SIMoN Says

TRACKING THE HEALTH OF OUR SANCTUARY

MONTEREY BAY NATIONAL MARINE SANCTUARY

INSIDE

NATIONAL MARINE SANCTUARIES
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Welcome to the second issue of *SIMoN Says*, the voice of the **Sanctuary Integrated Monitoring Network (SIMoN)**. A program of the Monterey Bay National Marine Sanctuary, SIMoN's purpose is to fund and track Sanctuary monitoring programs along the central and northern California coastline and to synthesize and present the research to scientists and the public. This issue focuses on monitoring efforts that are influencing processes to establish new marine protected areas - one of the most significant marine management efforts in central and northern California since the sanctuary's designation in 1992.

PROTECTED AREAS IN THE SANCTUARY

"Marine protected area" (MPA) is a broad term describing a managed area in the marine environment that provides some level of resource protection. MPAs are established as a means to protect the marine environment - from preserving existing organisms and habitat to promoting the re-establishment of absent species. The sanctuary is a federal MPA, but there are also MPAs within it that provide additional protection measures.

HOW IS SIMON INVOLVED?

The sanctuary actively funds and participates in monitoring efforts that focus on marine protected areas. Each year, SIMoN releases requests for proposals for new monitoring programs. After an extensive scientific review process, SIMoN funds selected proposals and makes the data and findings available through its web site and this publication.

As part of the sanctuary's research program, SIMoN staff also plans and implements various monitoring activities that result in an enhanced understanding of the biological and physical factors of protected areas. These activities include nearshore rocky reef surveys along the Big Sur coast, habitat characterization surveys of the continental shelf and fish habitat surveys of deep rocky shelf and slope habitats.

More information on SIMoN's role in sanctuary monitoring, including these specific projects, can be found at http://mbnms-simon.org.

WHAT'S INSIDE

This issue of *SIMoN Says* highlights important factors used in designating MPAs, including physical ocean conditions, habitat distribution, biodiversity and monitoring of protected areas. This issue will answer many questions regarding MPAs, including:

- ***How does a major oceanographic condition, such as upwelling, affect MPAs? (See p. 3)***
- ***What is the significance of bottom habitat in establishing MPAs? (See p. 4)***
- ***How do decision makers know the location of high biodiversity areas? Why is biodiversity important? (See p. 5)***

In addition, this issue provides an update on the SIMoN web site, an online resource with detailed information about the sanctuary's natural history and the research and monitoring that takes place here. Visit http://mbnms-simon.org for more information.

*Rosy rockfish (*Sebastes rosaceus*), giant kelp (*Macrocystis pyrifera*), and opalescent nudibranch (*Hermissenda crassicornis*). Photos: MBNMS*

As a management tool, a marine protected area (MPA) may employ a range of strategies to protect the marine environment, including prohibiting marine life harvesting, allowing take of selected species or restricting other kinds of human activities. Besides having different levels of protection and use, MPAs vary dramatically in size and shape, protect a range of natural or cultural resources and are established under a variety of authorities (Figure 1). The Monterey Bay National Marine Sanctuary (MBNMS) is an MPA itself: some human activities that are potentially harmful to the sanctuary's health - such as oil drilling, ocean discharges or seabed mining - are restricted or prohibited in sanctuary waters.

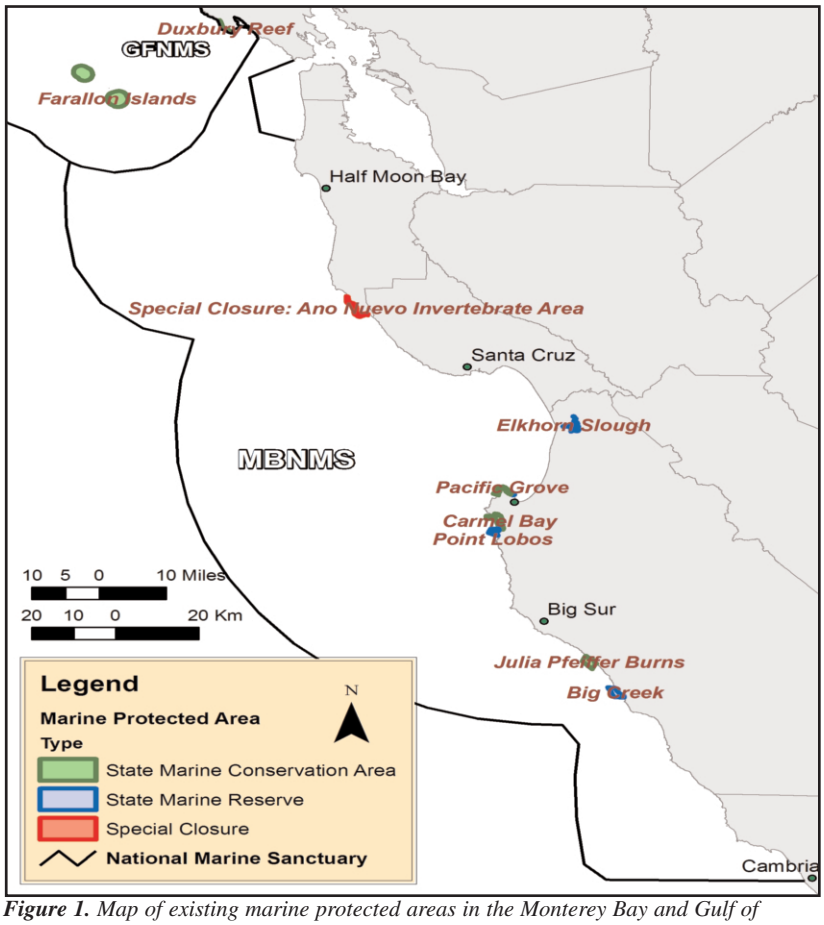


Figure 1. *Map of existing marine protected areas in the Monterey Bay and Gulf of Farallones National Marine Sanctuaries.*

WHAT ARE THE BENEFITS OF MPAS?

Scientific research has shown that carefully crafted MPAs - particularly those that restrict or prohibit the removal of marine life - can be effective tools for conserving plant and animal diversity, protecting habitats and increasing both numbers and individual sizes of some species. A well-designed MPA, in which the removal or alteration of marine life is prohibited or restricted, generally contains greater species abundance, higher species diversity and larger fishes within its boundaries relative to similar habitats outside the protected area.

In some cases, these larger fishes produce many more young than smaller fishes do. Studies on larger, older female rockfish have shown that their larvae are healthier and more likely to survive than larvae from younger females. These protected areas are a useful tool for preventing, slowing or reversing the degradation of ocean habitats and maintaining the diversity and abundance of species inhabiting them.

WHY ARE WE CONSIDERING NEW MPAS?

During the scoping period of the Joint Management Plan Review (JMPR), the National Marine Sanctuary Program received approximately 7,000 public comments requesting greater ecosystem protection for the MBNMS by establishing a network of MPAs.

The sanctuary is considering the need for new MPAs and their potential locations for several reasons:

- ***To restore naturally functioning ecosystems and ecological health in sanctuary waters***
- ***To provide areas where marine research and monitoring can occur apart from the extraction of animals and plants***
- ***To provide ecological 'insurance' against environmental variability and unintentional mismanagement***

The sanctuary's broad goal is to determine if additional MPAs, in which the removal or alteration of marine life is restricted or prohibited, may play a role in effective marine conservation and sanctuary management. With partners, the sanctuary will evaluate whether additional MPAs can help protect, restore or enhance natural habitats, populations and ecological processes. When a need is identified, the sanctuary will design potential MPA networks with these goals in mind.

MPA ACTION PLAN

As part of the JMPR process, a 'Marine Protected Areas Action Plan' was developed jointly with a working group comprised of a variety of stakeholders and partners in order to ensure community involvement in the decision-making process. Sanctuary staff have been meeting regularly with stakeholders, including environmental representatives, researchers, fishermen, fisheries managers, harbor masters, divers and others since 2002. Staff are also working closely with the State of California in the Marine Life Protection Act process (see p. 5.), and they plan to address this issue in offshore, federal waters at a later date.

For more information, visit the sanctuary web site at http://montereybay.noaa.gov.

Typically, spring is an upwelling season - when northwesterly winds blow along the coastline, driving warm surface waters offshore which are replaced with cold, nutrient-rich subsurface water. Coupled with increasing amounts of sunlight, these cold waters allow phytoplankton (single-celled plants) to bloom in the Monterey Bay National Marine Sanctuary and along much of the West Coast of the United States and Canada. Zooplankton, such as krill, respond to these phytoplankton blooms and also dramatically increase, leading to an abundance of food for larger predators, such as fishes, birds and whales.

TYPICAL UPWELLING YEARS

The patterns of upwelling conditions - including their frequency, duration and any persistent location - are important in considering the establishment of marine protected areas (MPAs). Through the use of NOAA satellites, ocean observing programs track seasonal upwelling patterns. This provides data summaries that show the typical location of upwelled water in the sanctuary.

Summary maps that show the typical location of upwelled waters during the months of March through May from 1985 to 2004 allow stakeholders in the MPA process to determine 'hot-spots' where upwelling is typically high. Some of the potential 'hot-spots' include areas near Año Nuevo, Point Sur (on the Big Sur coast) and Soquel Point (in Santa Cruz).

LATENT UPWELLING OF 2005

Oceanographic conditions such as upwelling do not always adhere to their typical patterns. Oceanographers and marine ecologists noticed an example of this by July 2005, as information was compiled from disparate monitoring programs. The various data sets indicated that sea surface temperatures were abnormally high in April, May and June (0.5-1.5° C warmer than average) - particularly close to shore along central California. Since the prevailing winds were relatively weak or absent, upwelling was diminished, so less of the colder, nutrient-rich water was able to reach the surface. It is also likely that when upwelling did occur during the spring, only the warmer water was cycled, since the layer of warm water was deeper than usual. This translated into low plankton production, with cascading negative effects throughout the pelagic and coastal food webs (Figure 2).

Observations during the 2005 relaxed spring-time upwelling included:

- ***Krill:*** *researchers from the Center for Integrated Marine Technologies (CIMT) recorded May 2005 as the lowest month for juvenile krill recruitment since 1998 (a 10-fold decrease from the long-term average).*
- ***Fisheries:*** *NOAA Fisheries encountered the fewest pelagic juvenile rockfishes in the 23 years of its May-June mid-water trawl survey.*
- ***Seabirds:*** *the Beach COMBERS program reported that malnutrition and emaciation due to the reduction in juvenile fish caused an increase in beach strandings and mortality and a decrease in nesting success of some seabirds.*

Abnormal upwelling events such as these are difficult to factor into the MPA designation process. This natural variability may make it more difficult for MPA managers to gauge the success of their protected areas over shorter periods of time.

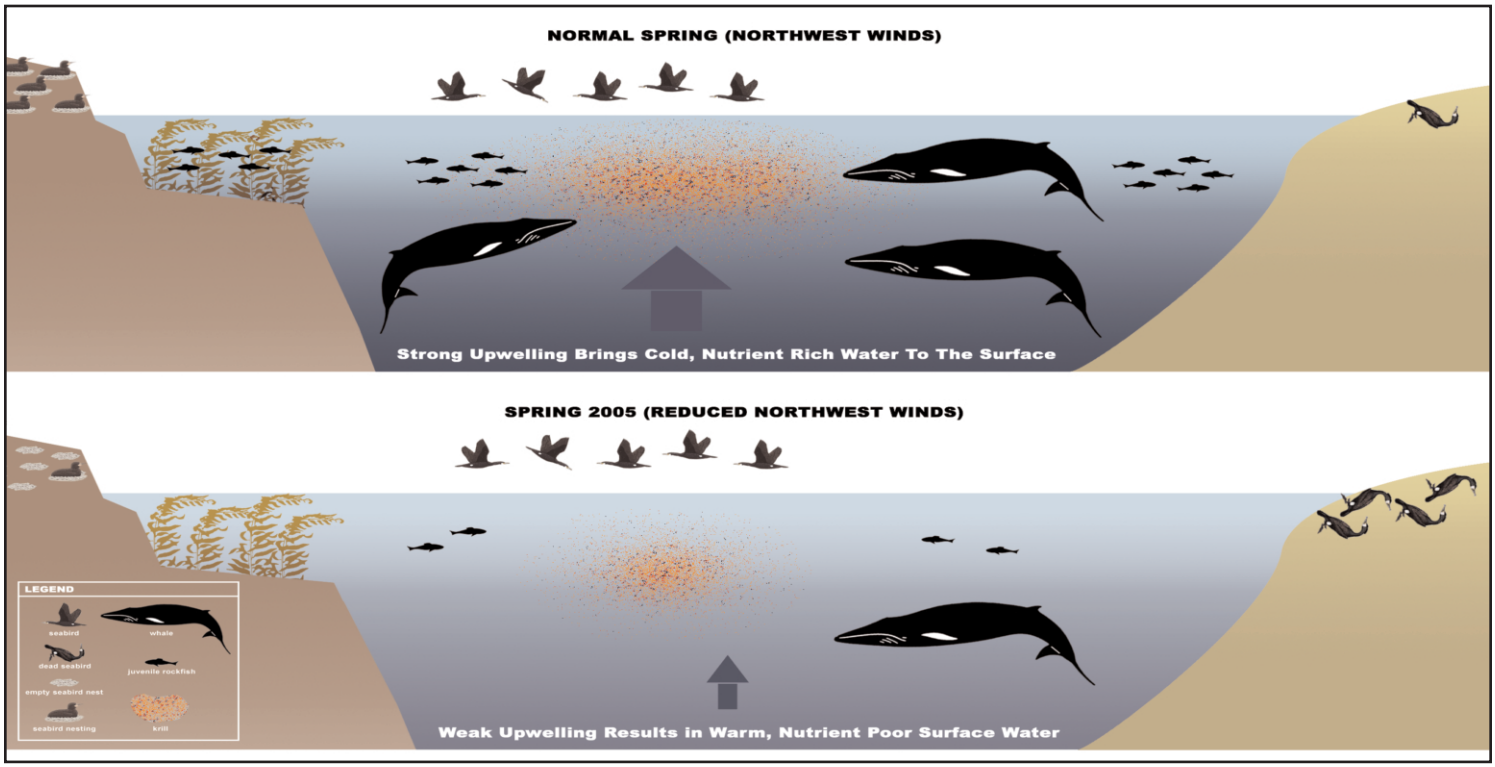


Figure 2. *During normal spring conditions (top panel), krill thrive and their predators are abundant. In 2005, upwelling conditions were abnormal (lower panel). The decline in krill lead to bird starvation, nest failure, and delayed recruitment of rockfishes into kelp forests.*

Habitats are combinations of physical and biological environmental factors that are necessary for a living organism to survive and reproduce. For example, many groundfish species (those that live most of their lives on or near the sea bottom) prefer hard-bottom habitats, including rocky headlands, rocky outcrops and submarine canyon walls. These areas of hard-bottom habitat provide food, shelter and nursery areas not only for groundfishes but also for a wide variety of plants and invertebrates.

ESSENTIAL FISH HABITAT

Essential fish habitat (EFH) is defined by the U.S. Congress as 'those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity.'

The physical characteristics necessary for EFH, including seafloor geology, bathymetry and latitude, were chosen by marine fisheries experts as the essential elements of groundfish habitat. The West Coast Groundfish Habitat Characterization effort, managed by NOAA Fisheries, delineates physical seafloor characteristics of the continental margin of the U.S. West Coast that are consistent with the definition set by EFH.

Geologic mapping experts interpreted various data sources, including side-scan sonar, bottom samples, seismic data and multibeam bathymetry, to produce the EFH summaries (Figure 3). The Monterey Bay National Marine Sanctuary is using this information to identify areas of known hard-substrate bottom habitats of the seafloor where populations of certain groundfish species may occur.

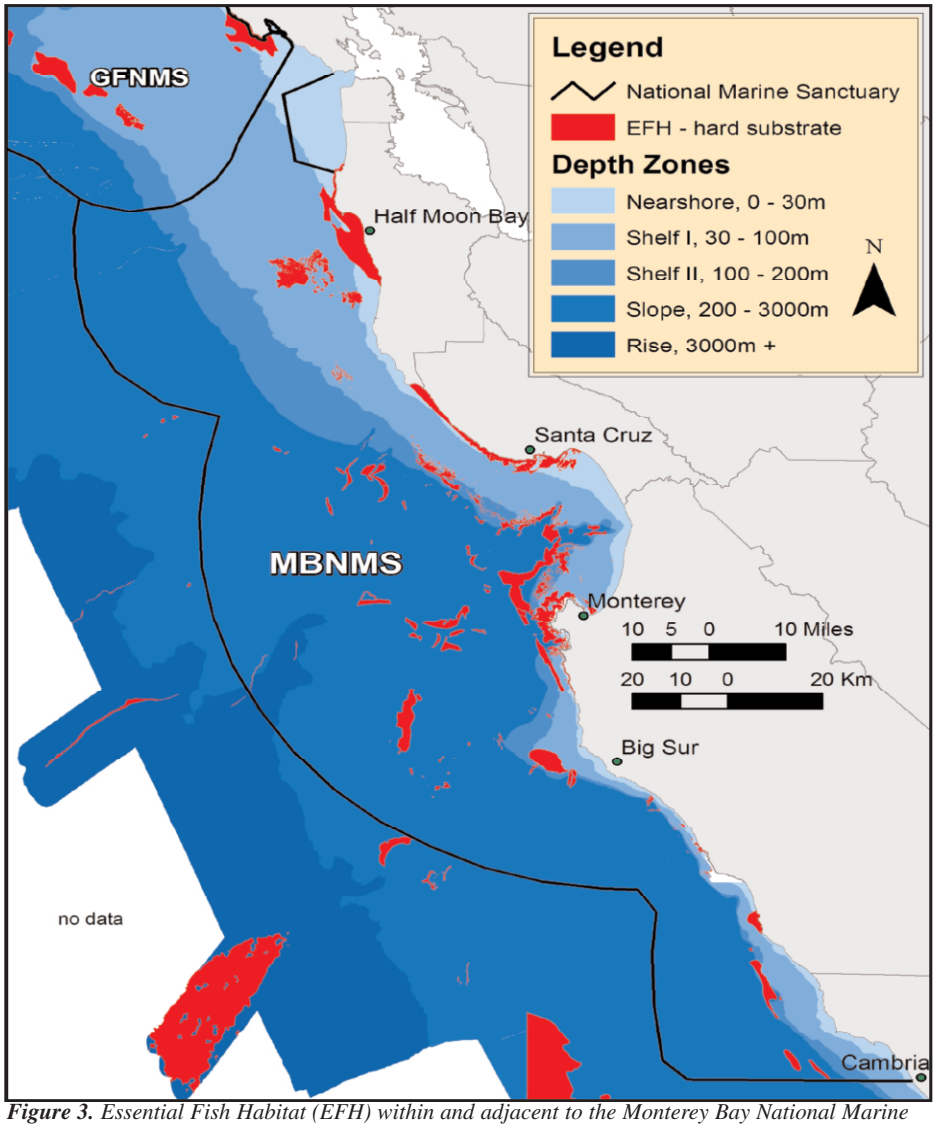


Figure 3. *Essential Fish Habitat (EFH) within and adjacent to the Monterey Bay National Marine Sanctuary. The sanctuary MPA working group stratified depth and habitat into these functional units.*

EVALUATION OF CHANGE TO PROTECTED HABITATS

A rockfish conservation area, established in 2002, prevents the harvest of all shelf rockfish species from 20 to150 fathoms (40 to 300 meters) deep, south of Cape Mendocino, California. In 2003, in collaboration with Moss Landing Marine Laboratories and other local scientists, the sanctuary began developing a long-term monitoring plan to assess changes of deep-water groundfishes, macroinvertebrates and their habitats in the sanctuary. By August 2004, 144 video transects were completed using the Delta submersible, at depths ranging from 70 to 120 meters, in rocky habitats off the Monterey Peninsula and Point Sur.

This project's goals included developing a baseline to compare future changes in species composition, size composition and relative abundance of groundfishes and macroinvertebrates from these and other habitats of similar depth in the sanctuary. In addition, groundfishes at specific sites off the Monterey Peninsula were compared with a similar survey conducted in 1993.

Scientists are still analyzing the data, but their initial results indicate that:

- ***Deeper, low-relief areas have higher species diversity and more large rockfishes than shallower, high-relief areas;***
- ***Overall species diversity was greater, and large rockfish species were more numerous and larger in size, off Point Sur than off the Monterey Peninsula;***
- ***Relative to the 1993 survey, scientists observed an increased number of small lingcod, bocaccio and canary rockfishes in 2004.***

Biological diversity (biodiversity), has no single, standard definition. However, one that describes most instances of its use is 'the totality of genes, species and ecosystems, and their relative abundance.' Research suggests that a more diverse ecosystem is better able to withstand environmental stress and is consequently more productive. The loss of a species is thus likely to decrease a system's ability to maintain itself or to recover from damage or disturbance.

IDENTIFYING AREAS OF HIGH BIODIVERSITY

In support of the Monterey Bay National Marine Sanctuary's management plan review, NOAA's National Centers for Coastal Ocean Science (NCCOS) conducted an analytical assessment to define important biological areas within and adjacent to the sanctuary boundary for targeted species. Long-term data from NOAA Fisheries' shelf and slope benthic trawl surveys were used to describe demersal fish diversity, richness and species assemblages. These surveys were conducted along relatively soft, flat-bottom areas with a minor incline from 50 to 1,280 meters depth during June to November every third year from 1977 to 2001. Survey results included:

- Soft-bottom shelf and slope habitats make up a large proportion (31 percent and 64 percent, respectively) of the sanctuary and host a diverse group of groundfishes. Rockfish species richness (the number of species - including the genera *Sebastes* and *Sebastolobus* - present at a location) was calculated from the trawl survey data. Water depth has a strong influence on rockfish species richness. For example, a band of high rockfish richness is located around 200 to 300 meters and parallels the edge between the continental shelf and slope, where shallow and deep rockfish assemblages meet (Figure 4).

- To describe marine bird diversity, density and biomass, scientists analyzed data from eight survey programs from federal, state and individual researchers from 1980 to 2001. Density (birds/km^2) of 76 marine bird species was tabulated for the three oceanographic seasons (upwelling, oceanic, and Davidson Current) and for all seasons combined (Figure 4). Density was highest during the upwelling season, with high density areas most widespread as well. Particular hot spots were inshore Monterey Bay, Farallon Ridge and Cordell Bank. Overall density is dominated by two abundant marine bird species: Common Murre and Sooty Shearwater.

The sanctuary's MPA Working Group is using these and other geo-referenced data layers as part of a decision-support tool for the MPA process. The working group is interested in identifying areas of high biodiversity, biomass and density, among other goals.

Long-term data sets like these are useful for characterizing sanctuary resources and for tracking changes over time. These data are also valuable due to their wide-ranging geographic extent.

More information on this project can be found at http://biogeo.nos.noaa.gov.

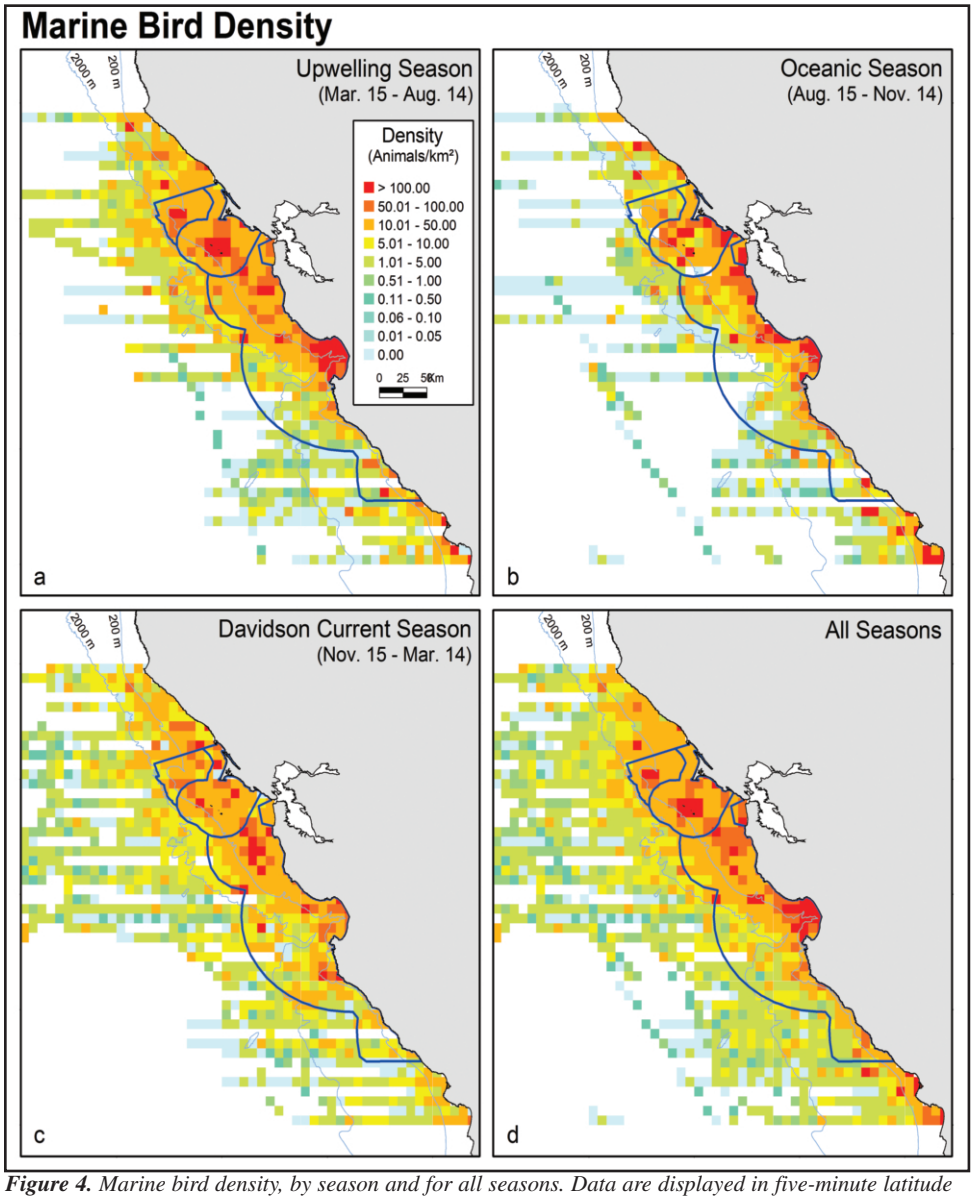
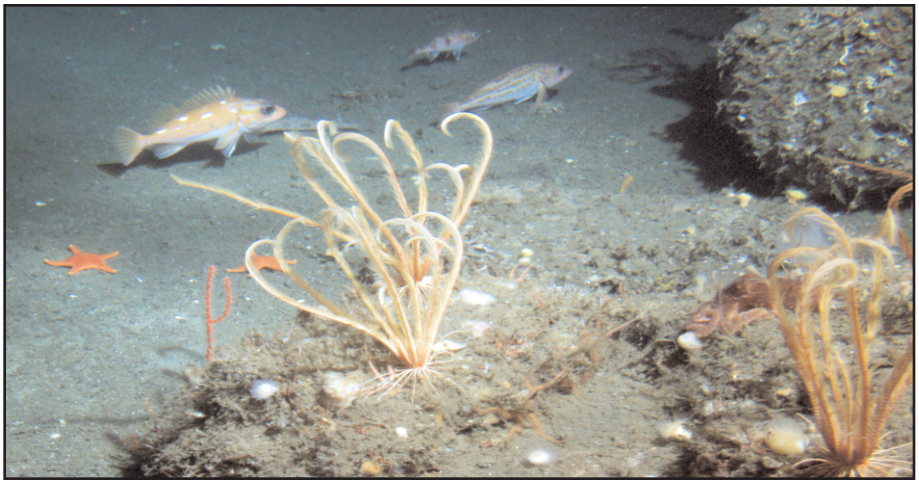


Figure 4. *Marine bird density, by season and for all seasons. Data are displayed in five-minute latitude by five-minute longitude cells. Note the increased density during the upwelling season.*

Along the central California coast, two efforts are currently underway to determine where additional marine protected areas (MPAs), if any, should be located. The Central Coast Project, led by the State of California via the Marine Life Protection Act, is focused in state waters (within three miles of the coast) between Pigeon Point and Point Conception. A separate effort, led by the Monterey Bay National Marine Sanctuary and discussed below, is focused in federal waters (beyond three miles) of the sanctuary south of Pigeon Point.



Rosy, greenstriped, and half-banded rockfishes among soft, rocky and biogenic habitats. Invertebrates include red gorgonians, feather stars, sponges, sea stars, brittle stars, and octopus. Photo taken during a Delta submersible survey. Photo: L. Snook.

MARINE PROTECTED AREAS WORKING GROUP

The sanctuary's MPA Working Group has developed an action plan that summarizes the process, goals and criteria for effective consideration and design of MPAs in the sanctuary. The action plan is serving as a guide during the evaluation of issues including identification of specific habitats and ecological processes to be protected, identification of potential and existing threats, development of site-specific goals, consideration of design criteria that incorporate biological and socioeconomic issues, and articulation of monitoring needs.

Currently, the working group is reviewing many geo-referenced (mapable) data sets, such as habitats, biological attributes and oceanographic features, to aid in MPA evaluation and siting. A suite of representative habitat types in the sanctuary is being considered, including soft- and hard-bottom habitats stratified by depths zones (see Habitat section, p. 4) and submarine canyons. Biological data sets include but are not limited to biogenic habitats (e.g., kelp canopy and structure-forming invertebrates); seabird diversity, biomass and density (see Biodiversity section, p. 5); and demersal fish species richness and diversity. Oceanographic data include areas of persistent upwelled waters (see Seasonal Upwelling section, p. 3) and fronts. The MPA Working Group is using an online decision support tool that was created in collaboration with SIMoN to view the various data sets (maps), draw proposed MPA boundaries and report on the extent of area and resources protected in a hypothetical MPA.

*Brown pelicans (*Pelecanus occidentalis*) at Natural Bridges State Beach. Photo: Pederson / MBNMS.*

NATURAL RESOURCES ASSESSMENT

The MPA Working Group is also using a natural resources assessment, which compiles information gathered from the scientific literature and local scientists that is not available in map format. The assessment includes topics such as species composition, feeding relationships, natural- and human-induced species composition shifts, benthic-pelagic (i.e. sea floor - oceanic) coupling, movement and dispersal, and species of interest. This assessment supplements the aforementioned data layers and will help the working group evaluate MPA placement. In addition, it will be useful to other sanctuary programs and staff in characterizing habitats and ecological processes in the sanctuary. Other useful summary documents written for the sanctuary include two publications, "Trends in Fisheries and Fishery Resources Associated with the Monterey Bay National Marine Sanctuary from 1981-2000" and "A Review of the Ecological Effectiveness of Subtidal Marine Reserves in Central California."

By reviewing geo-referenced data layers, pertinent scientific literature and local knowledge, the working group can identify areas that may be suitable for MPAs. A quick glance at the maps and information in this issue highlight several areas of interest:

- ***Only a small percentage of federal waters in the sanctuary contains known hard-bottom habitat, yet certain species of groundfish and structure-forming invertebrates are only found in this environment.***
- ***Demersal rockfish species richness is greatest at the shelf-slope break because it is an area where two major depth-stratified rockfish assemblages overlap (Figure 5)***
- ***Persistent upwelled water is found primarily within three miles of the coast and in the outer portions of Monterey Bay.***
- ***Marine bird density is greatest within Monterey Bay and in the northern part of the sanctuary. This pattern may be influenced by the location of persistent upwelled water (high productivity) and roosting/nesting sites.***

Although they represent just a small subset of the available data, these large-scale, long-term data sets are useful in identifying productive and diverse habitats within the sanctuary. These and other data are being used in both California's and the sanctuary's MPA processes, illustrating how monitoring data sets influence decision-making by staff, stakeholders and policy makers.

*Embedded cucumber (*Cucumaria miniata*). Photo: Lonhart / MBNMS.*

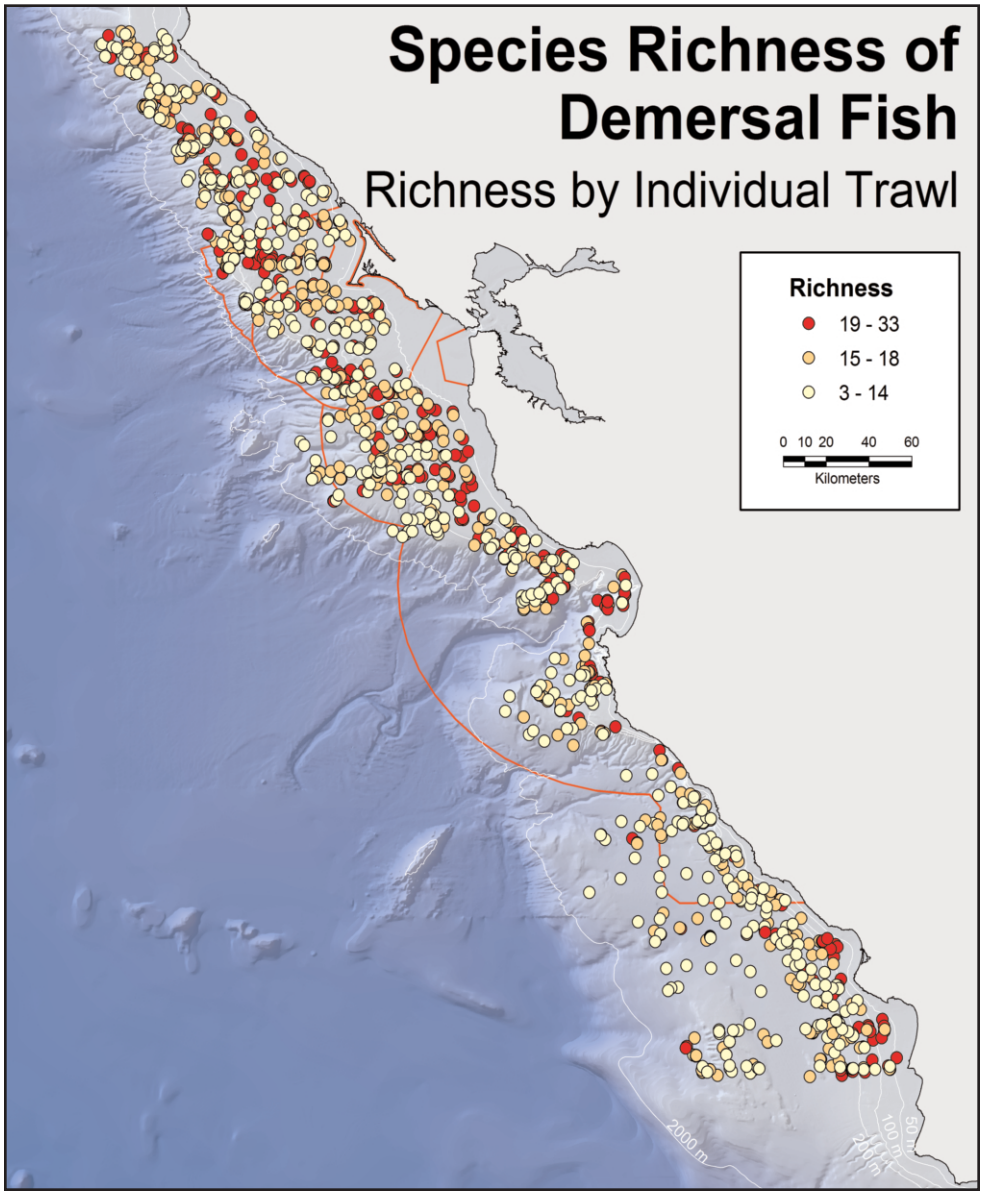


Figure 5. *Species richness of rockfish from individual NOAA Fisheries shelf and slope trawls.*

The SIMoN web site (http://mbnms-simon.org) is an online information resource for scientists, educators, students and the general public. It provides in-depth, current information on the natural history and monitoring of species and habitats within the Monterey Bay National Marine Sanctuary.

Featuring high-quality images and up-to-date scientific findings, the site is structured so users can quickly find a wealth of information on a wide range of topics.

MONITORING INFORMATION

The SIMoN web site provides information on more than 90 different monitoring projects. Each project web page includes an overview of the project; researchers' names; methods; and a summary of findings, including figures, images and downloadable documents.

Current monitoring project statistics:

- ***93 monitoring projects***
- ***110 contributing researchers***
- ***75 contributing institutions***

HABITATS AND ISSUES

The SIMoN site also provides information on more than 15 different sanctuary habitats and issues. This information includes natural history of habitats and species as well as updates on resource management issues. The information is presented in an accessible format and highlights the sanctuary's incredible and diverse marine environments.

PHOTO DATABASE

The web site now offers a searchable database of digital images that show the sanctuary's unique collection of organisms, habitats and issues. Visitors can search by species name, keyword and then download high-resolution images. Go to http://mbnms-simon.org/photos.

YOUR THOUGHTS ON *SIMoN SAYS*

SIMoN is interested in hearing your thoughts about this publication. Submit your comments online by going to http://mbnms-simon.org and clicking the Comments link at the bottom of the page.

ABOUT SIMoN

SIMoN is a collaborative effort, designed in partnership with the regional science and management community and managed by the Monterey Bay National Marine Sanctuary in cooperation with the Monterey Bay Sanctuary Foundation and the Monterey Bay Aquarium. For more information, please call (831) 647-4209 or visit http://mbnms-simon.org.

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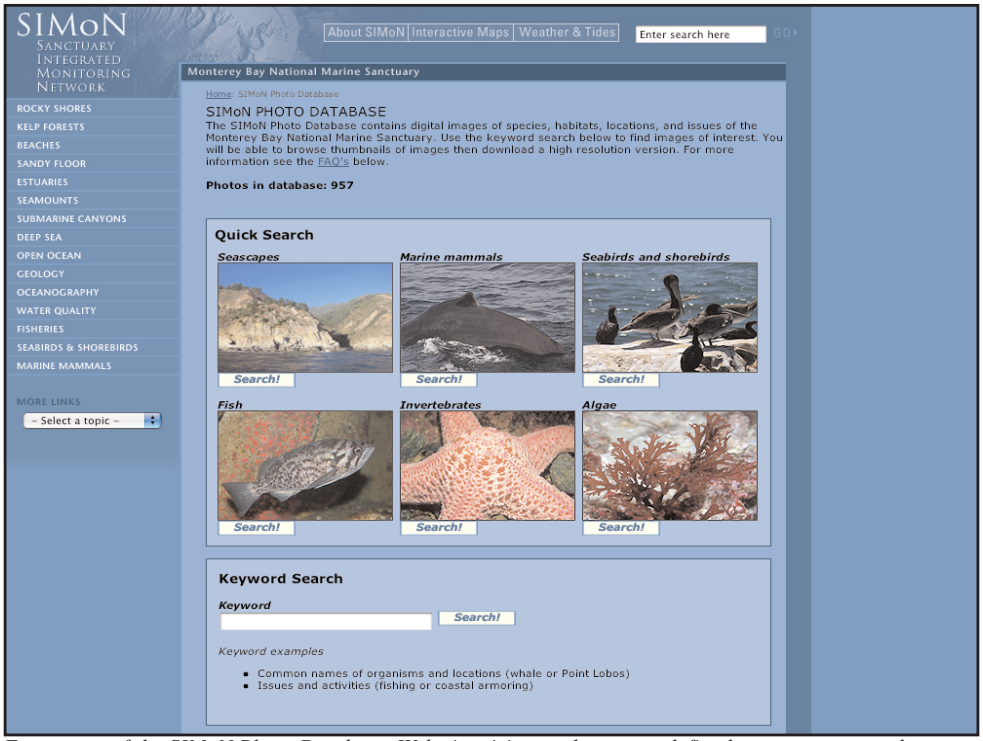


Front page of the SIMoN Photo Database. Web site visitors select a pre-defined category, enter a keyword, or enter a genus and species name to search the database.

SPECIES DATABASE

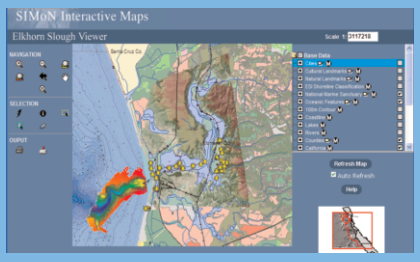
SIMoN is currently compiling a database of information on over 500 species of organisms occurring along the central California coast. This Species Database will include:

- ***natural history information***
- ***conservation issues***
- ***digital images***

Look for the Species Database to be launched on the SIMoN Website in October 2006.

ELKHORN SLOUGH MAPS

SIMoN has released a new interactive mapping project focusing on the Elkhorn Slough. This map viewer provides a look at historic changes to the slough and surrounding areas.



For more information visit the Interactive Maps section of the SIMoN web.

INFORMATION DISCLAIMER

Until results of the monitoring projects presented here are peer reviewed and published, they should not be considered conclusive. The project summaries do not necessarily reflect the views and policies of the National Marine Sanctuary Program, Monterey Bay Aquarium, or the Monterey Bay Sanctuary Foundation.