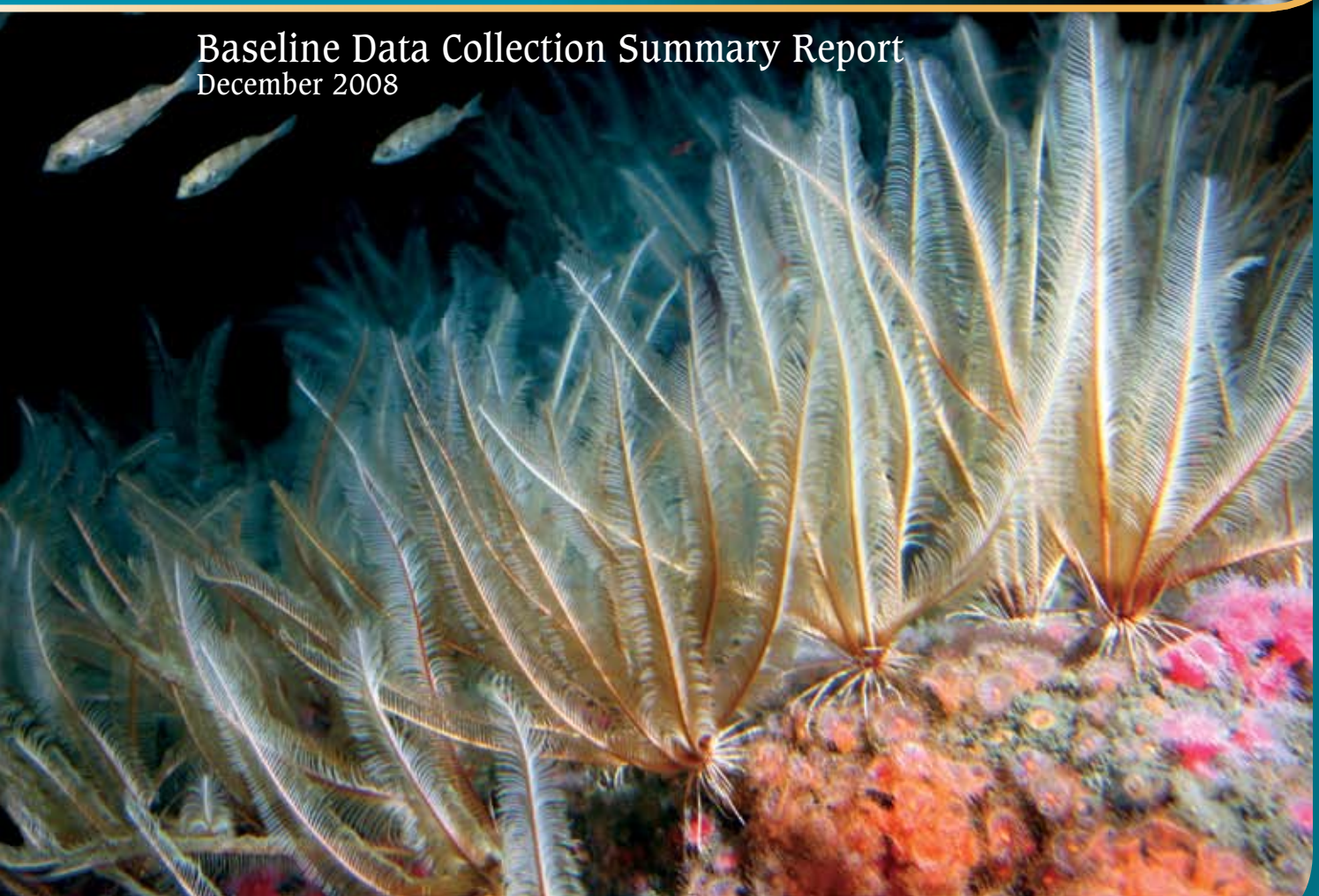
California's Central Coast Marine Protected Areas

Baseline Data Collection Summary Report

December 2008



SMCA = state marine conservation area SMP = state marine park
SMR = state marine reserve SMRMA = state marine recreational management area

Central Coast Marine Protected Areas Baseline Data Collection Projects

This report summarizes the 2007-08 Central Coast Marine Protected Areas Baseline Data Collection Projects, which were a collaborative effort between California's State Coastal Conservancy, Ocean Protection Council, California Department of Fish and Game (CDFG), and the California Sea Grant College Program.

The central coast marine protected areas (MPAs) were designated April 13, 2007 by the California Fish and Game Commission under the state's Marine Life Protection Act (MLPA) of 1999 and took effect Sept. 21, 2007. This new network effectively launched California's MLPA Program, which was designed to better conserve marine resources for their long-term sustainable use while enhancing outdoor recreation and ocean research opportunities along the coast.

The Central Coast Study Region (CCSR) was the first of five statewide study regions to complete the MLPA planning and implementation process and extends from Pigeon Point in San Mateo County, southward to Point Conception in Santa Barbara County (see map).

As mandated by the MLPA, the CCSR process (2004-2007) examined all existing MPAs within the CCSR and created a suite of new MPAs along the central coast that will be part of a statewide network of MPAs once MLPA implementation is completed. The series of 29 marine protected areas represent approximately 204 square miles (or approximately 18%) of state waters in the study region.

The central coast MPAs include:

- 15 State Marine Conservation Areas (SMCA), which limit recreational and commercial fishing.
- 13 "no-take" State Marine Reserves (SMR); a total of 85-square miles and;
- 1 State Marine Recreational Managed Area (SMRMA), Morro Bay State Marine Recreational Management Area, where recreational fishing is limited or restricted.

The five baseline characterization studies administered by California Sea Grant were conducted from June 2007-May 2008. The data collected will provide a baseline against which to measure future changes in living marine resource abundance and diversity. The data will be maintained in a database to be created by the MPA Monitoring Enterprise. These five projects are summarized in the following pages:

R/MPA-1 Surveys of Shallow-Water Rocky Reef Communities
Mark Carr, UCSC, 831.459.3958, carr@biology.ucsc.edu

R/MPA-2 Baseline Data Collection for Rocky Intertidal Marine Protected Areas in the Central Coast
Peter T. Raimondi, UCSC, 831.459.5674, raimondi@biology.ucsc.edu

R/MPA-3 Baseline Surveys of Deep-Water Demersal Communities in and near Central Coast MPAs
Richard M. Starr, CSGEP/MLML, 831.771.4442, starr@mlml.calstate.edu
Mary M. Yoklavich, NOAA/SWFSC, 831.420.3940, mary.yoklavich@noaa.gov

R/MPA-4 Collaborative Surveys of Nearshore Fishes in and Around Central Coast MPAs
Dean E. Wendt, CPSLO, 805.756.2988, dwendt@calpoly.edu
Richard M. Starr, CSGEP/MLML, 831.771.4442, starr@mlml.calstate.edu

R/MPA-5 Socioeconomic Baseline Data Collection, Resource-Use Mapping and Rapid Social Assessment
John S. Petterson, IA, 858.459.0142, iaia.san.rr.com
Edward W. Glazier, IA, 858.459.0142, iaia.san.rr.com

Front cover photos: Widow rockfish, Tom Laidig; Canary rockfish, Rick Starr; Feather stars and strawberry anemones, Brian Tissot; metridium, Tom Laidig
Back cover photo: Crinoid, Brian Tissot

Surveys of Shallow-Water Rocky Reef Communities

R/MPA-1 *June 2007-May 2008*
Mark Carr, *UC Santa Cruz*

Summary

In this project, scientists quantified fish, benthic invertebrate and macro algal assemblages in kelp forests of the central coast marine protected areas (MPAs) and associated reference sites. The survey design and sampling protocols were modeled after the large-scale, long-term monitoring program developed by the Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO) and incorporated into the Cooperative Research and Assessment of Nearshore Ecosystems (CRANE) program. As in the CRANE program, the project used divers to count fishes, invertebrates and algae. The baseline data collected during this project will make it possible to monitor the effects of the MPAs on kelp forest ecosystems, including commercially and recreationally harvested species.

"No one has ever mobilized such a massive survey to characterize kelp forest ecosystems throughout Central California," says the project's leader Mark Carr, a professor in the Department of Ecology and Evolutionary Biology at UC Santa Cruz. "The sheer amount of detailed data collected for this project is what is truly impressive."

Sites Surveyed

Divers surveyed kelp forest habitat between depths of 5 meters (m) and 20 m at 14 MPAs, including Asilomar State Marine Reserve (SMR); Big Creek SMR; Cambria State Marine Conservation Area (SMCA); Carmel Bay SMCA; Carmel Pinnacles SMR; Edward F. Ricketts SMCA; Lovers Point SMR; Natural Bridges SMR; Pacific Grove Marine Gardens SMCA; Point Sur SMR; Point Lobos SMR; Point Buchon SMR and White Rock SMCA. As with the other monitoring projects, a reference site for each MPA was also surveyed.

Close-up of a giant kelp blade and snail

Steve Lonhart, NOAA SIMoN

"No one has ever mobilized such a massive survey to characterize kelp forest ecosystems throughout Central California. The sheer amount of detailed data collected for this project is what is truly impressive."

Mark Carr, Department of Ecology and Evolutionary Biology at UC Santa Cruz

PISCO divers return to the R/V FULMAR after a survey at Plaskett Rock.

Steve Lonhart, NOAA SIMoN

Method

Each MPA and its reference site were surveyed once between June and October 2007.

For each survey, divers swam multiple 30-meter-long transects at multiple depths, identified all conspicuous fishes and noted their sizes (in training workshops they were taught how to do this). They also sampled the species composition and percent bottom cover of macro invertebrates and macro algae along multiple transects. Rock type and vertical relief was also recorded at select sites. Water temperatures were measured throughout the study, too.

It is worth noting that these are the same methods being used in MPAs in the Santa Barbara Channel.

PISCO divers at a kelp bed at Weston Cove in the Point Lobos State Marine Reserve Steve Lonhart, NOAA SIMoN

For detailed information about the survey method visit: http://www.piscoweb.org/research/community/subtidal/protocols.

Data Overview

A total of 29 trained divers spent more than 1,200 hours surveying about 7,520 acres of shallow kelp forest habitat. They counted (and sized) about 39,000 fish, representing 56 taxa; 71,000 macro invertebrates, representing 41 taxa and 67,000 canopy-forming kelps, representing nine taxa.

From the raw data, scientists will be able to compute site-specific estimates of fish densities, species richness, relative fish abundances and fish size distributions, as well as relative densities and percent bottom cover of macro invertebrates and algae.

Key Observations

1. Kelp forest communities in Central California are not uniform, says Steve Lonhart, a biologist and diver at the Monterey Bay National Marine Sanctuary, who participated in the project. Geology explains some of the differences. In kelp forests growing on large vertical pinnacles, rich invertebrate communities dominate the bottom. In contrast, sandy channels mixed with car-sized boulders and low outcrops create numerous microhabitats. These prevent dominance by either invertebrates or macro algae.

   Big Sur, for example, provides habitat for several rarely seen species in Monterey Bay. "Diving along the Big Sur coast is an entirely different experience," Lonhart says. "There is a greater sense of adventure, in part because of the logistics of diving in such a remote location, but also because Big Sur represents a relatively pristine ecosystem that we are only now starting to explore in depth."

2. Kelp canopy cover cannot be used reliably to infer bottom habitat, community structure or otherwise characterize a site. "We have seen too many cases where kelp cover is not a good surrogate," Lonhart says. "You might see a thick kelp bed at the surface but the site has relatively few fishes, low invertebrate cover and few algal species. Similarly, a site with little kelp cover could have an incredibly rich invertebrate community and lots of fish."

Conclusions

This project has led to the collection of a huge amount of statistically rigorous data on kelp forest fishes, algae and invertebrates. The data establish the beginnings of a monitoring program for detecting the effects of the central coast MPAs on kelp forest ecology. Because of this project, scientists can now compare kelp forests at the start of the MPA process. The data may also prove useful in tracking and modeling ecosystem-level responses to fishing and climate change.

Cooperating Organizations

NOAA's Monterey Bay National Marine Sanctuary
Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO)
Institute for Marine Sciences at UC Santa Cruz
Kenneth S. Norris Rancho Marino Reserve of the UC Natural Reserve System

*A china rockfish (*Sebastes nebulosus*) emerges from a crevice.* Steve Lonhart, NOAA SIMoN

Contact:

Mark H. Carr
UC Santa Cruz
Long Marine Laboratory
831.459.3958
carr@biology.ucsc.edu

Baseline Data Collection for Rocky Intertidal MPAs in the Central Coast

R/MPA-2 *June 2007-May 2008*
Peter Raimondi, *UC Santa Cruz*

Summary

In this project, scientists surveyed rocky intertidal areas (tide pools) within the central coast marine protected areas (MPAs) and associated reference sites.

They coordinated their sampling with the two largest rocky intertidal monitoring programs in the state—Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO) and Multi-Agency Rocky Intertidal Network (MARINe). The main goal was to document community structure of target assemblages (e.g., mussels, barnacles and surfgrass), as well as to quantify abundances and sizes of key species (e.g., abalone, owl limpets and seastars). They also recorded biodiversity hotspots and species-habitat associations. With this baseline data, scientists may be able to detect changes in intertidal areas associated with the MPAs.

"There is a great need to capture the diversity of sites and to map it in 3D," says the project's leader, professor Peter Ramondi of the Department of Ecology and Evolutionary Biology at UC Santa Cruz.

"The intertidal is where most people interact with the shoreline," he says. "These areas are very sensitive to trampling, collecting, development and agricultural and urban runoff."

Tide pool in Santa Cruz Mila Zinkova, Wikipedia

"The intertidal is where most people interact with the shoreline. It is very sensitive to trampling, collecting, development and agricultural and urban runoff."

Pete Raimondi, Department of Ecology and Evolutionary Biology at UC Santa Cruz

Scientists carefully avoided stepping on fragile organisms as they counted species. UC Santa Cruz

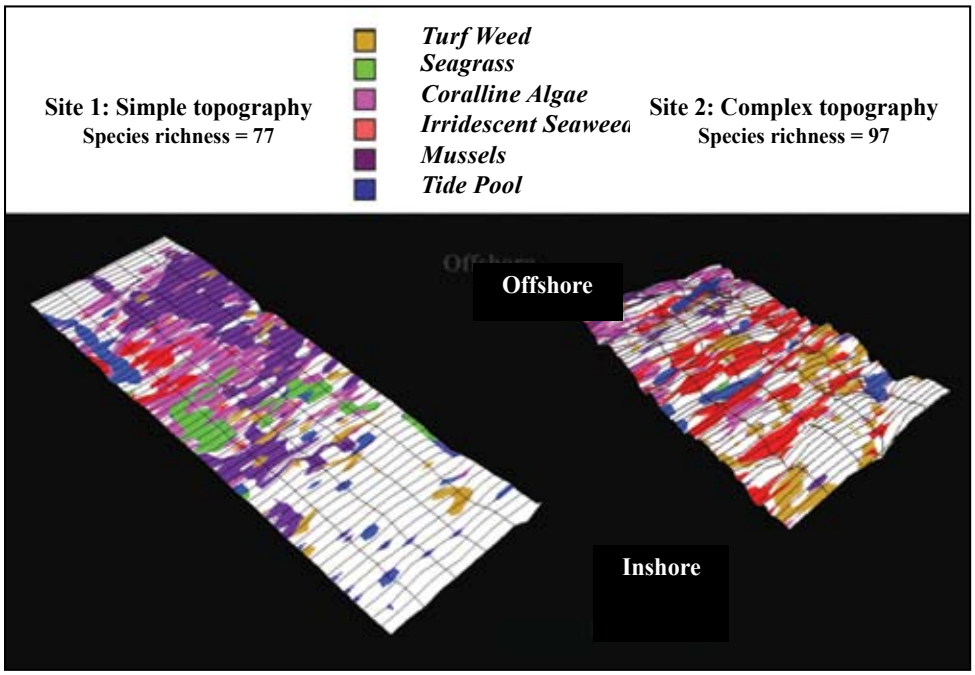
Sites Surveyed

Scientists surveyed all 12 of the MPAs with rocky intertidal ledges and benches, as well as associated reference sites. Their study did not include cobble and boulder beaches.

Method

As mentioned in the summary, scientists employed two standardized field methods for documenting intertidal ecology: MARINe techniques for describing community structure and PISCO ones for characterizing biodiversity.

All fieldwork was conducted shore-side, on foot, during low tide. Scientists either laid out grids with meter tape or used survey equipment to mark off measured rectangles within which all species and their sizes were counted.



Scientists created 3-D models of the topography and species diversity that will be useful in monitoring changes over time.

Pete Raimondi, UC Santa Cruz

Ecological Zones

In terms of conceptualizing the ecology of the rocky intertidal, Raimondi divides the Central Coast Study Region into three distinct zones: one from Point Conception to Cayucos, another from Cayucos to Monterey, and the last from Santa Cruz to Pigeon Point.

POINT CONCEPTION TO CAYUCOS

The conspicuous absence of black abalone, historically the region's most abundant herbivore, defines the southernmost zone, Raimondi says. "Black abalone have crashed and are verging on extinction in their southern range," he says, largely because of the abalone wasting disease known as withering syndrome.

The loss of abalone has had profound consequences for community structure and diversity. "For the most part, in places without black abalone, there is an overgrowth of sessile invertebrates (sponges and tunicates), barnacles and algae," he says.

CAYUCOS TO MONTEREY

While the absence of black abalone defines the southern zone, the reappearance of these mollusks defines the middle one, as Cayucos marks the northern limit of the withering syndrome epidemics that wiped out black abalone populations to the south."We see large populations of black abalone beginning at about Cayucos," Raimondi says. "The problem is you have a lot of poaching."

Big Sur's igneous and metamorphic geology, and its inaccessibility, also distinguish this region.

"We see more owl limpets, mussels and black abalone, and they are much bigger (older) in Big Sur because they are not being harvested," he says.

Mussels are important to intertidal ecology because so many other species live within and on top of them, while owl limpets are crucial because they maintain territories, thereby preventing other species from dominating all areas. Raimondi calls both "foundation species."

SANTA CRUZ TO PIGEON POINT

To a large extent, sand and its scouring action over rocky habitat shape the biogeography of this zone.

Sand covers much of the coastline from Monterey to Santa Cruz, Raimondi explains. In northern Santa Cruz, the geology changes and sedimentary rocks dominate. Visitors see this manifested in the region's many pocket beaches and partially sand-covered rocky ledges.

"This is a very dynamic zone because of the seasonal sand scour and build up," Raimondi says. Summer swells can pile up 3 meters of sand onto beaches in a couple days. One winter swell can take it all away.Only some species (notably algae) can tolerate this level of sand scour and disturbance. "The region is its own little biologically distinct community," Raimondi says.

Conclusions

In this project, scientists identified outstanding characteristics and differences among the sites surveyed, located hotspots of biodiversity, and showed that MPAs protect parts of all these important areas. They also identified three biogeographical zones within the central coast that they expect will respond uniquely to the MPAs. Much of the Big Sur coast, for example, has been a de facto reserve and so may not change much in the future. In other areas, the creation of the MPAs might actually lead to more human visitors to the coast. This may exacerbate ecological degradation from trampling, litter and poaching and create a need for more monitoring and public education about the fragile nature of many coastal resources..

Contact:

Pete Raimondi
UC Santa Cruz
831.459.5674
raimondi@biology.ucsc.edu

Baseline Surveys of Deep-Water Demersal Communities in and near Central Coast MPAs

R/MPA-3 *June 2007-May 2008*
Richard M. Starr, *California Sea Grant Extension Program*
Mary M. Yoklavich, *NOAA's Southwest Fisheries Science Center*

Summary
In this project, scientists surveyed the fishes and macro invertebrates of deep, rocky banks and outcrops, underwater pinnacles, submarine canyons, cobble fields and mud flats of eight of the new central coast marine protected areas (MPAs) and their associated reference sites. Because these surprisingly colorful demersal habitats are beyond the reach of divers and ROVs, scientists conducted their baseline study from the submersible *Delta*.

All observed fish were identified and measured (using paired lasers). Scientists also videotaped each dive and later analyzed the images to characterize all structure-forming invertebrates and benthic habitats.

A full-color, 21-page report summarizes the habitats, fishes and invertebrates seen in each survey area (see www.csgc.ucsd.edu/BOOKSTORE/comp_publications.html). Its bar graphs, pie charts and tables meaningfully distill for readers the huge wealth of data in an easily digestible format. This page summarizes some of what was seen during the dives.

Delta *off the coast of Point Sur* Rick Starr

"As ecosystem-based management becomes more important, we will need to know more about species that are not fished. Using the submersible, we are able to identify species you cannot see any other way."

Rick Starr, California Sea Grant Extension Program

Survey Sites
The eight MPAs surveyed were Soquel Canyon State Marine Conservation Area (SMCA); Portuguese Ledge SMCA; Point Lobos State Marine Reserve (SMR) and SMCA; Point Sur SMR and SMCA, and Big Creek SMCA and SMR. For each of these sites, researchers also surveyed an appropriate reference site.

Method
Scientists directed the *Delta's* pilot to follow standard protocols for submersible surveys vetted in peer-reviewed literature. The basic idea was to divide each dive into a series of 10-minute-long transects in a pre-determined habitat, selected from multi-beam sonar benthic maps and 15 years of submersible data. High-relief rocky habitat was surveyed in three depth ranges: 30 meters (m) to 100 m; 100 m to 200 m, and 200 m to 300 m. Low-relief, soft-bottomed habitat, about which relatively little is known, was also described. Fish densities and relative fish abundances were calculated for each of the three depth ranges. Pie charts in the final report also depict relative abundances of common benthic macro invertebrates.

Cowcod Rick Starr

Data Overview
In 2007, *Delta* completed 337 transects, covering about 164,000 square m of seafloor habitat. On these, scientists observed about 66,000 fishes from 110 taxa, as well as 158,000 aggregating and 14,000 structure-forming invertebrates from 70 taxa. Biological hotspots of deep-water corals and fragile structure-forming invertebrates were also located.

Soquel Canyon SMCA
The MPA protects complex submarine canyon habitat and an amazing diversity of fish life. In addition, several species of management concern, including bocaccio, cowcod and yelloweye rockfish, were observed in

relatively high numbers. Scientists also noted the presence of the deep-sea coral *Lophelia* here. "We are just learning about deep sea corals," says the project's leader Rick Starr, a California Sea Grant marine advisor based at Moss Landing Marine Laboratories. "Most are really old, more than a hundred years old. A lot have been affected by trawling. We should know more about them. In the world of the ocean, corals are important."

Portuguese Ledge SMCA

Scientists observed a high diversity of fish species (68 taxa) but a comparatively low density of commercially fished species. "There is something about this area that makes it very productive," Starr says. "It has been fished for over 100 years. But there are still a lot of fish here."

Flag rockfish Rick Starr

Point Lobos SMR and SMCA

What is most impressive about this area is the incredible variety of invertebrates. Scientists identified, for example, 10 seastar species. "We don't really know why there are so many invertebrates," Starr says. "But the geology and geography of the area is pretty unique. There is a lot of granite rock and you are next to the Carmel submarine canyon. The high relief and high energy probably helps." The shallows have also been protected from exploitation since 1973.

In the Conservation Area, scientists noted the predominance of dwarf rockfishes, which are less than 10-inches long and are not commercially harvested.

"The prevailing hypothesis is that the bigger fish have been fished out," Starr says. "The fish that would normally eat the little guys are gone." Hence, the abundance of dwarf rockfishes not just at Point Lobos but at other survey sites.

Point Sur SMR and SMCA

Point Sur itself is a high-energy center of intense upwelling in the lea of a headland. Nearshore habitats are characterized by lots of rocky ridges and high-relief rock-sand and rock-cobble reefs. A persistent upwelling plume courses through deeper habitats. In the marine reserve, the area's high-energy, high-relief habitat creates a haven for invertebrates, including bat seastars (41 percent), red gorgonian corals and hydrocorals (30 percent) and nipple sponges (26 percent). In the Conservation Area, fish density was high (about 65 fish per 100 square m) and about half of the observed fish were young-of-the-year rockfishes. At depths between 100 m and 200 m, pygmy, greenspotted and rosethorn rockfishes and poachers were abundant.

Big Creek SMR and SMCA

The marine reserve expands protection of the existing, small Big Creek Ecological Reserve established in 1990 at the southern end of Big Sur. Its shallow habitats include sandy beach, rocky intertidal, surfgrass, kelp beds, pinnacles, rock outcrops and soft sediments. Low-relief sand and mud comprised about half of the habitat. Scientists observed 70 fish taxa in the marine reserve, reflecting the area's impressive diversity of habitats. Blue rockfish (12.7 fish per 100 square m), blackeye gobies and young-of-the-year rockfishes were particularly abundant at depths less than 100 m. In the Conservation Area, scientists observed 31 fish taxa, including a particularly rich abundance of flatfishes than at the other sites, reflecting the expanses of soft-bottom habitat in this survey area.

Conclusion

More than 75 percent of the state's central coast seafloor habitat lies at depths greater than 30 m. The data collected during this project contribute substantially to depicting a snapshot of marine life in what are among the region's most prevalent marine habitats.

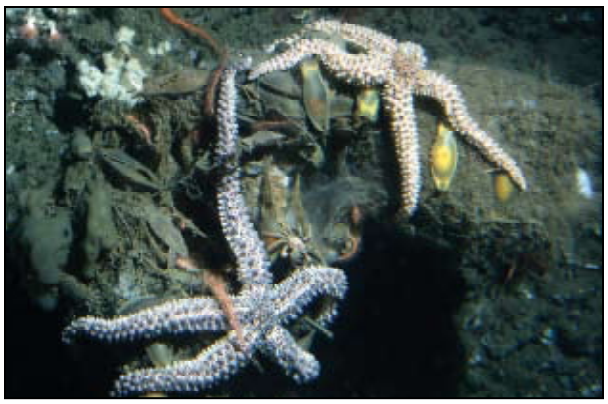
"As ecosystem-based management becomes more important, we will need to know more about species that are not fished," Starr says. "Using the submersible, we are able to identify species you cannot see any other way."

Cooperating Organizations

NOAA Fisheries Southwest Fisheries Science Center
California Department of Fish and Game
Moss Landing Marine Laboratories
Washington State University at Vancouver

Contact:

Rick Starr
California Sea Grant Marine Advisor
Moss Landing Marine Laboratories
831.771.4442
starr@mlml.calstate.edu



Fish-eating seastars on catshark eggs Rick Starr

Collaborative Surveys of Nearshore Fishes in and Around Central Coast MPAs

R/MPA-4 *June 2007-May 2008*
Dean E. Wendt, *Cal Poly San Luis Obispo*
Richard M. Starr, *California Sea Grant Extension Program*

Summary

In this project, researchers and the local fishing community jointly developed statistically rigorous protocols for using volunteer anglers to collect fisheries management data. The test-bed for this citizen science/collaborative fisheries project was to collect baseline data for three of the new central coast marine protected areas (MPAs) and their associated reference sites. The project hinged on the volunteer participation of 174 experienced recreational anglers who caught and released fish in the survey sites for set periods of time and with standardized gear.

With this high level of community support, scientists were able to identify, measure, tag and release almost 8,000 fish in a three-month period. From a scientific perspective, the species caught, their sizes and relative abundances provide an immediate snapshot of the region's bottom fishes in 2007. This snapshot or baseline can be used to track future ecological changes associated with the MPAs. The huge number of tagged fish now swimming in the region also have the potential to add substantially to what is known about local fish populations, growth rates and home range sizes of key species. Such information would be a boon to federal and state stock assessments. From a public relations and educational standpoint, the researchers leading the project strongly believe that stakeholder collaboration in the MPA monitoring project enhanced local support for the state's bold conservation plan. The value of this, they say, cannot be over-stressed.

Tom Mattusch

Researcher Noëlle Yochum of Moss Landing holds a seastar.

"One of the unique aspects of this project is that fishermen were encouraged to contribute to the science. We used fishermen's expertise to improve our sampling strategy."

Dean Wendt, Cali Poly San Luis Obispo

Noëlle Yochum

A tagged black and yellow rockfish

Sites Surveyed

Año Nuevo, Point Lobos and Point Buchon marine reserves and corresponding reference sites were surveyed.

Method

Five chartered party boats took anglers fishing at randomly selected areas within the survey sites. Fishing techniques were standardized throughout to enable scientific analysis of the angler data: All anglers, for example, fished with the same kinds of hooks. Baits, jigs and lures were also standardized. Although consistency was paramount in the data collection phase of the project, the fishing community provided valuable insight in designing and selecting the gear used. To reduce pressure-induced injuries in caught fishes, fishing was limited to waters shallower than 40 meters.

Each commercial passenger fishing vessel (known colloquially as a party boat) carried between nine and 15 anglers, four or five scientists, two deck hands and the captain. Anglers caught fish; scientists measured, identified, tagged and released them. With the exception of Año Nuevo, each of the six sites was sampled two days a month for three months: August, September and October 2007. The precise fishing areas within the survey site were selected at random. The boat captain, however, could position the vessel within the sampling cell so as to maximize fishing opportunity. Anglers were directed to fish for 45 minutes in the cell. Four cells were fished during a day at sea.

A recreation vessel chartered for the study Noëlle Yochum

"One of the unique aspects of this project is that fishermen were encouraged to contribute to the science," says marine biology professor Dean Wendt of Cal Poly San Luis Obispo. "We used fishermen's expertise to improve our sampling strategy."

"We tried to blend scientists' expertise in designing rigorous experimental designs with fishermen's expertise and intimate knowledge of the sea," Starr said. "We want to be statistically rigorous but not ignorant of the information that is out there from fishermen."

Data Overview

During the 34 completed fishing trips, anglers caught about 7,928 fishes, representing 27 species. Scientists were able to tag and release most of these. About 2 percent of fish died during capture.

Common Species

Across all six survey sites, the three most common species were: blue rockfish (38 percent of the total); gopher rockfish (27 percent); and black rockfish (11 percent).

The most common species at Point Buchon was the gopher rockfish, at Año Nuevo, the black rockfish and at Point Lobos, blue rockfish. This reflects habitat differences at those locations.

Catch Rates

Across all sites, the highest catch rates (more than double any other site) occurred within the old portion of the Point Lobos marine reserve in which fishing has been prohibited since 1973.

Fish Size

In general, fish sizes fell within historic lengths documented by the 1987-98 Department of Fish and Game observer study. Some differences, however, are worth noting.

In all three reserves, olive rockfishes were smaller than the lower end of their historic length range. In both Año Nuevo and Point Buchon, copper rockfish were on the small size of the historic range; vermilion rockfish were small in Año Nuevo, too. It should be noted that in the old part of the Point Lobos reserve, fishes were on average longer than those in the new part of the reserve and the reference site.

Maturity

Most of the fish caught were immature based on lengths at 50 percent maturity.

Conclusions

This project has been valuable in validating the utility of hook-and-line surveys to detect meaningful differences in catch rates, fish sizes and relative fish abundances at different sites. If the sampling design developed for this project is repeated over time, scientists say that they will be able to quantify the effects of the MPAs on fish populations and sizes, and hence on sexual maturity and spawning biomass. The hook-and-line data would be particularly useful in gaining information on cryptic species such as the gopher rockfish, which are easily missed by diver-based, visual surveys.

Since the completion of this project, researchers have developed a similar collaborative fishing project with nearshore commercial trap fishermen. "We've designed these studies so that they can be transported easily to Southern and Northern California," Wendt says. "We envision using collaborative fishing data not only for MPA monitoring but also for state and federal stock assessments."

Noëlle Yochum

Vermilion rockfish caught, tagged and released by a volunteer angler

Participating Fishing Vessels

Fiesta, Morro Bay
Caroline, Monterey Bay
Huli Cat, Half Moon Bay
Patriot, Avila Beach
Pacific Horizon, Avila Beach

Cooperating Organizations

Cal Poly San Luis Obispo
California Sea Grant Extension Program
Moss Landing Marine Laboratories
California Department of Fish and Game
San Luis Obispo Science and Ecosystem Alliance (SLOSEA)

Contact:

Dean Wendt
Cal Poly San Luis Obispo
805.756.2988
dwendt@calpoly.edu

For further information:

California Department of Fish and Game
Marine Life Protection Act Initiative
http://www.dfg.ca.gov/mlpa/

Central Coast Study Region
http://www.dfg.ca.gov/mlpa/phase1.asp

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