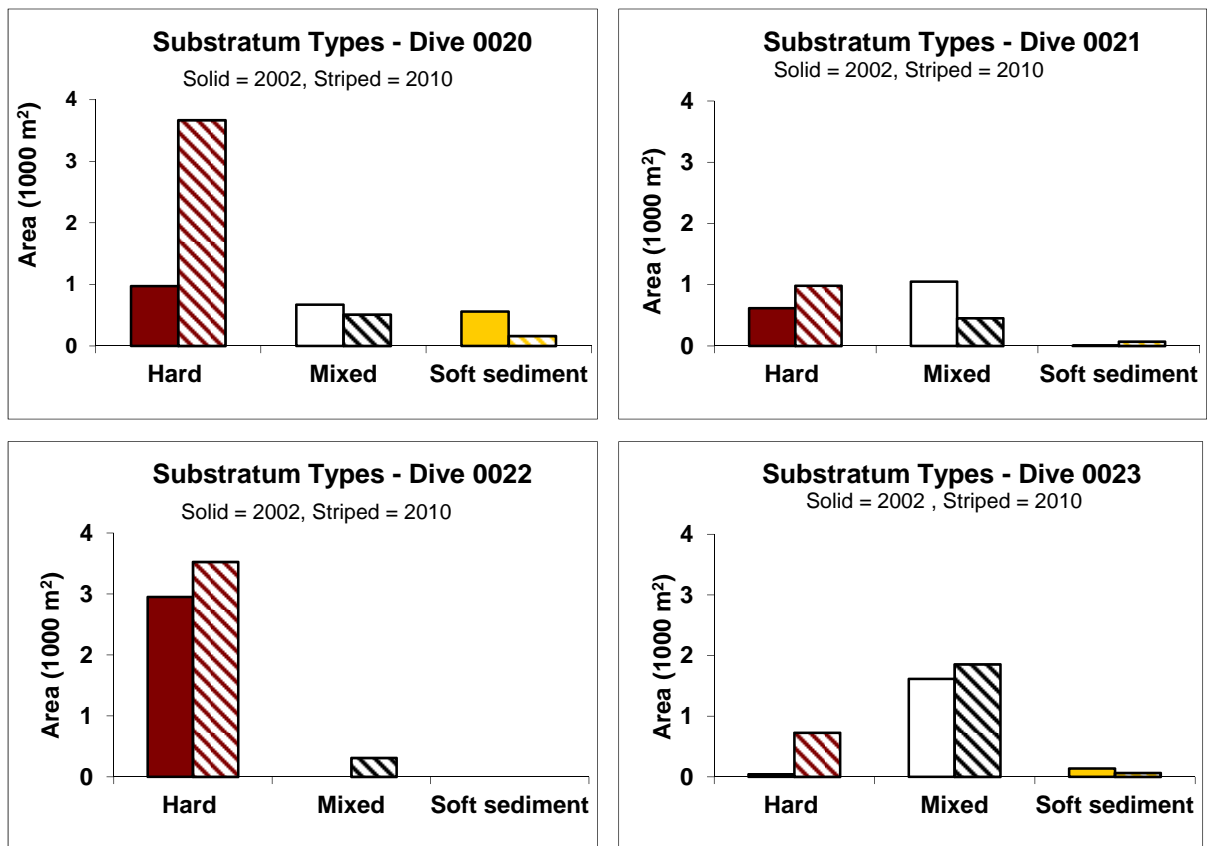


A greater percentage of dying and dead coral colonies were associated with fishes (24% and 11%, respectively) than that of healthy corals (5% of which had associated fishes).

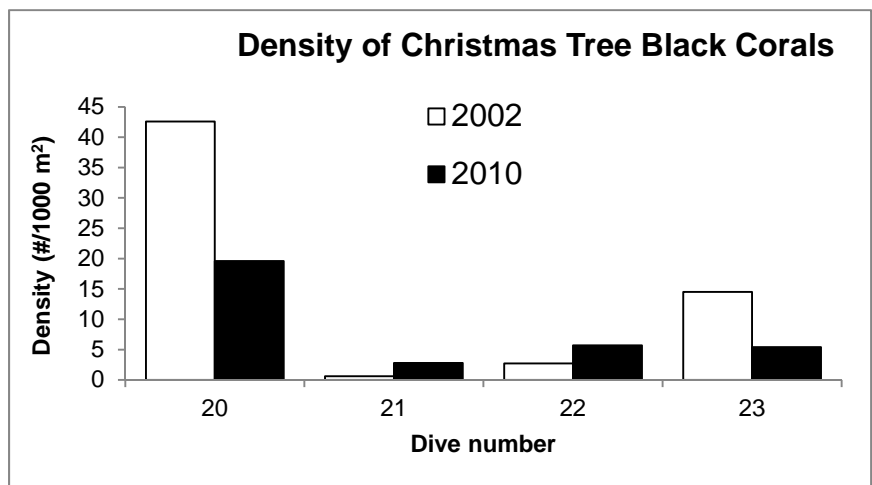


CHANGE IN CHRISTMAS TREE BLACK CORALS

We evaluated density, size composition, and condition of Christmas tree black corals that were surveyed on Hidden Reef in 2002 and again in 2010. Dives conducted in 2010 were located in the vicinity and depth of the 2002 dives (see map on p.3). The amount of substratum types (Hard, Mixed, Soft Sediment) varied among the dives and between the two surveys.

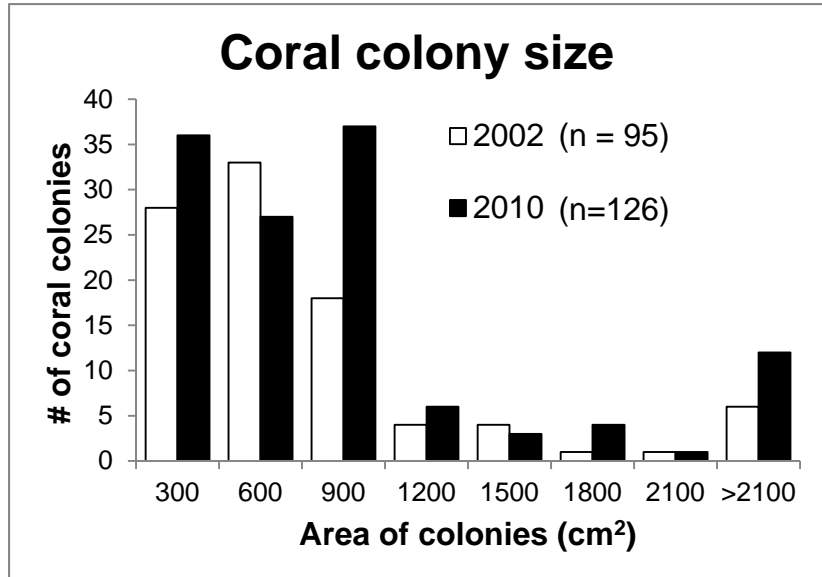


Highest densities of Christmas tree black corals occurred on Dive 0020 and 0023 in both years, but those densities significantly declined from 2002 to 2010 at those two sites. Lowest densities were estimated from counts on Dives 0021 and 22 in both years.

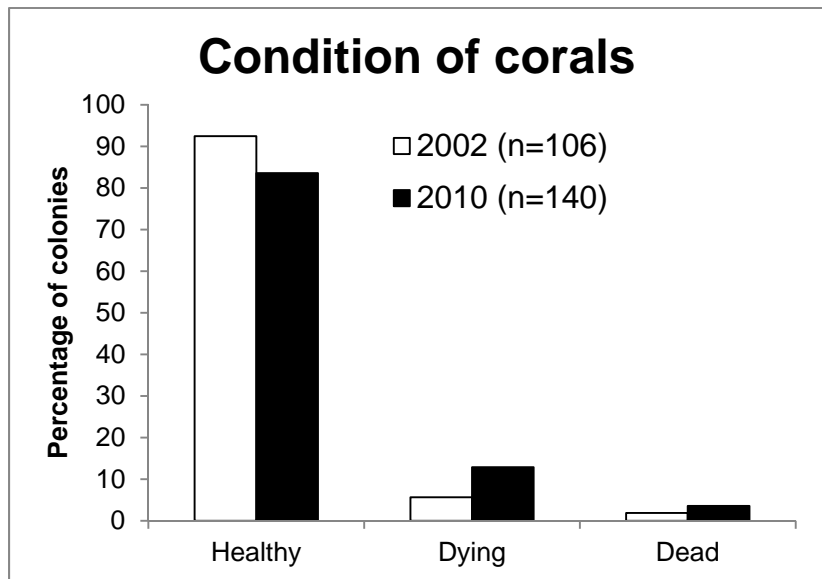


CHANGE IN CHRISTMAS TREE BLACK CORALS

Most Christmas tree black corals were small (<900 cm²) in both the 2002 and 2010 surveys, and size of these small colonies did not differ between years. There were relatively more large colonies (>2,100 cm²) observed in the 2010 survey compared to those in 2002.



Most Christmas tree black corals were healthy in both the 2002 and 2010 surveys, but the relative amount of healthy colonies declined from 2002 to 2010. The proportion of dead and dying colonies doubled in 2010.



CONCLUSION

- 1) A total of 272 Christmas tree black corals were observed during 11 dives (~ 13 hours) on three offshore banks in the Southern California Bight.
- 2) Christmas tree black corals occurred only on Hard (85% of colonies) and Mixed (15%) substrata.
- 3) We estimated an overall density of 10 Christmas tree black corals/1,000 m².
 - a. Coral density declined from 2002 to 2010.
- 4) Most colonies were relatively small (<900 cm²), but about 13% of the colonies were >2,100 cm² in area (width x height). Some individual colonies were up to 200 cm tall.
 - a. Relatively more large colonies were observed in the 2010 survey than in 2002.
- 5) Over 80% of the black coral colonies were healthy.
 - a. A much greater number of macro-invertebrates were living on dead or dying black corals, compared to healthy colonies.
 - b. A greater percentage of dead or dying colonies were associated with fishes.
 - c. The relative number of healthy colonies declined from 2002 to 2010.
- 6) Only 94 fishes (<1% of all fishes on the survey) were associated with only 21 Christmas tree black corals (<8% of the colonies on the survey).
 - a. Young, small (<10 cm) unidentified rockfishes (*Sebastes* spp.) and cat shark egg cases were most frequently associated with these corals.
 - b. These fishes typically associated with the largest colonies.
 - c. More dying and dead coral colonies were associated with fishes, compared with healthy colonies.
- 7) All data from this survey have been added to a comprehensive database of DSC throughout the Southern California Bight.
 - a. These data have been used in recent habitat-based models to map predicted distribution and densities of Christmas tree black corals throughout the Bight.
 - b. These data, maps, and models will help researchers and managers to understand habitat requirements of these corals and to prioritize areas for future field work and protection.

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We thank Nuytco's *Dual DeepWorker* team and the captain and crew of the F/V *Velero IV* for their outstanding efforts to safely and competently operate the submersible and support vessel. We appreciate the assistance of M. Nishimoto and L. Snook with data collection and J. Field for use of the CTD. Thanks to S. Cairns and W. Austin for their assistance in identifying specimens of deep-sea corals and sponges. NOAA NMFS SWFSC and DSCRTP supported this research; we especially thank Tom Hourigan, Fan Tsao, and the West Coast DSC Plan Team.

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Participants

BACK ROW: Mike Leask (F/V *Velero IV*), Jeff Heaton (Nuytco Research, Ltd), Lisa Krigsman (NMFS SWFSC), Linda Snook (UC Santa Barbara), Mary Nishimoto (UC Santa Barbara), Diana Watters (NMFS SWFSC), Andrew Taylor (NMFS SWFSC). FRONT ROW: Tom Laidig (NMFS SWFSC), Sasha LeBaron (Nuytco Research, Ltd), Milton Love (UC Santa Barbara), Mary Yoklavich (NMFS SWFSC), Paul Dunn (F/V *Velero IV*), Jeff (Nuytco Research, Ltd), Rob Millsap (F/V *Velero IV*), Doug Bishop (Nuytco Research, Ltd), Irv Leask (F/V *Velero IV*), crew (Nuytco Research, Ltd)