

NOAA
CORDELL BANK NATIONAL MARINE SANCTUARY
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CRUISE REPORT

VESSEL: McARTHUR II

CRUISE NUMBER: M2-10-02, LEG 2

CRUISE DATES: JUNE 17-25, 2010

PROJECT: DEEP SEA CORAL AND BENTHIC HABITAT SURVEYS IN CORDELL BANK
AND GULF OF THE FARALLONES NATIONAL MARINE SANCTUARIES



OVERVIEW OF OPERATIONS:

This cruise was conducted to survey for deep sea corals and sponges and their associated communities in Washington and California. The second leg of the cruise focused on target locations in Cordell Bank National Marine Sanctuary (CBNMS) and Gulf of the Farallones National Marine Sanctuary (GFNMS), primarily on the continental slope. Daytime operations consisted of ROV surveys and nighttime operations consisted of CTD casts and water sampling focused on obtaining baseline data that could be used to assess ocean acidification. Weather preempted most of the operations that were planned for this cruise. A single ROV dive was performed on the continental slope just west of Cordell Bank at depths to 470m. One coral specimen was collected during the ROV dive. Thirteen CTD casts and discrete-depth water sample collections were completed at 5 stations along an east-west cross-shelf/slope transect.

ITINERARY:

June 17 – Science party embarked in Port Angeles, WA at 1230. Vessel transited south.

June 18 – Vessel transited south.

June 19 – Vessel transited south.

June 20 – Arrived at first dive location ‘Football’ (within potential GFNMS expansion area) at 0800. Attempted ROV dive number one. Problems with ROV video signal and dive aborted. Headed to Bodega Canyon to conduct CTD casts, but weather prevented operations. At 1330, vessel began transit to Drake’s Bay to test ROV. At 1800, ROV in water for dive number two for testing. Successful dive. Plans to perform night CTD casts cancelled due to high winds.

June 21 – At 0630, arrived 4 miles southeast of first ROV station in Bodega Canyon. Operations were postponed due to high winds (16-25 knots) and seas (8-10 ft.). Vessel arrived in Drake’s Bay at 1030. At 1530, ROV in water for dive number three for testing in Drake’s Bay. At 1700, vessel began transit to first CTD station. Completed two CTD casts at station 1 before winds exceeded 25 knots and operations were cancelled.

June 22 – At 0530, on station west of Cordell Bank on continental slope for ROV dive. Operations were stalled to wait for winds to drop from 30 knots. At 1400, a decision was made to deploy the ROV; however, a medical emergency cancelled operations and the vessel transited to Bodega bay for crew member to disembark. Vessel headed back out and two CTD casts were conducted at station 2. A third cast at that station was cancelled due to increasing winds. Vessel returned to Drake’s Bay for crew member to re-embark. Vessel headed back to ROV station.

June 23 – At 0800, decision made to postpone ROV operations due to high winds (27 knots). At 1445, started CTD operations. Seven CTD casts were performed at stations 3, 4, and 5.

June 24 – At 0815, ROV dive number four started at a continental slope station west of Cordell Bank. Dive completed at 1900. This was the only survey dive of leg 2 – the other three dives were either aborted dives or test dives. Three CTD casts were conducted on the night of June 24/25 at stations ‘3B’ (a repeat of station 3, due to considerable drift on station 3 casts) and 2 (third cast at this station).

June 25 – At 0900, leg 2 science team disembarked via skiff at Horseshoe Cove, Sausalito.

SCIENTIFIC GOALS AND OBJECTIVES:

1. To survey and characterize the distribution, abundance, and condition of deep-sea coral (DSC) and sponge communities in and adjacent to Cordell Bank (CBNMS) and Gulf of the Farallones (GFNMS) National Marine Sanctuaries with a remotely operated vehicle (ROV).
2. To quantify fish and invertebrate associations with DSC to help understand DSC importance as habitat.
3. To apply this new information to help address Essential Fish Habitat (EFH) information needs for the Pacific Fishery Management Council (PFMC) for management of existing or future EFH Conservation Areas.
4. To document environmental conditions in DSC habitats, including variables related to depth, temperature, substrate, bathymetry, and carbonate saturation state; towards the purpose of generating reliable maps, including predictive models of DSC distribution.
5. To compare DSC abundance and diversity in three substrate classes: soft, hard flat, and hard rugose; to understand habitat requirements for DSC settlement and growth.
6. To collect bamboo corals for age and growth analysis using bomb carbon and stable isotopes of Sr/Ca; for the purpose of understanding population sources and sinks in Central California.
7. To conduct cross shelf CTD transects to characterize carbonate saturation state; for the purpose of establishing baseline data related to ocean acidification.
8. To collect limited coral and sponge samples to confirm taxonomic identification.
9. To collect/process information under the auspices of NOAA's Deep-Sea Coral Research Program, managed through NOAA's Coral Reef Conservation Program.

EDUCATION/OUTREACH GOALS AND OBJECTIVES:

1. To incorporate information and images into outreach and education materials to increase the awareness and appreciation for the habitat and resources protected by CBNMS.
2. To create an Office of National Marine Sanctuaries (ONMS) expedition web site.

METHODS:

Daytime operations consisted of ROV surveys and nighttime operations consisted of CTD casts and water sampling focused on obtaining baseline data that could be used to assess ocean acidification.

Surveys of deep sea coral (DSC) ecosystems were conducted using the University of Connecticut's Kraken2 (K2) science class ROV. The K2 ROV was equipped to collect two types of data: 1) seafloor images from still and video cameras to enumerate DSC abundance and diversity associated with varied habitats, and 2) physical specimens of DSC and associated species to serve as taxonomic and genetic voucher specimens. Photo and video data were collected to obtain both high-quality representative images of coral habitats and fauna and quantitative samples using ROV-mounted cameras with lasers in the frame to estimate size and area.

Lasers were set a distance of 20 cm apart. The ROV had two video cameras – one recording in high definition that was angled at 30 degrees and one that faced forward and provided a wider angle of view. A SBE19 CTD with temperature, salinity, and pressure sensors was mounted to

the ROV and run autonomously during dives; however, due to a lapse in calibration of the sensors, these data are somewhat suspect. Speed of the ROV averaged 0.78 knots (0.40 m s^{-1}). The ROV was operated at an altitude of approximately 1m above the seafloor.

Originally, ROV dives were planned at five sites that were representative of continental shelf and continental slope habitats that had a higher likelihood of containing deep sea coral and sponge assemblages. Recently acquired multibeam sonar data from the NOAA R/V Okeanos Explorer were used to produce bathymetric maps and preliminary substrate classification maps for the target dive locations. These data were used to select ROV dive locations. Within each site, transects were to be chosen randomly from areas believed to contain hard bottom. Due to the drastic reduction in the days of operation, one dive site was selected that maximized the probability of sampling hard substrate habitats that would have a high likelihood of containing deep water corals (Figures 1 and 2).

Post-processing of video and still images will be used to identify and enumerate invertebrates and fish as well as classify bottom type. Patterns of coral and sponge response variables will be analyzed as a function of habitat type and depth. Evidence of potential human-related disturbances to corals and the surrounding seabed will also be assessed.

During night-time operations, ocean chemistry work was conducted to document environmental conditions in deep sea coral habitats and to identify background conditions related to aragonite saturation state (Ω_{arag}) and calcite saturation state (Ω_{calc}). Thirteen CTD casts and water sampling were completed at 5 stations along a cross-shelf/slope transect just north of Point Reyes and in the vicinity of the ROV operations (Figure 3).

CTD casts were collected to within 10 meters of the seafloor. Data collected from the CTD sampling included temperature, salinity, dissolved oxygen and pH. At discrete depths, water samples were collected above the continental shelf and slope using Niskin bottles mounted on the CTD rosette. Parameters measured or calculated from the water samples included: phosphate, silicate, nitrite, nitrate, ammonium, dissolved inorganic carbon, total alkalinity, pH, pCO_2 , aragonite and calcite saturation levels. Water samples were collected on the up cast at multiple depth intervals at each station (standard depths: 10, 20, 30, 50, 75, 100, 125, 150, 200, 250, 300, 400, 500, 600, 700, 900, 1000 m).

Nutrient samples and salinity samples were analyzed at the University of Washington Oceanography Technical Services Marine Chemistry Laboratory. Phosphate (PO_4), silicate (Si(OH)_4), nitrite (NO_2), nitrate (NO_3), and ammonium (NH_4) concentrations were determined using a Technicon Model AAII. Dissolved inorganic carbon (DIC) and total alkalinity (TA) samples were analyzed at the NOAA Pacific Marine Environmental Laboratory. DIC and TA were measured on all samples and pH_{SW} (pH is reported using the seawater scale) and pCO_2 were calculated from the resulting data utilizing the program of Lewis and Wallace (1998). More detailed methods are included in Feely et al. (2008), but in short, DIC was determined by gas extraction and coulometry using a modified Single-Operator Multi-Metabolic Analyzer (SOMMA) system with a precision of $\pm 1.5 \text{ } \mu\text{mol kg}^{-1}$. Seawater TA was measured by acidimetric titration employing the open cell method with a precision of $\pm 2.0 \text{ } \mu\text{mol kg}^{-1}$. Aragonite and calcite saturation levels were calculated using the program of Lewis and Wallace

(1998). Duplicate samples from different Niskin bottles were taken at one depth during each cast.

RESULTS:

ROV surveys

A single eleven hour ROV dive was performed on the continental slope just west of Cordell Bank within CBNMS at depths to 500m (Figures 1 and 2). Video was collected continuously and photos were taken when items of interest were observed. One octocoral sample was collected for genetic analysis and species identification.

During the 11 hours of ROV dive operations, significant findings included: (1) over 2400 total records of at least six deep sea coral (DSC) species (*Paragorgia sp.*, *Plumarella longispina*, *Swiftia sp.*, *Anthomastus ritteri*, *Virgularia sp.*, and unidentified cup corals), three of which are habitat-forming species (*Paragorgia sp.*, *Plumarella longispina*, *Anthomastus ritteri* – over 220 observations) (Figure 4) and over 60 total observations of various morphological forms of sponges (foliose, upright, barrel, shelf, vase, mound)(Figure 5); (2) observations of large rockfishes in bedrock habitat around 200 meters; (3) regular occurrences of fishes and invertebrates in close association with DSCs and sponges; and (4) evidence of human disturbances to the seafloor including a bottom trawl stretched on the seafloor, long lines, monofilament line, piece of cable, and trash.

In addition to biological observations, the video and still images from the ROV provide data for ground truthing habitat maps created from multibeam sonar data. Video and still images collected during this leg will inform data interpretation and improve the quality of habitat maps that can be used to locate deep corals.

Water Chemistry

CTD profile data indicate a change in oceanographic conditions along the transect from nearshore to offshore. Surface values of nutrients (silicate, phosphate, nitrate), dissolved inorganic carbon (DIC), total alkalinity and pCO₂ were generally lower at the stations farthest west (stations 4&5) over the continental slope compared to those over the continental shelf (Figure 3). Similarly, surface values of pH, aragonite saturation state, oxygen concentration and temperature were higher at those stations farthest west. These patterns are consistent with past studies and suggest that there is a stronger influence of nearshore upwelling plumes over the continental shelf (upwelled water indicated by colder temperature, lower oxygen, higher nutrients and lower pH) and surface oceanic waters over the continental slope (indicated by warmer temperature, higher oxygen, lower nutrients and higher pH).

The aragonite saturation state levels decreased from the surface to depth, and reached 1 (values below 1 indicate undersaturated conditions where dissolution is favored) between 55 and 75m. The depth at which the aragonite saturation level reached 1 decreased (became deeper) as the distance from shore increased.

Education results

Information on corals and the daily activities of the cruise were posted to an Office of National Marine Sanctuaries (ONMS) expedition web site:

http://sanctuaries.noaa.gov/missions/2010coral_west/welcome.html

as well as an ONMS Sanctuary Integrated Monitoring Network (SIMoN) web site:

http://sanctuarysimon.org/cordell/sections/deepSea/project_info.php?projectID=100370&sec=ds

SCIENTIFIC PERSONNEL:

<u>Name</u>	<u>Position</u>	<u>Organization</u>
Dan Howard	Chief Scientist	Cordell Bank National Marine Sanctuary
Kaitlin Graiff	Biologist	Cordell Bank National Marine Sanctuary
Dale Roberts	Biologist	Cordell Bank National Marine Sanctuary
Jan Roletto	Biologist	Gulf of the Farallones National Marine Sanctuary
Jamie Hall	Biologist	Farallones Marine Sanctuary Association
Peter Etnoyer	Biologist	National Center for Coastal Ocean Science
Jeff Hyland	Biologist	National Center for Coastal Ocean Science
Brendon Roark	Chemist	Texas A&M University
Adrian Minor	Chemist	Texas A&M University
Sarah Stryker	Chemist	Texas A&M University
Guy Cochrane	Geologist	U.S. Geological Survey - Santa Cruz
Rudy Schlepp	ROV Technician	Deep Ocean Exploration and Research
Dennis Arbige	ROV Technician	University of Connecticut
Mike McKee	ROV Technician	University of Connecticut
Jeff Godfrey	ROV Technician	University of Connecticut

DISPOSITION OF DATA:

Video tapes, still images, track line information and physical data from the cruise are stored at the Cordell Bank National Marine Sanctuary office, 1 Bear Valley Road, Point Reyes Station, CA 94956. Coral specimen is housed at National Center for Coastal Ocean Science, Charleston.

Literature Cited:

Feely, R. A., C. L. Sabine, J. M. Hernandez-Ayon, D. Ianson, and B. Hales. 2008. Evidence for upwelling of corrosive "acidified" water onto the continental shelf. *Science* 320(5882): 1490-1492.

Lewis, E., Wallace, D.W.R., 1998. Program developed for CO₂ system calculations. Oak Ridge National Laboratory. ORNL/CDIAC-105, 33pp.

Cordell Bank and Gulf of the Farallones National Marine Sanctuaries ROV Dive Targets

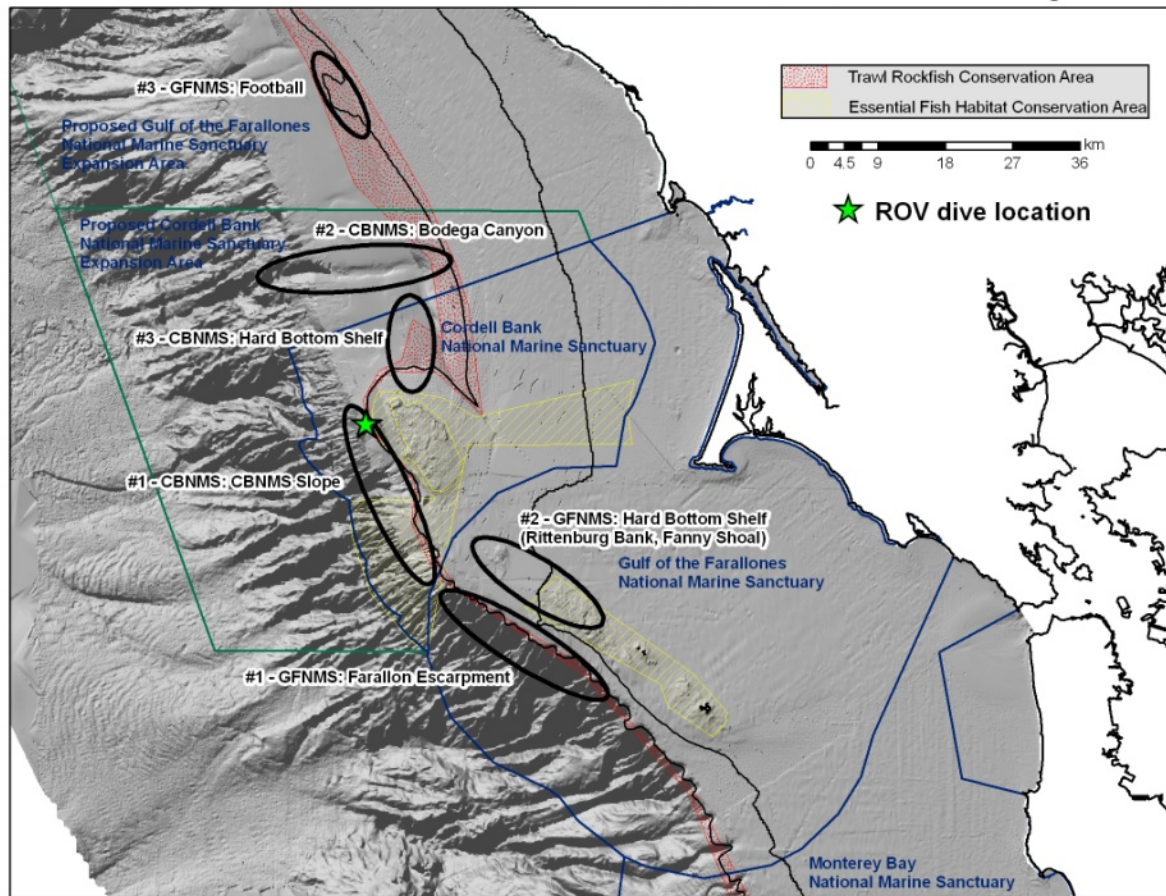


Figure 1. Planned areas of ROV operation and location of one ROV dive conducted on June 24.

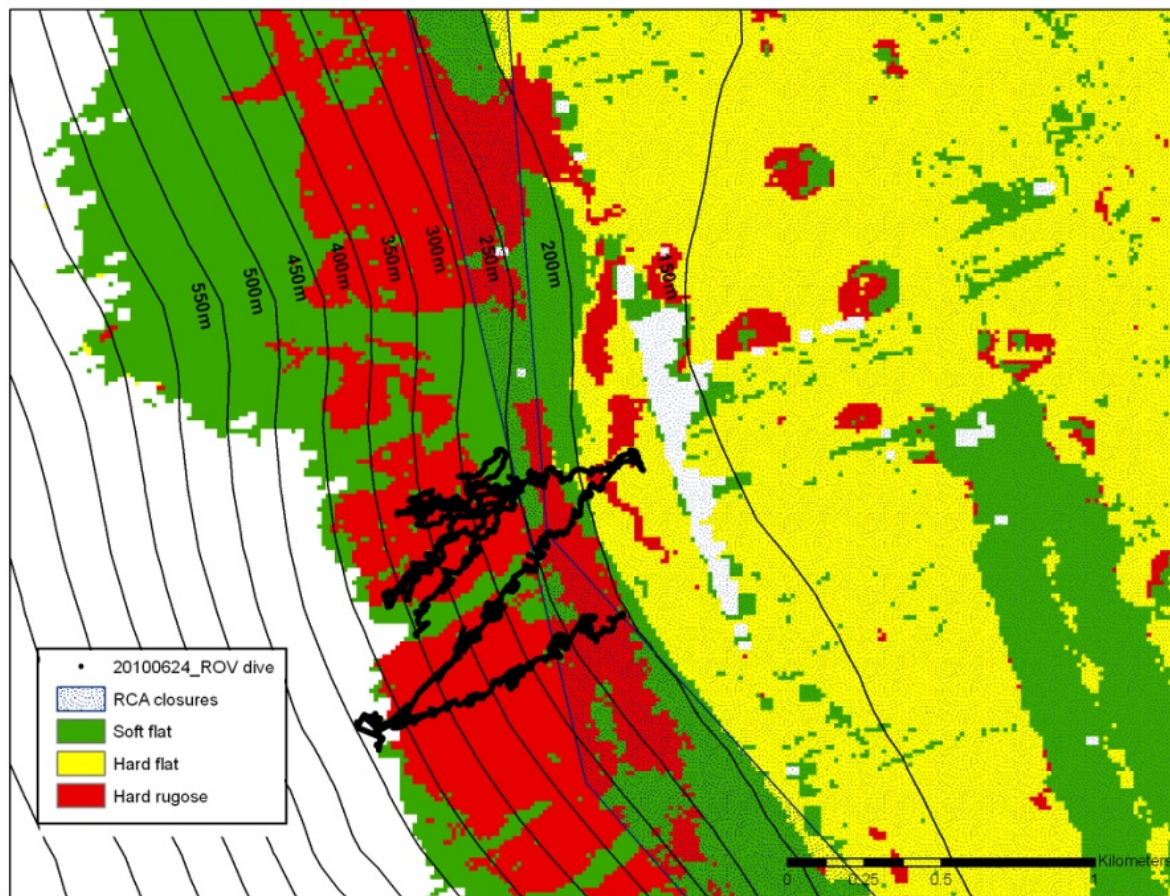


Figure 2. Location of ROV dive conducted on June 24 overlaid on preliminary habitat classification. Also presented are trawl and Cordell Bank RCA closures.

M2-10-02, Leg 2 - CTD Rosette Sampling Stations

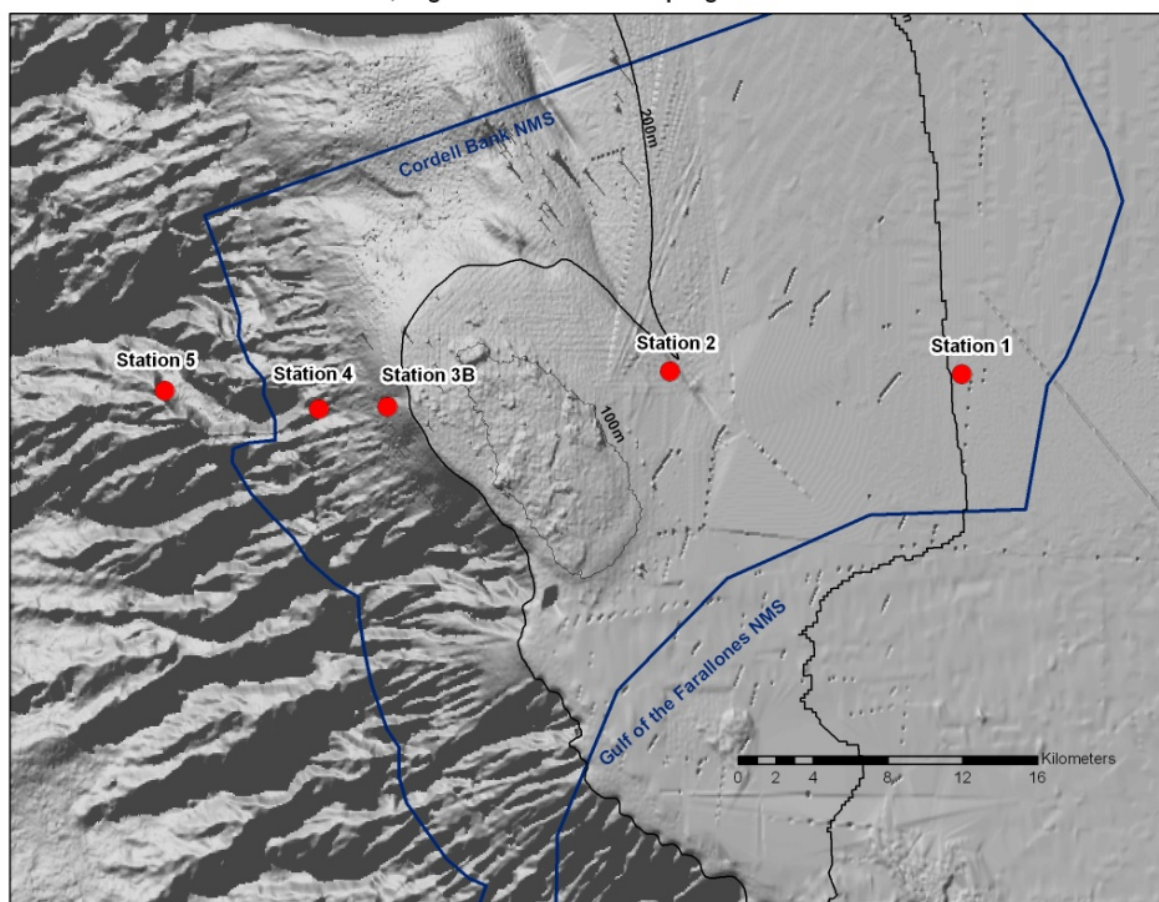


Figure 3. Locations of CTD casts and discrete depth water sampling.

Figure 4. Representative photos of deep-sea corals observed on continental slope.



Paragorgia sp.



Plumarella longispina, rockfish, and fragile sea urchin



Anthomastus ritteri and rockfish



Swiftia sp. (notice that left half of organism looks dead)



Plumarella longispina and *Paragorgia sp.*



Unidentified sea pen (tentative identification: *Virgularia sp.*)

Figure 5. Representative photos of deep-sea sponges observed on continental slope.



Lacey vase-shaped sponge with crinoids



'Boot sponge' (tentative identification: *Rhabdocalyptus dawsoni*); sea pens in background



Foliose sponge with crinoids and hiding rockfish