Abstract

The Monterey Bay National Marine Sanctuary (Sanctuary) and the California Coastal Commission are working closely with the California Department of Transportation (CalTrans) and several other local, state, and federal agencies to develop a Corridor Management Plan along the Big Sur Coast. Highway 1 in Big Sur is often subject to delays and closures due to storms, washouts, and landslides. The purpose of the Big Sur Coast Highway Management Plan (CHMP) is to develop sustainable strategies that ensure the safe and efficient operation of the highway while protecting the unique qualities and sensitive terrestrial and marine resources of this remarkable coastline.

As one part of the CHMP, this project has been designed to survey intertidal and nearshore subtidal areas along the Big Sur coast. The surveys will focus on areas of coastline known or with the greatest potential to be affected by highway repairs from landslides or other storm-related events. Data collected will include species lists, population densities, and presence of economically important, particularly sensitive, and/or endangered species. The results will be placed into multiple GIS data layers and maps for resource managers and the public.

Study Objectives

Researchers from the Partnership for Interdisciplinary Studies of Coasta9l Oceans (PISCO) at UC Santa Cruz and SANCTUARY staff scientists are working together to survey six subtidal sites and adjacent intertidal sites. In particular, they collect data to:

1. Characterize geological substrate types at selected sites according to 5-10 categories, such as granite, boulder, sand.
2. Identify physical factors at these sites which may affect the sensitivity of marine biota to disposal activities, such as wave energy, relative exposure and aspect, presence of protective offshore rocks, etc., and qualitatively rank each site by physical exposure categories which could affect disposed material.
3. Characterize biological assemblages at these sites. Identify and note the abundance of those species that may be particularly susceptible to disposal activities, such as the sea palm, and owl limpet.
4. Rank critical and/or disposal-sensitive habitats using indices such as location, size, and quality in order of most critical to least critical; consider species assemblages' degree of tolerance to sediment disposal (i.e., burial, scour, turbidity) and physical factors.

Methods

The initial site selection process focused on three issues: recent landslide activity at a site, its geology, and proximity of a similar site with no or reduced effects due to landslide material. In consultation with geologists from the

California Geologic Survey, CalTrans staff, and a representative of the State Water Resources Control Board, Sanctuary staff identified 14 candidate sites. Several sites were similar to one another and many were considered alternatives; it was never planned to survey all 14 sites.

The R/V *Shearwater*, a 62-foot catamaran from the Channel Islands National Marine Sanctuary, served as the research platform from September 12-27, 2003. This vessel was able to transit quickly from Monterey to Ragged Point at speeds of up to 20 knots, support up to 10 live-aboard researchers and two crew, anchor overnight at remote sites, fill SCUBA tanks, and quickly deploy inflatable boats and kayaks used by subtidal and intertidal researchers, respectively. Its high maneuverability and state-of-the-art technology often allowed the crew to place the vessel immediately adjacent to the study sites.

Divers (from left to right): Mark Carr (UCSC) Tim Tregoning (USCG), Steve Lonhart (SIMoN), and Mark Readdie (UCSC).

An experienced dive team and an intertidal crew qualitatively surveyed 9 of the 14 sites over a three day period, then used this information to select six sites for full quantitative surveys (only six could be surveyed due to logistical constraints). Qualitative diver sampling at each site involved three divers descending to 20 m depth and swimming as shallow as possible. Divers recorded all fishes, invertebrates, and algae encountered during the course of an entire dive, and also noted topography and substrate types (e.g., sand, cobble, boulders, reef). Four rocky shore researchers used kayaks and wetsuits to access intertidal sites. Once upon the shore, or in some cases from the kayak, they filled out a species checklist while viewing the shore at locations on either side of a slide (if one was present). They also evaluated the sites for their suitability to collect quantitative data.

After the initial four days of qualitative sampling, six sites were selected and quantitatively sampled. However, due to poor tides, only subtidal data were collected. The intertidal sampling was postponed until November/December 2003. Each of the six sites was subdivided into two areas (upcoast and

downcoast). Within each area one pair of divers collected data on fishes while a second pair of divers collected data on invertebrates and algae using two 30 m long belt transects at different depths (e.g., 20, 15, and 10 m). At each site, divers collecting fish data completed a total of 24 transects, while divers collecting invertebrate and algae data completed a total of 18 transects. Fishes were counted and total length of individuals was estimated. Mobile invertebrates were counted, and estimated percent cover of sessile organisms and algae was done using uniform point contacts. Divers also counted all stipitate understory algae and counted the stipes of giant kelp *Macrocystis pyrifera* and bull kelp *Nereocystis luetkeana*.

Findings

Of the 14 sites originally identified, four (Hurricane Point, Pitkins Curve, Grey Slip, and south of Salmon Creek) were not qualitatively surveyed and subsequently omitted from the sampling program. These four sites presented either hazardous diving conditions or logistical constraints that made them unsuitable. Divers qualitatively sampled the remaining 10 sites, and six of those were quantitatively sampled (Partington Cove, McWay slide, north of Salmon Creek, Duck Ponds slide, Wild Cattle Creek, and Lucia).

The following results are preliminary; the six sites will be revisited in spring 2004 and a final report is not expected until summer/fall 2004. In general, areas at or near the base of a slide site were not strikingly different from the more distant area within the same site. Between sites there was much more variation in both the type of terrain and the relative abundances of species. For example, the deeper sections of some sites were dominated by high vertical relief and high densities of sessile invertebrates, but were dominated by stipitate algae at shallow depths. From site to site the relief and substrate type (e.g., boulders, cobble, gravel or sand) would vary as would the density of sessile invertebrates and algae. However, the list of species at all of these sites was fairly consistent.

Relevance to Resource Management

This project is being undertaken as part of the Big Sur Coast Highway Management Plan. The California Department of Transportation (CalTrans) received a grant to develop most of the management plan; however, it lacks adequate funds for an essential component of the plan—a survey of marine resources along typical landslide areas and sites where CalTrans may seek to dispose of rock and soil debris on the shoreline and into the ocean. Highway management and repair strategies, even with objectives to minimize earthwork impacts and overall disturbances, may continue to require suitable locations for depositing excess material. The handling of material at a landslide site or exporting to a suitable disposal site continues to raise concern about the potential for impacts to shoreline habitats. Evaluating shoreline habitats for sensitivity to these activities will be an essential component to determining the effects of landslide material being deposited or redistributed on or near the

shoreline. The data collected during the course of this project will directly address these issues and serve as a baseline to detect changes in the future.

Fish and Invertebrate Surveys, Geological Habitat Characterization, and Shipwreck Reconnaissance: *Delta* Submersible Cruise

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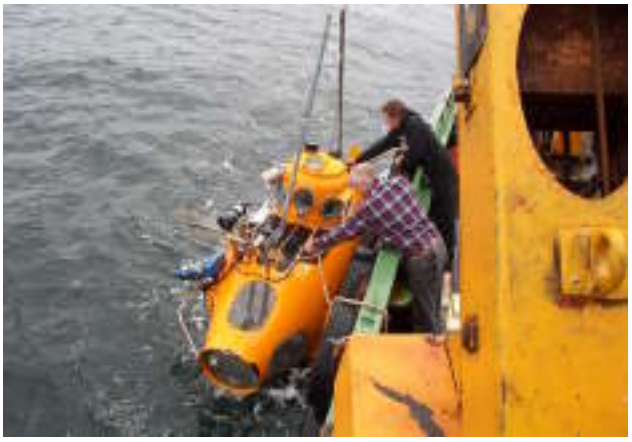
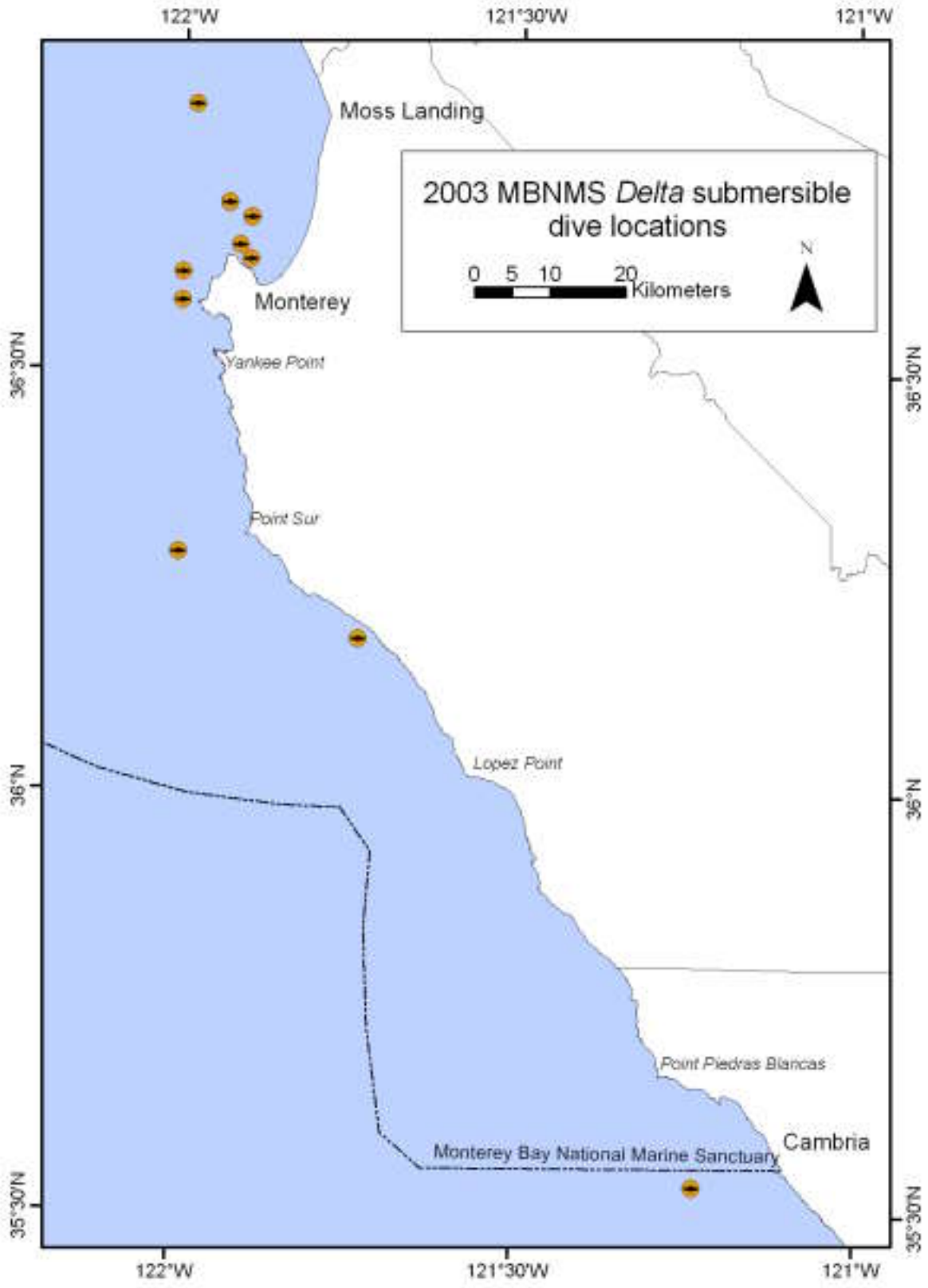


Recovery of *Delta* submersible on RV *Velero IV.* Photo: MBNMS/NOAA.



Map of *Delta* submersible survey locations.

Abstract

The Monterey Bay National Marine Sanctuary led a research cruise aboard the RV *Velero IV,* using the 2-person submersible *Delta*, 16-25 September 2003. Four research projects with overlapping goals were conducted in collaboration with 6 principal investigators, 9 participating institutions, and 15 participants. Thirty dives were conducted at 5 survey locations in depths of 60-350 meters. Projects included fish and invertebrate assemblage surveys at Soquel Canyon, Partington Canyon, and the Monterey Peninsula/Point Sur Area; ground-truthing of geological habitat, recorded earlier using side scan sonar, at Partington Canyon; and reconnaissance of the oil tanker *Montebello* attacked during World War II near Cambria, CA. Video data have yet to be analyzed. Biological and geological data will be used to determine habitat associations, and long-term changes in species and size composition. Preliminary results of the *Montebello* survey indicate that the ship's hull is intact.

Study Objectives

1. Survey of Demersal Fish and Macroinvertebrate Assemblages at Soquel Canyon. This project is a collaborative effort between the Sanctuary and Mary Yoklavich from NOAA Fisheries.
   a. Assess the importance of small-scale refugia to species of demersal rockfishes in the Soquel submarine canyon, located at the north end of Monterey Bay, CA.
   b. Revisit study sites that were surveyed in 1992-1993 using the *Delta* submersible, and estimate abundance, species-habitat relationships, and species and size composition of demersal fishes using transect methodology; comparisons will be made with data collected in 1992-1993 and also elsewhere off California during past years.

Lingcod (*Ophiodon elongatus*) and white-plumed anemone (*Metridium farcimen*). Photo: T. Laidig/NOAA.

2. Long-Term Monitoring of Demersal Fish and Macroinvertebrate Assemblages. This project is a collaborative effort between the Sanctuary and Richard Starr from California Sea Grant.
   a. Identify long-term trends in species composition, size composition, and relative abundance of demersal fishes and macroinvertebrates in selected areas of the Sanctuary;
   b. Evaluate recovery rates of fishes and macroinvertebrates in areas that were historically abundant but are now depleted, and compare those with population trends of species in similar habitats that are currently abundant.
   c. Explore potential sites for the long-term monitoring plan.
      i. Portuguese Ledge, just north of Monterey, CA was chosen because it has been historically fished, is in a relatively sheltered area, and is easily accessible from Monterey.
      ii. Additional dive locations to be visited will be off Point Sur, CA., fishermen and scientists will be consulted, and alternate locations may be selected depending on weather.

Montebello being launched on January 24, 1921 at East San Pedro, CA. Photo: Unocal.

3. Partington Canyon Habitat Characterization and Macrofauna Survey. This project is a collaborative effort between the Sanctuary and Joseph Bizzarro from the Center for Habitat Studies at Moss Landing Marine Laboratories.
   a. Ground-truth seafloor map of Partington Canyon, CA, which was produced with side scan sonar during summer 2003. Geologists will use the submersible to search for evidence of sediment transfer in the canyon.
   b. Survey demersal fishes and macroinvertebrates.

4. Shipwreck Reconnaissance: Oil Tanker Montebello. This project is a collaborative effort between the Sanctuary and Robert Schwemmer from the

Channel Islands National Marine Sanctuary.

a. Site reconnaissance for the potential threat posed by this 82 year old oil tanker, now 62 years underwater adjacent to the Sanctuary;
b. Characterize the archeological remains of the *Montebello* and record the bow section of the shipwreck partially recorded in 1996;
c. Characterize the fishes and invertebrates fauna
d. Organize and conduct media event, including interview with Richard Quincy, a seaman who was on-board the *Montebello* site when she was sunk.
e. Compare data and information collected during the 2003 *Delta* submersible dives to *Delta* submersible data collected in 1996 to assess biological changes and hull degradation.

Methods

The primary sampling tool for these projects was the manned-submersible *Delta*. Visual strip transects were used to survey fishes and macroinvertebrates in selected rocky habitats in shelf and slope habitats. Submersible strip transects followed protocols commonly used in underwater surveys (e.g., Stein et al 1992, Pearcy et al. 1992, Yoklavich et al. 2000, Yoklavich et al. 2002). Paired lasers were used to measure fishes, invertebrates, rocks, objects, and transects. Observations were recorded on mini-digital video tapes; which included verbal annotation of identification of species, estimation of species size, and depth of field. A submersible study of Soquel Canyon has been published, thus baseline data are available for comparison (Yoklavich et al. 2000).

Reconnaissance of the *Montebello* was conducted by circumnavigating the main structure and hull, bow section, and propellor. The biological characterization was opportunistic, and did not include strip transects, due to ghost fishing gear hazards. Shipwreck structure and biological data will be compared to the 1996 survey (Hunter 2002; personal communication, Robert Schwemmer).

Findings

The Sanctuary and partners conducted 30 dives during 8 days at 5 survey locations in depths of 60-350 m. Video data have yet to be analyzed. Using video footage and geographical position information, we will describe fish and invertebrate assemblages, estimate densities, determine habitat associations, and evaluate and modify the design of a long-term monitoring plan.

The hull of the *Montebello* appeared to be intact, with small “rust bulges” on both sides of the hull near the stern area. These may be early signs of hull decay. There was no sign of oil leakage underwater or on the surface. In addition, no oil-associated bacteria were observed. Characterization of the structure, and further comparison with the 1996, including biological data, will be analyzed.

Relevance to Resource Management

The Sanctuary was established for the purpose of resource protection, research, education, and public use of this national treasure. The Sanctuary research program assesses change in species and habitats, and participates in regional research to better understand the Sanctuary ecosystem.

One of the mandates of the Sanctuary, as it pertains to characterizing submerged cultural resources, is to assess and provide protection. The *Montebello* is an oil tanker that was sunk by a Japanese submarine during World War II. *Montebello*'s historic role is important both regionally and to our nation. Although the shipwreck's position is just outside the southern sanctuary boundary, potential oil leaks from the *Montebello*'s hull is a probable threat to the marine resources of the sanctuary and contiguous waters, assuming the *Montebello*'s cargo of 73,571 barrels (3,089,982 gallons) of unrefined petroleum are entombed in the slowly deteriorating steel hull. The *Montebello* is also host to a magnificent biologically rich marine life community, on the wreck and in the surrounding water column.

Environmental Impact of the ATOC/Pioneer Seamount Submarine Cable: R/V *Pt Lobos* and R/V *Western Flyer* Cruises

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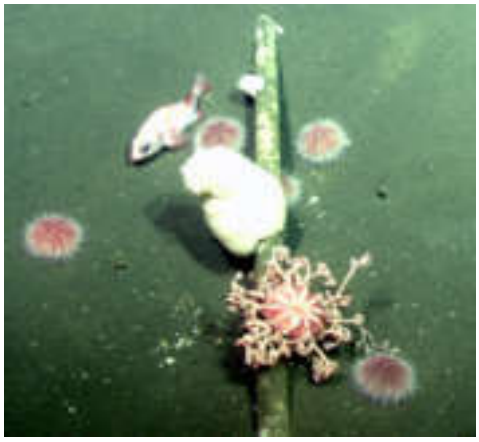
Abstract

To better understand the potential impacts of the presence of cables on the seabed, a study of the environmental impacts of the ATOC/Pioneer Seamount cable was conducted. The 95 km long, submarine, coaxial cable extends between Pioneer Seamount and the Pillar Point Air Force Station in Half Moon Bay, California. Approximately two-thirds of the cable lies within the Monterey Bay National Marine Sanctuary. The cable is permitted to NOAA Oceanic and Atmospheric Research for transmitting data from a hydrophone array on Pioneer Seamount to shore. The cable was installed unburied on the seafloor in 1995. A

RV *Lobos*. Photo: MBARI Copyright 2003.

total of 13 sites along the 95 km cable route were surveyed using MBARI ROVs *Ventana* and *Tiburon* equipped with cable-tracking tools during research cruises on February10-14, 2003 and July 28–August 1, 2003. Quantitative comparison between cable and control sites was performed at nine stations. A total of 42 hours of video footage and 138 push cores were collected over 15.1 km of seafloor. Approximately 12.1 km of the cable was observed (13% of the cable route). The condition of the cable, its effect on the seafloor, and its effect on benthic megafauna and infauna were determined.

Video data indicated the nature of interaction between the cable and the seafloor. Rocky nearshore areas, where wave energies are greatest, showed the clearest evidence of impact. Here, evidence of abrasion included frayed and unraveling portions of the cable's armor and vertical grooves in the rock apparently cut by the cable. The greatest incision and armor damage occurred on ledges between spans in irregular rock outcrop areas. Unlike the nearshore rocky region, neither the rocks nor the cable appeared damaged along outcrops on Pioneer Seamount. Multiple loops of slack cable added during a 1997 cable repair operation were found lying flat on the seafloor. Several sharp kinks in the cable were seen at 240 m water depths in an area subjected to intense trawling activity. Two crossings with other cables were also seen. Most of the cable has become buried with time in sediment substrates on the continental shelf whereas much of the cable remains exposed in sediments at deeper depths. The cable is exposed in rocky environments of the nearshore region and on all of Pioneer Seamount.



A variety of organisms living on or near the ATOC/ Pioneer Seamount cable: basket star (Gorgonocephalidae), anemone (*Metridium farcimen*), rockfish (*Sebastes sp.*) and urchins (*Allocentrotus fragilis*). Photo: MBARI/ NOAA Copyright 2003.

The main biological features

Anemones (*Metridium farcimen*) living on the ATOC/Pioneer Seamount cable. Photo: MBARI/ NOAA Copyright 2003.

associated with the cable were organisms utilizing the cable as substrate and occasionally as shelter. Considerable care was taken to count megafauna in video transects and macrofauna from the top 5 cm of push cores. Few differences were found between cable and control sites at the 95% confidence level. Cnidaria (especially anemones such as *Metridium farcimen* and *Stomphia sp*.) colonize the cable and were more abundant in cable transects at most soft sediment sites. Where the cable was buried, the presence of linear rows of anemones proved to be reliable indicators of the cable's position. Flatfish and rockfish apparently congregate near the cable. The cable may also have a subtle local hydrodynamic effect that concentrated shell hash and drift kelp near the cable. Coarse extrapolation of the transect data suggest that approximately 500,000 organisms may live on or near the cable.

Study Objectives

- Describe state of the cable (buried, suspended, damaged, entangled, etc.)
- Observe any effects of cable on the seafloor
- Analyze effects of cable on benthic organisms

Methods

Survey locations were chosen to target representative substrate and habitat types, features of interest, and for logistical reasons. Side scan sonar data collected on October 21-25, 2002 from the R/V *Zephyr* helped select these sites.

A total of 13 sites along the 95 km cable route were surveyed using MBARI ROVs *Ventana* and *Tiburon* during research cruises on February 10-14, 2003 and July 28–August 1, 2003. Cable-tracking tools were used to aid in cable location and to quantify burial depth. An Innovatum Ultra 44 was installed on the ROV *Ventana* during the February 2003 survey and a TSS 350 was installed on the ROV *Tiburon* during the July 2003 cruise. Tone generators were connected to the shore end of the cable during each cruise and used to send a 25 Hz signal along the cable that would be located by the cable-tracking apparatus installed on the ROVs.

Quantitative comparison of megafauna and infauna along cable (<1 m) and control (~100m from cable) transects was performed at nine stations. Video footage and digital still images were collected and megafaunal abundance was analyzed at two scales: entire video frame and in a region of interest 48 cm x 66 cm centered on the cable or in the center of the frame in control transects. Lasers mounted on the ROVs were used to define the size of the area covered in the video images. If the substrate was soft sediment, push cores were collected

within an estimated 30 cm of the cable. Infaunal organisms (macrofauna) were sorted from the top 5 cm and mean organism abundance and number of different taxa were statistically compared. In all cases, organism identification was performed to the lowest practical taxonomic level and organisms were grouped into functional groups prior to comparison. Transect lengths at sites where cable and control data were collected ranged from 30 to 870 m with most transects 200 to 500 m long.

RV *Western Flyer.* Photo: Todd Walsh Copyright 2000 MBARI.

Findings

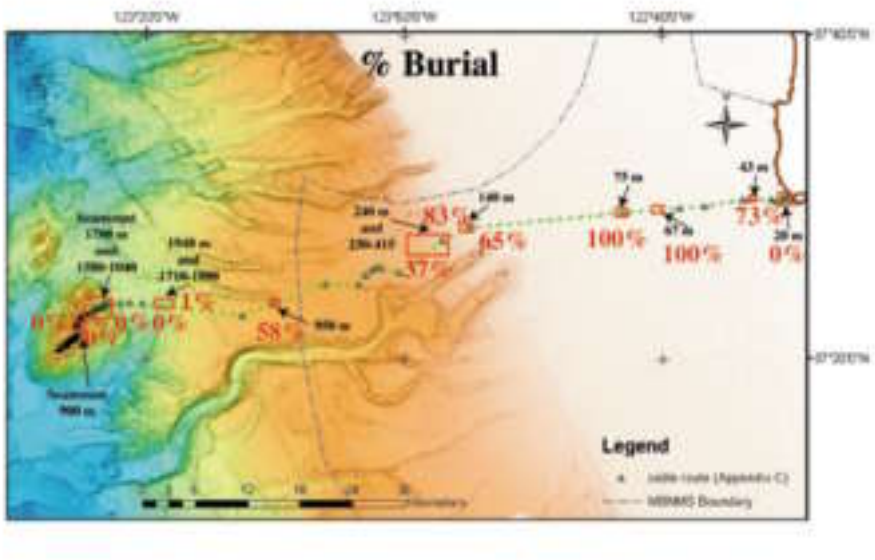
A total of 42 hours of video and 138 push cores were collected from 13 stations using the ROVs *Ventana* and *Tiburon* equipped with cable-tracking tools. A cumulative distance of 15.1 km of seafloor was surveyed along 13 cable and nine control transects. Thirteen percent (12.1 km) of the cable route was observed.

Video observations indicated the nature of interaction between the cable and seafloor. Most of the cable has become buried with time in sediment substrates on the continental shelf (water depths <120 m) whereas much of the cable remains exposed on the seafloor at deeper depths. Burial depth on the continental shelf ranged from 0 to 27 cm and averaged approximately 10 cm. Burial depth may fluctuate due to shifting substrate and buried cable may become exposed during storms. The cable is exposed in rocky environments of the nearshore region and on all of Pioneer Seamount.

The cable's condition was assessed where it was exposed on the seafloor. Video images from the rocky nearshore areas, where wave energies are greatest, show the clearest evidence that the cable has been damaged. Here, evidence of abrasion included frayed and unraveled portions of the cable's armor. In many places the cable occupies vertical grooves in the rock that were apparently cut by the cable. Incisions ranged from 6.6 cm (diameter of double armored cable)

to 45 cm wide. The greatest incision and armor damage occurred on ledges between spans in rocky areas with irregular bathymetry. Snagged kelp was seen intertwined with frayed cable in the near shore areas.

The most notable suspensions were in rocky areas with irregular bathymetry. Such rocky areas occur at both ends of the cable. Suspensions up to 40 m long and greater than 1 m high were seen in the nearshore rocky area and up to 25 m long and 2 m high were seen on Pioneer Seamount. Unlike the nearshore rocky region, neither the rocks nor the cable appeared damaged along outcrops on Pioneer Seamount. Short (~10 cm) suspensions were also common bridging low spots associated with irregular topography in sediment substrate areas. Multiple loops of slack cable, added during a 1997 cable repair operation, were found lying flat on the seafloor at 950 m water depths. Several sharp kinks in the cable were seen at 240 m water depths in an area subjected to intense trawling activity (NRC 2002). Cable crossings were seen in 13 m water depth at 37° 29' 50" N, 122° 33' 04" W and in 344 m water depth at 37° 29' 54" N, 122° 30' 30" W.



Map showing the percentage of cable buried at surveyed locations.

The main observed biological differences between cable and control areas were the number of organisms attached or adjacent to the cable. Anemones colonized the cable and were more abundant in cable transects at most soft sediment sites. Where the cable was buried, the presence of linear rows of anemones proved to be a reliable indicator of the cable's position. Coarse extrapolation of transect data suggests over 50,000 anemones may live in the modified habitat created by the cable. Echinoderms and sponges were also seen living on the cable. At three of nine stations, flatfish and rockfish congregated near the cable. The cable has had no apparent effect on infaunal abundance. Other differences between cable and control sites were probably

due to patchiness of animals. Considerable care was taken to count megafauna in video transects and macrofauna from the top 5 cm of push cores. Few differences were found between cable and control sites at the 95% confidence level. The cable may also subtly affect local hydrodynamic conditions that concentrate shell hash and drift kelp near the cable.

Relevance to Resource Management

Results and observations from this survey will aid decision makers regarding the ATOC/Pioneer Seamount cable's future and provide scientific data for shaping cable policy within Sanctuaries.

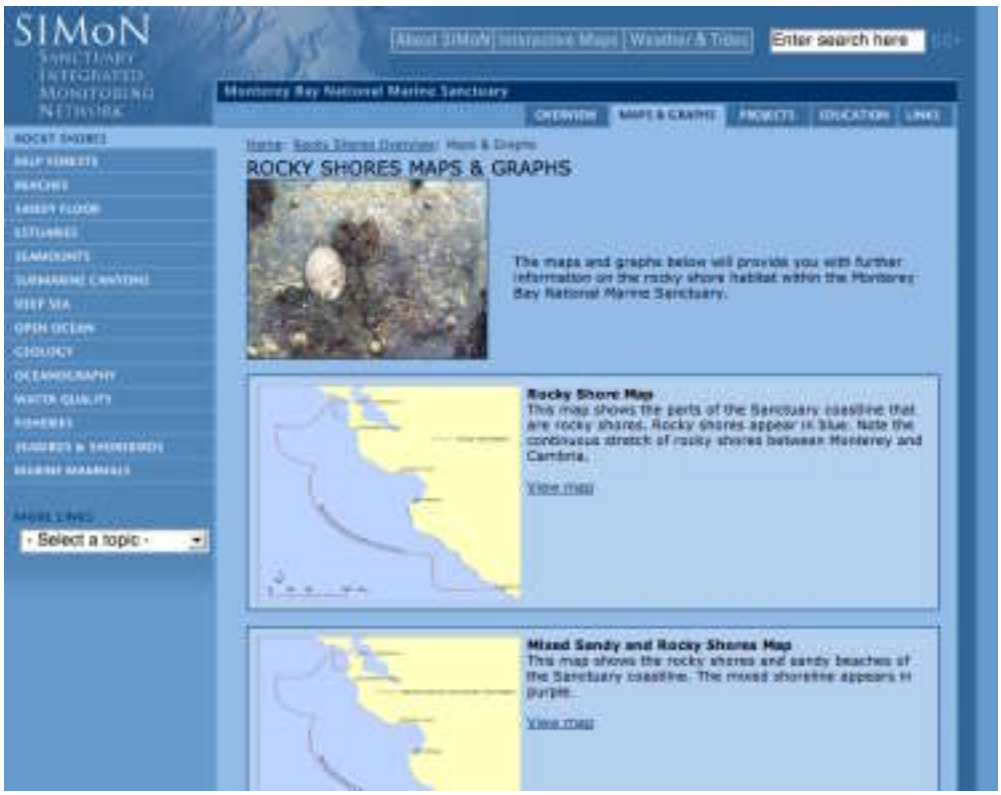
INTEGRATING RESEARCH INFORMATION

Sanctuary Integrated Monitoring Network (SIMoN): Web Portal

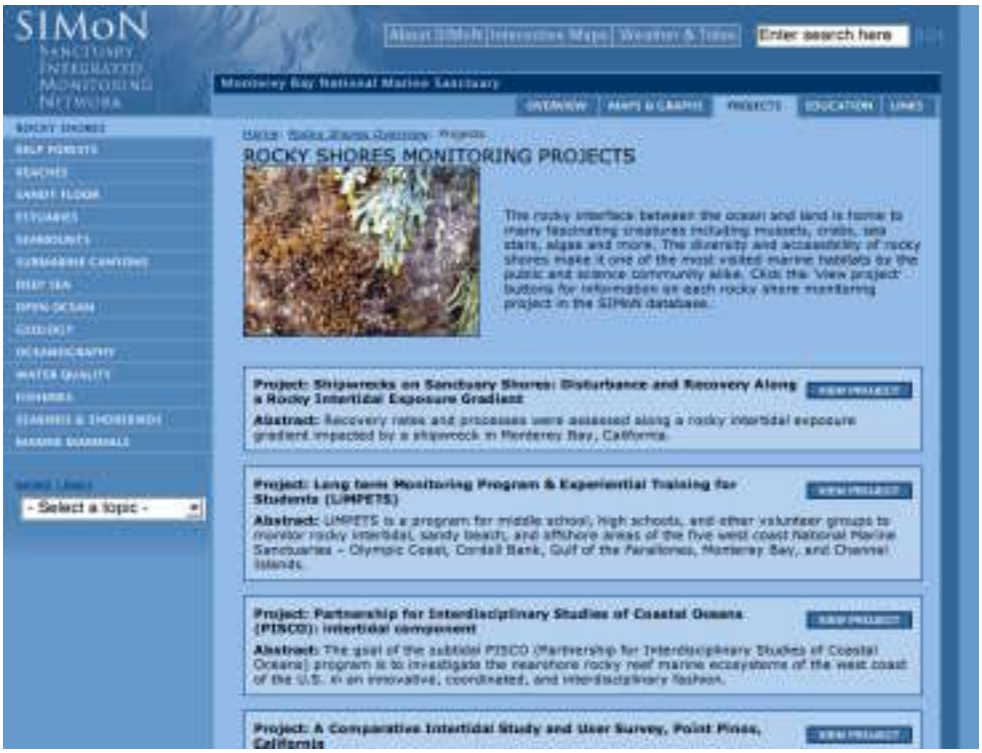
The SIMoN portal (http://www.mbnms-simon.org) is the primary outreach tool of the SIMoN program. It was released to the public in 2003. Aimed at sharing monitoring-related information to a diverse audience, including educators, resource managers, marine scientists, and the public, this web site provides information suitable for users of varying scientific knowledge and experience. The SIMoN web site also serves as the central point for the integration of current and historic monitoring programs in the Monterey Bay National Marine Sanctuary, including SIMoN's own field projects.

Home page of the SIMoN website. Fifteen sections along the left-hand side represent the major habitats and issues of the Sanctuary.

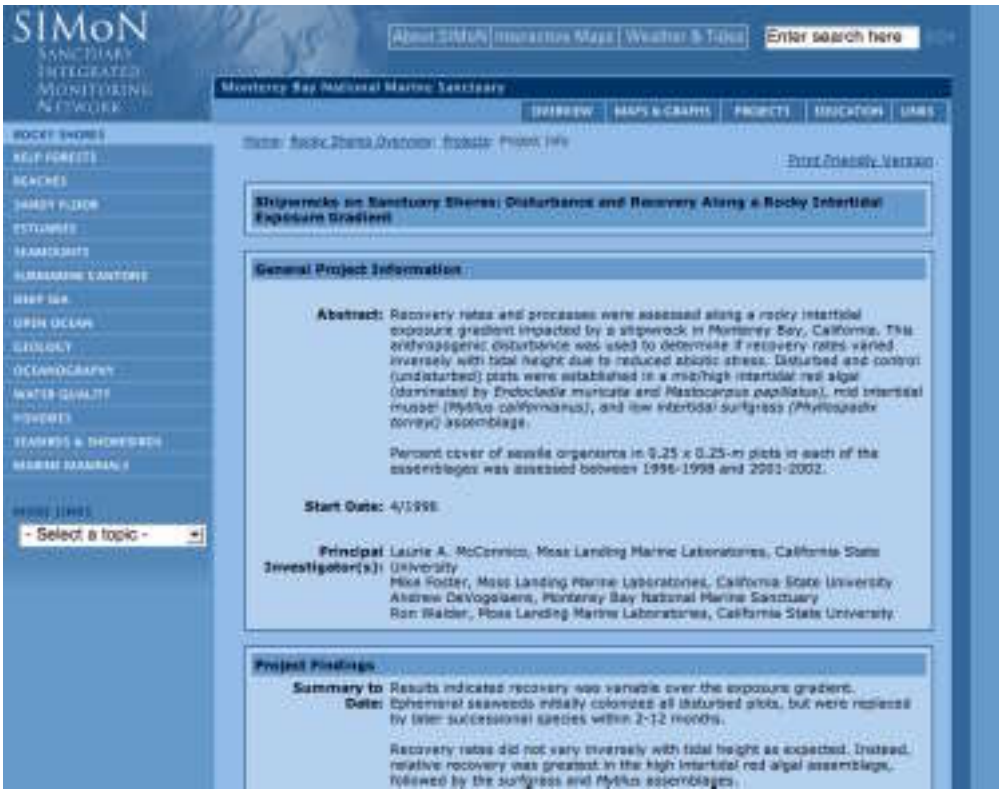
Overview page of the rocky shores section. Each section has an overview page that provides information on the natural history and monitoring issues of the habitat/issue.



Maps and graphs page of the rocky shores section. Each section has a page that uses static maps and graphs to provide specific monitoring information.



Rocky shores monitoring projects page. This page lists all of the projects stored in the SIMoN database and provides links to information on each.



Individual monitoring project page. Each project in the SIMoN database has a page showcasing the project abstract, findings, trends and supporting materials.

Outreach

As an outreach tool, the SIMoN web site provides information on habitats, issues, and events of the Monterey Bay National Marine Sanctuary. Supplied through the effective navigational structure of the web site, this information is delivered by concise textual content, high resolution imagery, and a comprehensive list of links to other sources.

The SIMoN web site is broken up into fifteen sections that represent the major habitats and issues of the Monterey Bay National Marine Sanctuary. Each of these sections have the following:

- Overview information (what it is, important issues and trends, etc)
- Static maps and graphs of interesting data
- List of relevant monitoring projects
    - Link to individual project information (containing textual and visual summary information)
- Educational material and links to educational web sites
- List of links to relevant web sites for further information on the topic

The SIMoN web site also offers an internet mapping application, SIMoN Interactive Maps, that allows users to dynamically create maps using Sanctuary GIS data. This high powered feature of the SIMoN web site allows users to take a virtual tour of the Monterey Bay National Marine Sanctuary by creating maps with the scale, location, and data layers of their choosing. User documentation and tutorials are provided for reference and effective use of this outreach tool.

Integration

The SIMoN web site serves to integrate the various monitoring programs in the Monterey Bay National Marine Sanctuary, including those implemented by SIMoN staff. By providing a single platform where summary information of these programs is presented, the web site provides a comprehensive overview of resource monitoring in the Sanctuary. This integration allows visitors of the SIMoN web site to accomplish various goals, depending on what user group they are part of. Each of these user groups and their goals for monitoring program information are described below:

- General public and educators
    - Find out what is being done to monitor the health of particular habitats and the Sanctuary in general
    - Gain new knowledge that allows them to judge the health and status of the Sanctuary
- Resource managers
    - Find up-to-date results of specific monitoring efforts helpful to management decisions
    - Find new programs working in the managers area of interest

- Marine scientists
  - Find relevant monitoring efforts unknown to them, which may lead to unanticipated partnerships
  - Find answers to questions being addressed by other monitoring efforts
  - Showcase their own monitoring project on the SIMoN web site

The SIMoN database stores information on over 50 monitoring projects and the web site makes them accessible. Projects are primarily grouped according to the web site section (habitat and issue) that they are most relevant to. They are secondarily grouped by institution(s) responsible for the project. Users may use either of these options for finding projects on the web site or take advantage of the user defined keyword search function to locate a project.

Statistiscs

Various statistics to-date of the SIMoN web site include:

- Released October 29, 2003
- > 220,000 hits
- > 1,400 unique visitors
- 50 monitoring projects presented
- 60 contributing institutions/organizations
- 98 contributing principal investigators

Other Reports and Presentations

Scientific information will only be applied to resource management issues if it is shared with potential users. The Sanctuary research team uses a variety of venues to present our research findings. Below are abstracts developed by memebers of the research team for professional conferences, technical reports, book chapters, and scientific publications in 2003.

Andrews, A.H.[1], G.M. Cailliet[1], L.A. Kerr[1], K.H. Coale[1], C. Lundstrom[2], and A.P. DeVoglaere[3]. [1]Moss Landing Marine Laboratories, [2]University of Illinois - Urbana Champaign, [3]Monterey Bay National Marine Sanctuary.
INVESTIGATIONS OF AGE AND GROWTH FOR THREE DEEP-SEA CORALS FROM THE DAVIDSON SEAMOUNT OFF CENTRAL CALIFORNIA. *Chapter submitted for the Proceedings of the Deep Sea Coral Symposium, Erlangen, Germany.*

Recent investigations of the Davidson Seamount off central California using a remotely operated vehicle have revealed communities rich with deep-sea corals. During these observations several corals were collected and three colonies were made available for an age and growth study. The colonies examined were identified as bubblegum coral (*Paragorgia sp.*), bamboo coral (*Keratoisis sp.*), and precious coral (*Corallium sp.*). Age was estimated from growth zone counts

made in skeletal cross sections. These age estimates were used to estimate growth rates and colony age. Estimated growth rates determined for each species were quite different. The bubblegum coral had a relatively high estimated growth rate, with the precious and bamboo coral being slow growing. These age and growth observations were evaluated relative to other studies on similar species and an attempt was made to validate the age and growth estimates with an independent radiometric ageing technique (e.g. lead-210 dating). This approach was not successful for the bubblegum coral and was successful for the bamboo and precious corals to differing degrees. For the bamboo coral a minimum colony age of about 200 yr was determined. For the precious coral a linear growth rate of approximately 0.25 cm/yr led to a colony age of about 115 yr; however, based on the radial growth rate an age of up to 200 yr is applicable.

Andrews, A.H.[1], L.A. Kerr[1], G.M. Cailliet[1], K.H. Coale[1], and A.P. DeVogelaere[2]. [1]Moss Landing Marine Laboratories, [2]Monterey Bay National Marine Sanctuary. **DETERMINING THE AGE AND GROWTH OF THREE SPECIES OF DEEP-SEA CORAL FROM THE DAVIDSON SEAMOUNT OFF CENTRAL CALIFORNIA.** *Oral presentation at the Deep Sea Coral Symposium, Erlangen, Germany.*

Recent investigations of the Davidson Seamount off central California using a remotely operated vehicle have revealed communities rich with deep-sea corals. During these observations several corals were collected and three colonies were made available for an age and growth study. The colonies examined in this study were identified as bubblegum coral (*Paragorgia sp.*), precious pink coral (*Corallium sp.*), and bamboo coral (*Keratoisis sp.*). Age was estimated from growth zone counts made in skeletal cross sections. These age estimates were used to estimate growth rates, and ultimately colony age and perhaps longevity. To validate the growth rate estimates from growth zone counts a radiometric

Bamboo coral (*Keratoisis sp.*) on the Davidson Seamount. Photo: NOAA/MBARI.

method called lead-210 dating was used to determine an independent growth rate for each colony. Agreement of growth rates derived from growth zone counts and lead-210 dating were used as an indicator of age estimate accuracy. Growth rates determined for each species were quite different. The bubblegum coral had a relatively high growth rate, with the precious pink coral being somewhat intermediate and the bamboo coral being the slowest growing.

Bizzarro, J.J.[1], J.M. Field[1], H.G. Greene[1], R.N. Lea[2] and J. de Marignac[3]. [1]Center for Habitat Studies, Moss Landing Marine Laboratories, [2]California Department of Fish and Game, [3]Sanctuary Integrated Monitoring Network (SIMoN), Monterey Bay National Marine Sanctuary.

HABITAT ASSOCIATIONS OF UPPER SLOPE ROCKFISHES (SEBASTES SPP.) AND CO-OCCURRING DEMERSAL FISHES IN THE HEADWARD PART OF ASCENSION CANYON, CA. *Poster presentation at the Sanctuary Currents Symposium, Seaside, CA.*

Due to their typical life history patterns (slow growth, late age at maturity, and extreme longevity) deep-water rockfishes (Sebastes spp.) are especially susceptible to overfishing, as evidenced by recent declines in most commercially targeted stocks. To establish effective Marine Protected Areas (MPAs), the interaction between fishes and their available habitats must be determined. Our objectives were to describe habitat associations for rockfishes and co-occurring fish species within the headward part of Ascension Canyon at large (100s of meters to kilometers) and small (10s of meters) scales. Geologic structure and lithology were investigated using high-resolution multibeam bathymetric and backscatter data. These data were interpreted to produce habitat maps of the study area. Seafloor features and fish assemblages were then surveyed using the Delta submersible along 50-meter depth contours, between 200 and 350 meters. Thirty-two ten minute transects were completed between two distinct large-scale habitat types. At 200 and 250 m, stripetail (Sebastes saxicola) and greenstripe (S. elongatus) rockfishes were the dominant fish species. At 300 and 350 m, splitnose (S. diploproa) and shortspine thornyhead (Sebastolobus alascanus) were the most abundant rockfishes. Large and small-scale habitat associations of these and several other commercially important demersal fishes were also determined.

Burton, E.J.[1], A.P. Devogelaere[1], R.E. Kochevar[2], G.M. Cailliet[3], T. Trejo[3], S.R. Benson[4], D.A. Clague[5], M.N. Tamburri[6], and W.J. Douros[1]. [1]Monterey Bay National Marine Sanctuary, [2]Monterey Bay Aquarium, [3]Moss Landing Marine Laboratories, [4]NOAA Fisheries, [5]Monterey Bay Aquarium Research Institute, [6]Alliance for Coastal Technologies.

EXPLORING DAVIDSON SEAMOUNT: BIOLOGICAL CHARACTERIZATION AND PROTECTION. *Poster presentation at the Deep Sea Biology Symposium, Coos Bay, OR.*

The Davidson Seamount is an impressive geologic feature located 120 km

southwest of Monterey, California. This inactive volcano is roughly 2,300 m tall and 40 km long, yet its summit is far below the ocean surface (1,300 m). In May 2002, a diverse group of scientists led by the Monterey Bay National Marine Sanctuary embarked on an exploration to more fully characterize the Davidson Seamount. Using the research vessel *Western Flyer* and ROV *Tiburon*, we completed 6 full-day dives and recorded 90 hours of video from all depths of the seamount. Meanwhile, at the surface, a team counted seabirds and marine mammals. We collected 104 rock samples, 21 sediment cores, 123 biological samples, and 3 trash items. The crest of Davidson Seamount had the highest diversity of species, including large gorgonian corals and sponges. While detailed analyses are still in progress, it is clear that these assemblages of species are arranged in previously undiscovered large, contiguous patches, and are susceptible to physical disturbance. The number of new species is unknown, but with the samples collected and associated digital video, there is a potential to describe several. At least 4 rare fishes were observed and many invertebrates have yet to be identified. Our work is helping resource managers make a decision regarding inclusion of the Davidson Seamount into the Monterey Bay National Marine Sanctuary boundary to conserve and protect the species and habitats there.

Burton, E.J.[1], A.P. DeVogelaere[1], R.E. Kochevar[2], G.M. Cailliet[3], T.Trejo3, S.R. Benson[4], D.A. Clague[5], M.N. Tamburri[6], and W.J. Douros[1]. [1]Monterey Bay National Marine Sanctuary, [2]Monterey Bay Aquarium, [3]Moss Landing Marine Laboratories, [4]NOAA Fisheries, [5]Monterey Bay Aquarium Research Institute, [6]Alliance for Coastal Technologies.

EXPLORING DAVIDSON SEAMOUNT: BIOLOGICAL CHARACTERIZATION AND PROTECTION. *Poster presentation at the Western Society of Naturalists Meeting, Long Beach, CA.*

The Davidson Seamount is an impressive geologic feature located 120 km southwest of Monterey, California. This inactive volcano is roughly 2,300 m tall and 40 km long, yet its summit is far below the ocean surface (1,250 m). In May 2002, a diverse group of scientists led by the Monterey Bay National Marine Sanctuary embarked on an exploration to more fully characterize the Davidson Seamount. Using the research vessel *Western Flyer* and ROV *Tiburon*, we completed 6 full-day dives and recorded 90 hours of video from all depths of the seamount. Meanwhile, at the surface, a team counted seabirds and marine mammals. We collected 104 rock samples, 21 sediment cores, 123 biological samples, and 3 trash items. The crest of Davidson Seamount had the highest diversity of species, including large gorgonian corals and sponges. While detailed analyses are still in progress, it is clear that these assemblages of species are arranged in previously undiscovered large, contiguous patches, and are susceptible to physical disturbance. The number of new species is unknown, but with the samples collected and associated digital video, there is a potential to describe several. At least 4 rare fishes were observed and many invertebrates have yet to be identified. Our work is helping resource managers make a decision regarding inclusion of the Davidson Seamount into the

Monterey Bay National Marine Sanctuary boundary to conserve and protect the species and habitats there.

DeVogelaere, A.[1], R. Kochevar[2], M. Tamburri[3], G. Cailliet[4], E. Burton[1], S. Benson[5], W. Douros[1]. [1]Monterey Bay National Marine Sanctuary, [2]Monterey Bay Aquarium, [3]Alliance for Coastal Technologies, [4]Moss Landing Marine Laboratories, [5]NOAA Fisheries.

EXPLORING THE DAVIDSON SEAMOUNT: COMBINING SCIENCE, PUBLIC OUTREACH, AND RESOURCE MANAGEMENT. *Chapter Submitted for the Proceedings of the California and the World Oceans Conference, Santa Barbara, CA.*

Scientific information is often interpreted to the public long after it has been discovered. NOAA programs and private organizations are interested in more immediate sharing of information with the public so that it can be more effectively used in resource management. The Davidson Seamount is an underwater volcano off the coast of Central California, and recent advances in technology provide the opportunity to explore and characterize the biology of this deep-sea habitat. With an interdisciplinary team of scientists, outreach specialists, and resource managers, this exploration was presented to the public as it was happening with daily updates on a web site. The public also interacted by e-mail with the explorers during the expedition. Huge corals and sponges, deep-water fishes, and the technology needed to study this deep, dark habitat particularly engaged the public, resource managers, and scientists alike. Following the cruise there was national media interest in discoveries from the expedition, not only because the findings were spectacular, but because significant efforts were made to provide the media with access to the explorers

MBARI's ROV *Tiburon*.

and images of the findings. Resource managers are already using summary information from the cruise in processes that may potentially protect Davidson Seamount habitats. Even before the scientific data has been completely analyzed, the public and resource managers have been engaged in a healthy process of information sharing. In characterizing the biology of Davidson Seamount, we found that this model of an interdisciplinary expedition effectively integrated new scientific information into public understanding and management options for a unique area.

DeVogelaere, A.[1], R. Kochevar[2], M. Tamburri[3], G. Cailliet[4], E. Burton[1], and W. Douros[1]. [1]Monterey Bay National Marine Sanctuary, [2]Monterey Bay Aquarium, [3]Alliance for Coastal Technologies, [4]Moss Landing Marine Laboratories.
EXPLORING THE DAVIDSON SEAMOUNT: COMBINING SCIENCE, PUBLIC OUTREACH, AND RESOURCE MANAGEMENT. *Poster presentation at the Sanctuary Currents Symposium, Seaside, CA.*

Scientific information is often interpreted to the public long after it has been discovered. NOAA programs are interested in more immediate sharing of information with the public so that it can be more effectively used in resource management. The Davidson Seamount is an underwater volcano off the coast of Central California, and recent advances in technology provide the opportunity to explore and characterize the biology of this deep-sea habitat. With an interdisciplinary team of scientists, outreach specialists, and resource managers, this exploration was presented to the public as it was happening with daily updates on a web site. The public also interacted by e-mail with the explorers during the expedition. Huge corals and sponges, deep-water fishes, and the technology needed to study this deep, dark habitat particularly engaged the public, resource managers, and scientists alike. Resource managers are already using summary information from the cruise in processes that may potentially protect Davidson Seamount habitats. Even before the scientific data has been completely analyzed, the public and resource managers have been engaged in a healthy process of information sharing.

DeVogelare, A.P.[1], E.J. Burton[1], T. Trejo[2], D.A. Clague[3], M.N. Tamburri[4], G.M. Cailliet[2], R.E. Kochevar[5], W.J. Douros[1]. [1]Monterey Bay National Marine Sanctuary, [2]Moss Landing Marine Laboratories, [3]Monterey Bay Aquarium Research Institute, [4]Alliance for Coastal Technologies, [5]Monterey Bay Aquarium.
DEEP SEA CORALS AND RESOURCE PROTECTION AT THE DAVIDSON SEAMOUNT, CALIFORNIA, U.S.A. *Oral presentation and chapter submitted for the Proceedings of the Deep Sea Coral Symposium.*

The Davidson Seamount is located 120 kilometers to the southwest of Monterey, along the California coast, USA. It is 2,400 meters tall; yet, it is still 1,250 meters below the sea surface. In May 2002, 90 hours of digital video was recorded from all depths of the Davidson Seamount, using a remotely operated vehicle, and deep sea coral specimens were collected. Preliminary analyses

indicate that 20 coral taxa were found, and they were almost exclusively located in high relief, crest areas. Other species were noted on or adjacent to the corals. Because of its pristine nature, as well as human threats and great potential for education, the Davidson Seamount is under consideration for protection as part of the Monterey Bay National Marine Sanctuary.

King, C.E. Monterey Bay National Marine Sanctuary.
SPATIAL ECOLOGICAL ANALYSIS OF MEGAVERTEBRATE POPULATIONS (SEAMAP). *Poster presentation at the Data Providers Meeting, Duke University, North Carolina.*

The Sanctuary Integrated Monitoring Network (SIMoN) has been designed in partnership with the regional science and management community to identify natural and human induced changes to the National Oceanic and Atmospheric Administration's (NOAA) Monterey Bay National Marine Sanctuary (SANCTUARY). Initiated in 2000 and just now fully staffed, SIMoN is intended to coordinate and enhances regional monitoring of the sanctuary. The principal goals of SIMoN are to integrate existing monitoring conducted in the SANCTUARY, initiate basic surveys or characterizations of all habitats and regions of the SANCTUARY, and specific, hypothesis-driven monitoring efforts of fixed duration, establish and maintain a series of essential long-term monitoring efforts that will continue into the future, and disseminate timely and pertinent information to resource managers and decision makers, the research community, educators, and the general public. A website will be the primary outreach vehicle, giving the user the ability to access general information regarding a specific habitat, issue or organisms. An interactive map will provide a means of visualizing the spatial distribution of every catalogued monitoring program. This availability of information facilitates communication and networking among researchers, resource managers, educators and the public. The success of SIMoN depends on the continued support of the research community. Submitting high-level project information, filling identified knowledge gaps with new research, and providing feedback are some of the ways researchers and the public help shape the future of the SIMoN website.

King C.E. Moss Landing Marine Laboratories.
FACTORS INFLUENCING THE PEDAL LACERATION FREQUENCY OF A SUBTROPICAL ANEMONE. *Master of Science Thesis, Moss Landing Marine Laboratories, Moss Landing, CA.*

Adaptation of sea anemones to changing environmental parameters such as temperature, irradiance and disturbance can manifest itself in the modification of individual size and frequency of asexual reproduction. The purpose of this study was to investigate, through manipulative field experiments and observational data, the effects that light, nutrition and disturbance have on size and asexual reproduction of Aiptasia californica, a subtropical zooxanthellate anemone that uses non-genicullate coralline algae as a common substrate

within Bahía Concepcíon, Mexico. Diversity of the symbiont (Symbiodinium sp.) was also investigated using restriction fragment length polymorphisms of partial 18S ribosomal DNA.

Results indicate that rhodolith instability is the primary determinant of pedal laceration frequency and biomass of A. californica. Biomass increases with depth, where water motion and disturbance decrease. The effects of irradiance and nutrition remain uncertain. Symbiosis occurs with one of five previously described clades of Symbiodinium. The adaptive significance of monomorphic symbiosis and worldwide symbioses are discussed.

King, C., A. DeVogelaere, S. Lonhart, and J. de Marignac. Sanctuary Integrated Monitoring Network (SIMoN), Monterey Bay National Marine Sanctuary.
A MAP OF MONITORING SITES IN THE MONTEREY BAY NATIONAL MARINE SANCTUARY. *Poster presentation at the Sanctuary Currents Symposium, Seaside, CA.*

Long-term ecosystem monitoring is a fundamental element of effective conservation and a requirement of the Monterey Bay National Marine Sanctuary's management plan. By integrating ongoing efforts at over 30 regional marine research institutions, and filling in critical gaps, the Sanctuary can gain a comprehensive understanding of its resources and processes. The Sanctuary Integrated Monitoring Network (SIMoN) has therefore been designed in partnership with the regional science and management communities to identify and track natural and human induced changes to the Sanctuary (see related poster by Lonhart et al.). This map represents SIMoN's initial effort at compiling historic and current monitoring sites. Associated with these sites are metadata, detailing who, when, where, why and how the data were collected, processed, and analyzed. These site locations represent a wide array of data types, resolution, time duration, age and complexity from varying sources, including state, federal and private organizations. However, some basic patterns are clear. For example, while the Monterey Bay is heavily studied, there are few monitoring data sets off of the Big Sur Coast. This poster presentation is interactive in that we are asking the reader to provide additional locations and contact information on data sets they feel are important. Within the next year, these data will be made available through an interactive mapping site on the World Wide Web.

King, C.[1], R. Kvitek[2], G.H. Greene[3], N. Wright[4]. [1]Sanctuary Integrated Monitoring Network (SIMoN), Monterey Bay National Marine Sanctuary, [2]California State University Monterey Bay, [3]Center for Habitat Studies, [4]California Department of Fish and Game.
INTEGRATING GEOSPATIAL TECHNOLOGIES FOR EFFECTIVE RESOURCE MANAGEMENT. *Poster presentation at the Sanctuary Currents Symposium, Seaside, CA.*

A pilot study to map the distribution of rockfish along the Monterey Formation outcrops off Del Monte Beach in Monterey, California was conducted using SCUBA sampling methods, remote sensing, and GIS technology through a cooperative, multi-agency effort. Reflective sonar (244 kHz) data were collected and processed to generate a shaded relief image, and acoustically different substrata were mosaicked and interpreted for construction of substrate maps. ArcView 3.2 was used to visualize these layers, and to plot a small sample of non-random transects) that included SCUBA diver observations. The observations made were of rockfish abundance and estimates of rocky substrate within each 2-meter wide and 10-meter long transect. Two hundred thirty-five (235) fish, belonging to 11 species were counted in 21 transects completed by SCUBA divers in September 2000. Rockfish densities were spatially and qualitatively correlated with percent cover of rock within each transect. The overall density was estimated as 2.88 +/- 0.191 (S.E.) fish per 100 m2 in transects that consisted of primarily rocky substrate. Breaking down the 21 transects into two groups of rock percent cover, 80-90% and less than 80%, yields a density twice as high in the 80-90% group. The area of study is not under any fishing protection and potentially low densities may warrant a management plan to protect the stock that is left in the area. This suite of technology holds the potential to correlate fish assemblages with habitat type, make related predictions, and develop management strategies.

Kogan, I.[1,2], C.K. Paull[1], L.Kuhnz[1], S. von Thun[1], E, Burton[2], H.G. Greene[1], J.P. Barry[1]. [1]Monterey Bay Aquarium Research Institute, [2]Monterey Bay National Marine Sanctuary.

ENVIRONMENTAL IMPACT OF A SUBMARINE CABLE: CASE STUDY OF THE ACOUSTIC THERMOMETRY OF OCEAN CLIMATE (ATOC) / PIONEER SEAMOUNT CABLE. *Oral presentation at the American Geophysical Union Meeting, San Francisco, CA.*

To better understand the potential impacts of the presence of cables on the seabed, a topic of interest for which little data is published or publicly available, a study of the environmental impacts of the ATOC/Pioneer Seamount cable was conducted. The 95 km long, submarine, coaxial cable extends between Pioneer Seamount and the Pillar Point Air Force Station in Half Moon Bay, California. Approximately two thirds of the cable lies within the Monterey Bay National Marine Sanctuary. The cable is permitted to NOAA- Oceanic and Atmospheric Research for transmitting data from a hydrophone array on Pioneer Seamount to shore. The cable was installed unburied on the seafloor in 1995. The cable path crosses the continental shelf, descends to a maximum depth of 1,933 m, and climbs back upslope to 998 m depth near the crest of Pioneer Seamount. A total of 42 hours of video and 152 push cores were collected in 10 stations along cable and control transects using the *ROVs Ventana* and *Tiburon* equipped with cable-tracking tools. The condition of the cable, its effect on the seafloor, and distribution of benthic megafauna and infauna were determined.

Video data indicated the nature of interaction between the cable and the

seafloor. Rocky nearshore areas, where wave energies are greatest, showed the clearest evidence of impact. Here, evidence of abrasion included frayed and unraveling portions of the cable's armor and vertical grooves in the rock apparently cut by the cable. The greatest incision and armor damage occurred on ledges between spans in irregular rock outcrop areas. Unlike the nearshore rocky region, neither the rocks nor the cable appeared damaged along outcrops on Pioneer Seamount. Multiple loops of slack cable added during a 1997 cable repair operation were found lying flat on the seafloor. Several sharp kinks in the cable were seen at 240 m water depths in an area subjected to intense trawling activity. Most of the cable has become buried with time in sediment substrates on the continental shelf whereas much of the cable remains exposed in sediments at deeper depths. The cable is exposed in rocky environments of the nearshore region and on all of Pioneer Seamount.

The main biological features associated with the cable were organisms utilizing the cable as substrate and occasionally as shelter. Considerable care was taken to count megafauna in video transects and macrofauna from the top 5 cm of push cores. Few differences were found between cable and control sites at the 95% confidence level. Anemones *Metridium farcimen* and *Stomphia sp.* colonized the cable and were more abundant in cable transects at most soft sediment sites. Coarse extrapolation of the transect data suggest that more than 5,000 *M. farcimen* may live on the continental shelf portion of the cable. Several other species of anemones living on the cable are common along deeper sections of the cable route. Where the cable was buried, the presence of linear rows of sea anemones proved to be a reliable indicator of the cable's position. Flatfish and rockfish apparently congregate near the cable and were as much as 1 order of magnitude more abundant near the cable at some sites.

Lonhart, S. Monterey Bay National Marine Sanctuary.
STATUS OF THE INVASIVE ALGA *UNDARIA PINNATIFIDA* IN MONTEREY HARBOR. *Oral presentation at the Western Society of Naturalists conference, Long Beach, CA.*

In the last decade, the invasive brown alga *Undaria pinnatifida* has spread throughout the Northeastern Atlantic and Southwestern Pacific, and most recently to California. In March 2000 it was detected in Los Angeles Harbor, and subsequently spread northward, reaching Monterey Harbor in 2001. *Undaria* is considered a threat because it can grow and spread quickly, and has the potential to overgrow native algae, although few studies have assessed its actual ecological impact. In October 2002 research divers surveyed the floating docks in Monterey harbor and mapped the distribution of *Undaria*. Volunteer divers used this information to begin a removal effort, diving the harbor monthly from December 2002 until April 2003. For each individual removed, researchers recorded total length, damage, reproductive status, and location. In one year volunteers removed almost 2000 *Undaria*, many of which were pre-reproductive. However, a dockside survey of the harbor in September 2003 indicated that despite these efforts the alga has spread within the harbor and is

more abundant than last year. It remains unclear whether a more concerted and systematic effort can reduce the spread of *Undaria*. This program is an on-going collaboration between the Sanctuary Integrated Monitoring Network (SIMoN) at the Monterey Bay National Marine Sanctuary, Elkhorn Slough National Estuarine Research Reserve, Department of Fish and Game, City of Monterey (Volunteer Services and Office of the Harbormaster), Moss Landing Marine Laboratories, and the University of California at Santa Cruz.

Lonhart, S. Monterey Bay National Marine Sanctuary.
AN INTEGRATED RESPONSE TO A NEW COASTAL INVASION: MONITORING AND MANAGING *UNDARIA PINNATIFIDA* IN MONTEREY BAY. *Oral presentation at the International Conference on Marine Bioinvasions, San Diego, CA.*

The Asian kelp *Undaria pinnatifida*, recognized as a marine threat because of its record of rapid spread and high abundance in invaded regions elsewhere, was first reported in 2001 from a site in the Monterey Bay region, California. Already widespread in other parts of the world, *Undaria* has recently appeared in various southern California harbors from Los Angeles to Santa Barbara. Because of its rapid population growth, high density, canopy-forming growth form and potential availability as a source of food and habitat for invertebrates, *Undaria* could have profound influences on the structure and function of our highly productive and species-rich coastal reef ecosystems. The population reported from Monterey Harbor is the northern-most known occurrence of the alga along coastal California. Regional agencies and researchers are collaborating to study: 1) the spatial extent of the invasion, 2) habitat associations, 3) seasonal dynamics of growth and reproduction, and 4) the costs/benefits of different potential eradication methods. This effort is also being used to create a regional management structure and decision-making process for rapid response to future coastal invasions.

Dr. Pamela Roe holding *Undaria pinnatifida* at Monterey Harbor.

Because the distribution of *Undaria* in central California is unknown, we are surveying *in situ* the four harbors in the Monterey Bay region and various adjacent natural sites along the open coast. To determine the phenology of the alga in its new environment (which can vary regionally), we use stratified random sampling to encompass all habitat types within each study site and across all seasons. Although eradication efforts rarely succeed, we will experimentally evaluate different methods of removal within the harbor.

Concurrent with measuring the response of *Undaria* to eradication efforts, we will monitor community composition in each of the treatments, employing multivariate analysis to assess community-wide impacts of the eradication methods and the presence/absence of *Undaria* in experimental plots.

Lonhart, S.I.[1], M. Carr[2], M.Fuller[2], M. Graham[3], S. Pryor[4], C. Syms[2], R. Walsh[2], and K. Wasson[5]. [1]Sanctuary Integrated Monitoring Network (SIMoN), Monterey Bay National Marine Sanctuary, [2]University of California, Santa Cruz, [3]Moss Landing Marine Laboratories, [4]City of Monterey Harbor and Marina, [5]Elkhorn Slough National Estuarine Research Reserve.

AN INTEGRATED RESPONSE TO A NEW COASTAL INVASION: MONITORING AND MANAGING *UNDARIA PINNATIFIDA* IN MONTEREY BAY. *Poster presentation at the Sanctuary Currents Symposium, Seaside, CA.*

The Asian kelp *Undaria pinnatifida*, recognized as a marine threat because of its record of rapid spread and high abundance in invaded regions elsewhere, was first reported in 2001 from a site in the Monterey Bay region, California. Already widespread in other parts of the world, *Undaria* has recently appeared in various southern California harbors from Los Angeles to Santa Barbara. Because of its rapid population growth, high density, canopy-forming growth form and potential availability as a source of food and habitat for invertebrates, *Undaria* could have profound influences on the structure and function of our highly productive and species-rich coastal reef ecosystems. The population reported from Monterey Harbor is the northern-most known occurrence of the alga along coastal California. Regional agencies and researchers are collaborating to study: 1) the spatial extent of the invasion, 2) habitat associations, 3) seasonal dynamics of growth and reproduction, and 4) the costs/benefits of different potential eradication methods. This effort is also being used to create a regional management structure and decision-making process for rapid response to future coastal invasions.

Lonhart, S.I., A. DeVogelaere, C. King, and J. de Marignac. Sanctuary Integrated Monitoring Network (SIMoN), Monterey Bay National Marine Sanctuary.

THE SANCTUARY INTEGRATED MONITORING NETWORK (SIMoN): A NEW PROGRAM AT THE MONTEREY BAY NATIONAL MARINE SANCTUARY. *Poster presentation at the Sanctuary Currents Symposium, Seaside, CA.*

Comprehensive, long-term monitoring is a fundamental element of resource management and conservation. The Sanctuary Integrated Monitoring Network (SIMoN) has been designed in partnership with the regional science and management community to identify natural and human induced changes to the National Oceanic and Atmospheric Administration's (NOAA) Monterey Bay National Marine Sanctuary (MBNMS). The integration of high quality scientific research and long-term monitoring data sets through this program will furnish the information needed for effective management and provide a greater basic understanding of the Sanctuary, its resources and its processes. The principal

goals of SIMoN are to: 1) integrate existing monitoring conducted in the MBNMS; 2) initiate basic surveys or characterizations of all habitats and regions of the MBNMS, and specific, hypothesis-driven monitoring efforts of fixed duration; 3) establish and maintain a series of essential long-term monitoring efforts that will continue into the future; and 4) disseminate timely and pertinent information to resource managers and decision makers, the research community, educators, and the general public.

McConnico, L.[1], M. Foster[1], R. Walder[1], A. DeVogelaere[2]. [1]Moss Landing Marine Laboratories, [2]Monterey Bay National Marine Sanctuary.
SHIPWRECKS ON SANCTUARY SHORES: DISTURBANCE AND RECOVERY ALONG A HEIGHT GRADIENT IN THE ROCKY INTERTIDAL ZONE. *Oral presentation at the Western Society of Naturalists Meeting, Long Beach, CA.*

The shipwreck and subsequent salvage of a fishing vessel in Monterey Bay, California (1996) caused physical and chemical damage over a gradient from the low to high rocky intertidal. Recovery from this anthropogenic disturbance was monitored and data were used to examine patterns of recovery and variability in recovery rates across the range of tidal heights. Disturbed and control (undisturbed) plots were established in a mid/high intertidal red algal (dominated by *Endocladia muricata* and *Mastocarpus papillatus*), mid intertidal mussel (*Mytilus californianus*), and low intertidal surfgrass (*Phyllospadix torreyi*) assemblage. Percent cover of sessile organisms in 0.25 x 0.25-m plots in each of the assemblages was assessed between 1996-1998 and 2001-2002. Results indicated recovery varied over the exposure gradient. Ephemeral seaweeds initially colonized all disturbed plots, but were replaced by later successional species within 2-12 months. Contrary to expectations, recovery rates did not vary inversely with tidal height. Instead, relative recovery was greatest in the high intertidal red algal assemblage, followed by surfgrass, and *Mytilus* assemblages. The patterns of recovery suggest that assemblages characterized by a few dominant species that recruit rapidly and grow quickly will recover faster than those dominated by organisms with variable, episodic recruitment, or those that have limited success with sexual reproduction relative to vegetative propagation.

Nevins, H.[1], K. Newton[2], J.T. Harvey[1], S.t Benson[1], A. DeVogelaere[2]. [1]Moss Landing Marine Laboratories, [2]Monterey Bay National Marine Sanctuary.
BEACH COMBERS: MONITORING CHANGES IN OILING RATES OF BEACHED MARINE BIRDS IN THE MONTEREY BAY NATIONAL MARINE SANCTUARY.
Poster presentation at the Sanctuary Currents Symposium, Seaside, CA.

In 1997, we initiated the Coastal Ocean Mammal and Bird Education and Research Survey (Beach COMBERS) to monitor deposition rates of marine birds within the Monterey Bay National Marine Sanctuary (MBNMS). Chronic oil pollution, originating from leaking shipwrecks, urban runoff, and additional non-point sources, continues to affect seabirds in the MBNMS. The average oiling rate (percent oiled carcasses km^{-1} $month^{-1}$) during 1997-2002 (2 %) was less

than recorded during 1971 – 1985 (8 %) by Pt. Reyes Bird Observatory. During 1997-2002, the greatest percentage of oiled birds occurred during November to May (2.2 – 9.8 %), and the least oiling rate occurred during June to October (0.2 – 2.1 %). Beach COMBERS recorded the greatest numbers of oiled birds during the 1997-98 Pt. Reyes Tarball Incidents. Species composition of oiled birds was similar among surveys, affecting mainly alcids (17- 20 %), and wintering loons (9 %), and grebes (7 %). Our comparison with past data indicates that oil pollution prevention measures implemented during the past 20 years have likely reduced oiling rates. However, the persistent occurrence of oiling (71 % of surveys have at least 1 oiled bird) indicates that chronic oiling is still a major problem for both resident and migratory seabirds in the MBNMS. Continued efforts to monitor oiling rates and document species-specific deposition patterns will aid sanctuary managers and help to identify those seabirds most vulnerable to oil pollution.

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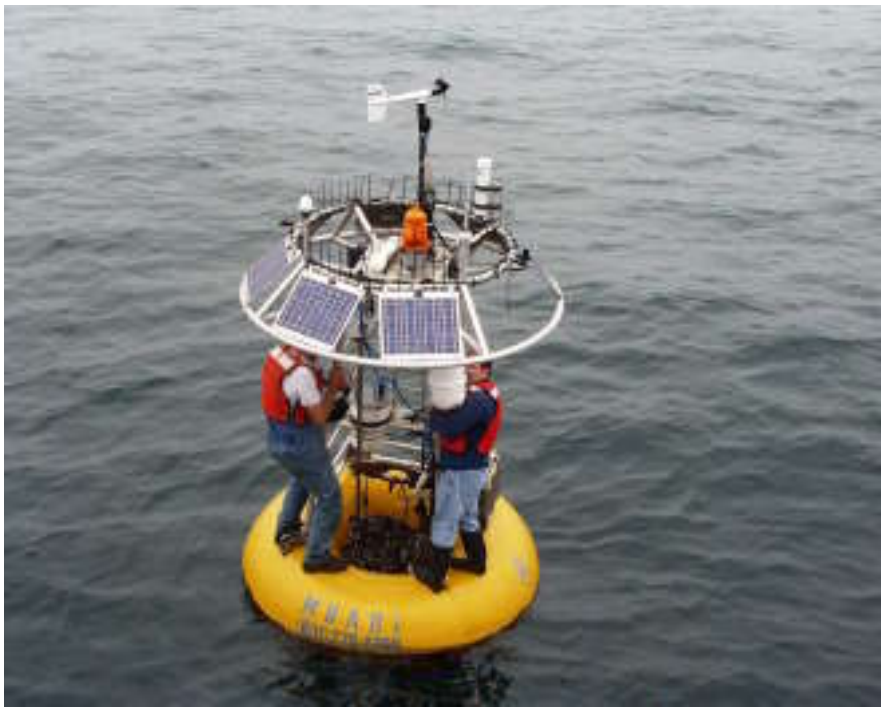
OCEAN OBSERVING AND MODELING SYSTEM DEVELOPMENTS AROUND MONTEREY BAY. *Chapter submitted for the Proceedings of the California and the World Oceans Conference, Santa Barbara, CA.*

MBARI mooring.



Participants within the Center for Integrated Marine Technologies are helping to bridge the gaps between disciplines within the marine sciences and between marine scientists and present and potential users of information from our coastal waters (*http://cimt.ucsc.edu*). CIMT is one of several projects making use of the wide range of interests and expertise around Monterey Bay as a "natural laboratory" for the understanding of coastal ocean processes and better dissemination of this understanding to the public. The scientific organizing theme of the Center, "wind-towhales," points out the complexities and interconnectedness of coastal marine ecosystems. No less complex is the adaptation of technology within the harsh ocean environment over extended periods of time and the efficient communication and archival of the data collected by the instruments deployed, which are the core technological goals of CIMT.

Pederson, J., S. Lyberg, and S. Smith. Monterey Bay National Marine Sanctuary, Monterey Bay Sanctuary Foundation.
THE SIMON WEBSITE AS A TOOL FOR SHARING MONITORING INFORMATION OVER THE INTERNET. *Poster presentation at the Western Society of Naturalists Meeting, Long Beach, CA.*

SIMoN, the Sanctuary Integrated Monitoring Network, is a comprehensive, long-term program designed to promote better understanding and protection of the Sanctuary and its resources. By gathering data on the historical and on-going monitoring efforts of over 40 research institutions operating within the MBNMS, SIMoN is able to provide important information to researchers, managers and the public. The internet is the primary medium SIMoN uses to disseminate this monitoring information. For each of the major habitats and issues in the Monterey Bay National Marine Sanctuary the SIMoN website shares overview information, maps and graphs, details on current and historic monitoring projects, educational materials, and links to other relevant websites. Coupled with an internet mapping application that allows users to create maps using MBNMS GIS data layers, the SIMoN website is an innovative new approach to sharing monitoring-based information with a wide audience. SIMoN is a collaborative effort, managed by the Monterey Bay National Marine Sanctuary in cooperation with the Monterey Bay Sanctuary Foundation and the Monterey Bay Aquarium.

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THE LIMITS TO BIOGEOGRAPHICAL DISTRIBUTIONS:INSIGHTS FROM THE NORTHWARD RANGE EXTENSION OF THE MARINE SNAIL, *KELLETIA KELLETII* (FORBES, 1852). *Journal of Biogeography 30:913–924.*

The development of accurate models predicting species range shifts in response

to climate change requires studies on the population biology of species whose distributional limits are in the process of shifting. We examine the population biology of an example system using the recent northward range expansion of the marine neogastropod *Kelletia kelletii* (Forbes, 1852).

This is a marine coastal shelf neogastropod species whose range extends from Isla Asuncion (Baja California, Mexico) to Monterey (CA, USA). Research sites spanned the extent of the range.

We examine abundance distributions and size frequency distributions of K. kelletii for evidence of factors determining historic and contemporary distributional patterns. Population studies were supplemented by historic and contemporary hydrographic data, including seawater temperature data from California Cooperative Oceanic Fisheries Investigations (CalCOFI) and National Data Buoy Center (NDBC), and seawater circulation data.

The structure of recently established populations varied dramatically from that of historic populations. Markedly low densities and irregular size frequency distributions characterized recently established populations and suggested only occasionally successful recruitment. The point of transition between historic and recently established populations also corresponded to the location of a gradient in seawater temperature and the confluence of two major oceanic currents. The accumulated data suggest that temperature and/or barriers to dispersal could have set both contemporary patterns in population structure as well as the former northern range limit.

Early life stages play a critical role in determining distributional patterns of *K. kelletii.* Dispersal barriers and temperature limitation are two plausible mechanisms that could determine both contemporary and historic distributional patterns. Future studies on this species should attempt to tease apart the relative importance of these factors in maintaining the populations at the northern edge of the range.

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