SIMoN Says

TRACKING THE HEALTH OF OUR SANCTUARY

Monterey Bay National Marine Sanctuary

Volume 1 Number 1 | Winter 2005

INSIDE

NATIONAL MARINE SANCTUARIES
MONTEREY BAY

NOAA

MONTEREY BAY AQUARIUM

MONTEREY BAY SANCTUARY FOUNDATION

Welcome to 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 resource managers, scientists, and the public. *SIMoN Says* is the first in a series of periodic publications to educate the public on findings and trends from this wide variety of monitoring programs and to help you learn about the health of the Sanctuary.

MONITORING IN THE SANCTUARY

What is a monitoring program?

Monitoring programs observe and document changes in a 'resource' over time and space. A resource can be a single species, a group of species, or a habitat such as a kelp forest. Monitoring programs also examine how natural processes, such as beach erosion, and human activities, such as development and harvesting, impact these resources. Monitoring is important because it helps identify trends and changes to a resource, enabling scientists to provide resource managers with the proper information for effective decision-making.

Who does monitoring?

Universities, federal, state, and local agencies, private consultants, citizen groups, and even school groups participate in monitoring the various resources within the Sanctuary. More than forty institutions and organizations conduct monitoring and research programs in the Sanctuary.

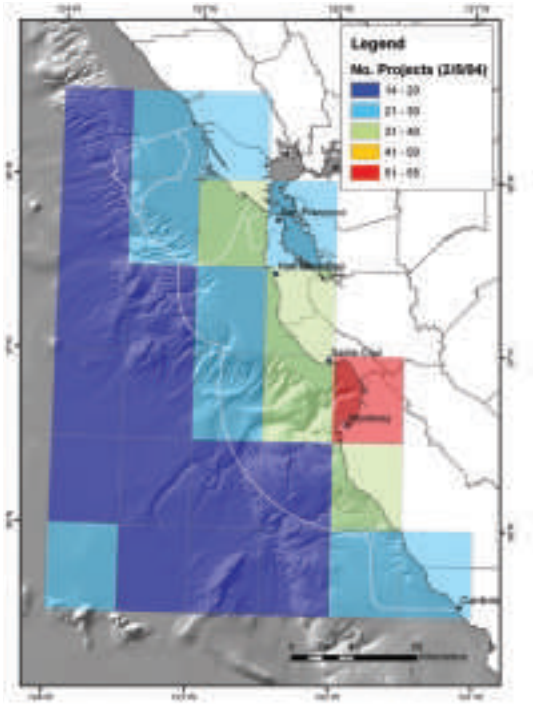


Figure 1. *Map of the central California coast showing the location and density of monitoring projects.*

The Delta submersible, a reliable tool for monitoring rockfish populations in the Sanctuary

How long has the Sanctuary been monitored?

Some projects have collected information for more than fifty years. These data are extremely valuable because they provide a long-term view of how resources are changing.

Does SIMoN participate in monitoring?

Each year, SIMoN releases requests for proposals on new monitoring programs. After an extensive scientific review process, SIMoN funds some of these proposals and then makes the data and findings available through the SIMoN web site, a public symposium, and the SIMoN Says publication.

More information on SIMoN's role in monitoring of the Sanctuary, including staff research, can be found at www.mbnms-simon.org.

WHAT'S INSIDE

In the first issue of SIMoN Says, you'll find results from monitoring programs focusing on estuaries, rocky shores, marine mammals, kelp forest communities, water quality, and the deep sea. This is just a sample of the vast number of current and historic programs that provide scientists and the public with information on how resources in the Monterey Bay National Marine Sanctuary are changing.

In addition, we'll introduce you to the SIMoN web site, an online resource where you'll find detailed information about the natural history of the Sanctuary, current weather and tide conditions, maps and graphs of the Sanctuary, and more data on current monitoring projects. Please visit www.mbnms-simon.org for more information.♻

ELKHORN SLOUGH EROSION

When the Army Corps of Engineers opened a new mouth to Elkhorn Slough in 1947 the natural sluggish tidal flow of the estuary was replaced by a higher volume flow. As a result slough habitats have been altered from their natural state due to channel erosion and loss of salt marsh. Erosion monitoring efforts by Elkhorn Slough National Estuarine Reserve, California State University, Monterey Bay, and the Monterey Bay National Marine Sanctuary have produced striking results:

- The depth at the mouth of the slough has increased from 1.5 meters to 7 meters since 1947.
- From 1993 to 2001 all channel depths increased by an average of 0.5 meters per year (Figure 2).
- Erosion rates along slough banks average 40 centimeters per year.
- The width of tidal creeks are continually increasing, up to 70% by some estimates.

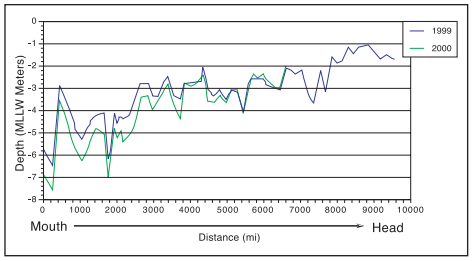


Figure courtesy of R. Kvitek and J. Brantner.

Figure 2. *Depth of the main Elkhorn Slough channel from mouth to head, with blue line for 2001 data and green line for 1993 data. Note the significant increase in depth over the seven-year time period.*

Continual erosion threatens Elkhorn Slough habitats that play a critical role at the base of estuarine food webs and provide shelter for birds, crabs, and other animals. Information from this project and SIMoN funded monitoring efforts are currently being used to develop a habitat plan for the Elkhorn Slough.

INVASIVE EUROPEAN GREEN CRAB

First observed in Elkhorn Slough in 1994, the European green crab *(Carcinus maenas)* is an invasive species that is spreading along the West Coast. This crab has demonstrated the ability to alter the biological diversity and abundance of native invertebrates and is being watched closely by staff at the Elkhorn Slough National Estuarine Reserve (ESNERR). One of ESNERR's monitoring programs detects changes in abundance, diversity, and distribution of invertebrate species in the estuary. Findings from this program show:

- The invasive European green crab population is increasing (Figure 3).
- Native yellow shore crabs *(Hemigrapsus oregonensis)* are decreasing.

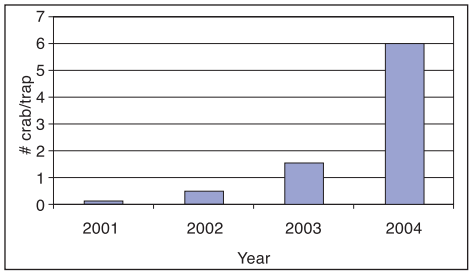


Figure courtesy of K. Wasson.

Figure 3. *Average number of green crabs found in ESNERR traps from 2001 to 2004. Note the significant increase in green crabs.*

In order to combat the invasion of other non-native organisms, ESNERR has developed an early detection program that monitors over 20 'least wanted' species that could potentially appear in the slough. When a 'least wanted' species is found, ESNERR has a brief window of opportunity to remove the organism before it can become established.

NITRATE LEVELS IN THE SLOUGH

With the growth of commercial agriculture in the Elkhorn Slough watershed over the past sixty years, nitrate levels in the estuary have risen dramatically. Nitrates, a primary component of many agricultural fertilizers, can be transported by water off of the fields where they are applied and into local tributaries that feed into the slough. Since 1988, a volunteer water monitoring program in Elkhorn Slough has collected data on the levels of these nutrients. Findings from this program include:

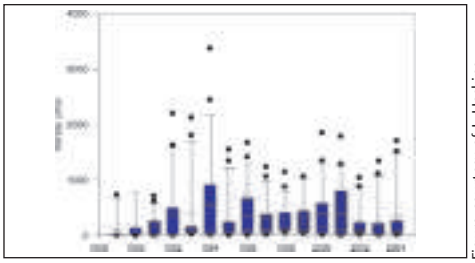


Figure courtesy of J. Haskins.

Figure 4. *Average nitrate concentrations of all stations sampled per year. Concentrations are highly variable between and among years. The last three years appear to have lower overall average concentrations than previous years.*

- Nitrate levels have increased since the 1970s.
- Nitrate levels peak during the dry summer months when irrigation on neighboring fields is most intense

This increase in nitrates and their effects on the aquatic ecosystem are of concern to resource managers. High nutrient inputs may cause an increase in algal abundance and may limit the amount of oxygen in the water during the summer months, ultimately restricting invertebrate and fish populations in the slough.♻

FOCUS ON TECHNOLOGY

The Land/Ocean Biogeochemical Observatory (LOBO) project of the Monterey Bay Aquarium Research Institute (MBARI) uses sensors moored in the Elkhorn Slough and Old Salinas River Channel to monitor chemical and physical characteristics of the aquatic environment around the clock. LOBO will complement other water monitoring programs by providing hourly time series data that can be combined with existing long-term data to better understand the complexities of nutrient patterns in the Elkhorn system.

WHAT YOU CAN DO

- Volunteer to help monitor the water quality of the Elkhorn Slough. Call (831) 728-2822.
- Visit the ESNERR interpretive center for a hands-on experience of the Elkhorn Slough. For information and directions see the ESNERR web site (www.elkhornslough.org).
- Find detailed maps and information in the Estuaries section of the SIMoN web site (www.mbnms-simon.org).

HUMAN IMPACTS AT POINT PINOS

Intertidal shorelines like those at Point Pinos on the Monterey Peninsula support diverse communities of organisms that are susceptible to impacts from trampling, handling, displacing, and collection by human visitors. From 2000 to 2003,

Photo courtesy of S. Lonhart.

Point Pinos intertidal area during a low-tide.

Tenera Environmental assessed visitor use levels and activities at Point Pinos, and compared the condition of intertidal communities in areas of high and low use. Tenera Environmental sampled over 150 species of invertebrates, algae, and intertidal fishes, analyzing the data for differences in abundance between the visitor use areas of Point Pinos and control areas with low use. Findings from the Tenera study include:

- Statistically significant differences were detected in total algal cover between high- and low-use areas, with control areas supporting a slightly higher total percent algal cover.
- No significant differences were detected in the abundance of invertebrates and fishes between the high- and low-use areas.
- There were no significant differences in the mean sizes or numbers of black abalone and owl limpets between the high- and low-use areas.

These findings are important for effectively managing high-use intertidal areas such as Point Pinos and the Fitzgerald Marine Reserve. In addition, the results provide valuable baseline data for assessing change with future surveys.

25 YEARS OF INTERTIDAL SURVEYS

After an oil spill off the Santa Barbara coastline in 1969, it became clear to regional scientists that it is extremely difficult to determine the impacts of a disturbance without knowing the pre-disturbance condition of a resource. This new concept of 'baseline data' motivated Dr. John Pearse, a professor at the University of California, Santa Cruz (UCSC) to begin surveys documenting the number of invertebrate and algal species. This monitoring project covered various intertidal areas from Pigeon Point on the San Mateo coast to Soquel Point in Santa Cruz. Trained undergraduate and graduate students from UCSC surveyed these areas from 1971 - 1973, and again 25 years later, from 1996-1997. Findings from these surveys indicate:

- Species richness and community structure remained remarkably unchanged over the 25-year period.

Data and a comprehensive list of species from these intertidal surveys will be available on the SIMoN web site in spring of 2005.

Photo courtesy of C. King.

Sunburst anemone (Anthopleura sola), a common intertidal invertebrate.

BLACK ABALONE

Since the mid-1980s, the intertidal black abalone *(Haliotis cracherodii)*, has experienced mass mortalities along the coast of California. Mortality is due to infection by a pathogen that leads to a fatal wasting disease called 'withering syndrome' where the foot of the abalone shrinks until it can no longer adhere to the substrate. This infectious disease is prevalent in southern California black abalone populations and seems to be spreading north. Researchers with the Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO) are surveying black abalone populations at several sites along the south-central coast of California. Findings from this monitoring program include:

- Mass mortalities of black abalone due to withering syndrome are indeed progressing northwards from southern California.
- Six study sites in the southern region of the Sanctuary currently have healthy populations of black abalone.
- Elevated seawater temperatures from El Niño events may promote withering syndrome.

Photo courtesy of S. Lonhart.

Black abalone exposed during a low tide.

Recovery of black abalone populations along the southern and central California coast will likely take decades. Black abalone populations along the central and northern coast of California are showing signs of withering syndrome, and mass mortalities may occur throughout the Sanctuary.♻

WHAT YOU CAN DO

- Be careful not to trample, remove, or harm intertidal organisms.
- If you sit quietly and look closely, you'll see much more
- Find more natural history and monitoring information by visiting the Rocky Shores section of the SIMoN web site (www.mbnms-simon.org).

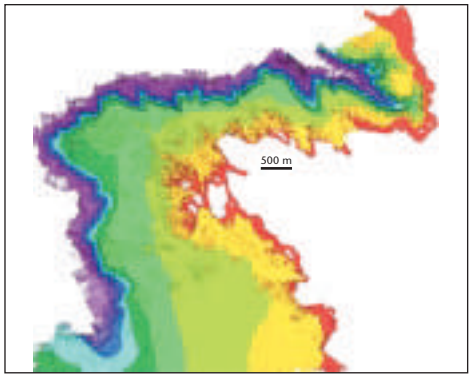


Image courtesy of SFML

Figure 5. *Sample seafloor map of Point Lobos and Monastery Beach in Carmel, California.*

IMAGING THE SEAFLOOR

One important component to understanding change in kelp forest communities is having a detailed understanding of the nearshore ocean bottom. The Seafloor Mapping Lab (SFML) at the California State University, Monterey Bay, provides high-resolution maps and geographic information system (GIS) products on central California nearshore habitats. The results of SFML mapping efforts allow scientists to:

- "See" the ocean floor as if the water was removed (Figure 5).
- Evaluate the structure and complexity of the seafloor habitat.

SIMoN has identified shallow, rocky, kelp forest habitats as the priority areas to be mapped along the coast of central California. With funding from SIMoN, SFML has generated valuable data that are used to better understand the relationships between the structure, form, and biodiversity of our nearshore coast.

KELP FOREST DYNAMICS

Kelp forests primarily composed of *Macrocystis pyrifera*, or giant kelp, create a unique and diverse habitat that is utilized by marine mammals, fishes, other algae, and invertebrates. In order to better understand the dynamics of kelp forests, Mike Donnellan from Moss Landing Marine Laboratories has used aerial imagery and state-of-the-art technology to analyze the change in kelp forest coverage from 1985 to 1989 over a 65 kilometer area of the Monterey Peninsula. He has found that:

- Canopy dynamics were much more predictable in central California than previously thought. Kelp coverage is greater during summer months than in winter months (Figure 6).
- Canopies exhibited typical 'patch sizes' of approximately 1.6 square kilometers.

This information establishes a detailed baseline of kelp forest variability and allows the changes seen in this study to be compared with kelp forests that have changed due to human-induced (e.g., harvesting) or natural causes (e.g., El Niño events).

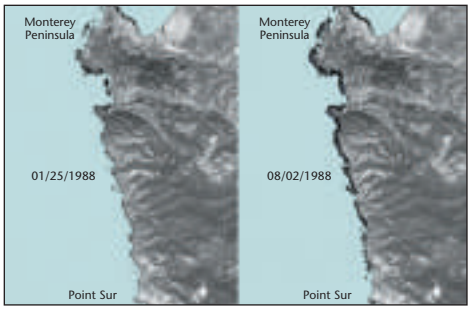


Image courtesy of M. Donnellan.

Figure 6. *Kelp canopy comparison between winter January 1988 and August 1998. Note the greater abundance of Macrocystis during the summer month.*

PISCO SUBTIDAL SURVEYS

In 1999, the Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO) began annual subtidal surveys in kelp forests along the coast of California. The purpose of this monitoring program is to examine relationships between the biological community and habitat features from Washington to Baja California. SCUBA divers assess the abundance of particular invertebrates, algae, and fishes at rocky-reef sites distributed across well-known oceanographic systems and habitat types. PISCO surveys have found that:

- Diversity within kelp forest communities is the result of several factors, including substratum type and relief, wave exposure, and ocean circulation.
- Regional-scale abundance patterns of purple urchins *(Strongylocentrotus purpuratus)* were correlated to the distribution of their primary predator, the southern sea otter.
- Reef fish assemblages are correlated with habitat type. For example, greenlings and some perches prefer areas of moderately flat habitat (low-relief), whereas other perches and rockfishes prefer reef areas with more vertical habitat (high-relief).

These findings help scientists predict the composition of certain communities based on habitat and provide a better understanding of diversity in kelp forest communities. Currently PISCO findings are helping Monterey Bay National Marine Sanctuary staff develop a policy on CalTrans road maintenance along the Big Sur coast.♻

FOCUS ON TECHNOLOGY

The National Marine Sanctuary Program (NMSP) is developing a network of sensors in four of the five West Coast Sanctuaries, including Monterey Bay. This system of buoys will monitor ocean temperature and currents to help resource managers and scientists better understand nearshore oceanographic processes that directly effect our biological resources. This effort will be part of the nationwide Integrated Ocean Observing System (IOOS) initiative.

Photo courtesy of J. Pederson.

Black and yellow rockfish (Sebastes chrysomelas), a common inhabitant of rocky reefs.

WHAT YOU CAN DO

- View wildlife responsibly. Southern sea otters spend a large part of their time in kelp forests and can be disturbed by kayakers and boaters.
- Go to the Kelp Forest section of the SIMoN web site for more interesting information (www.mbnms-simon.org).

WHALES IN MONTEREY BAY

Blue *(Balaenoptera musculus)* and humpback *(Megaptera novaeangliae)* whales are important members of the Sanctuary marine mammal community. Both species forage in Monterey Bay from spring through early fall, taking advantage of the high concentrations of krill and anchovies that thrive in the nutrient rich waters off the California coast. Since 1997, the Wind to Whales program has conducted frequent marine mammals surveys in Monterey Bay.

Findings from this program include:

- An increasing number of sighted whales are consistent with general increasing population trends (with some variation between years) of the Eastern North Pacific stocks of both species.

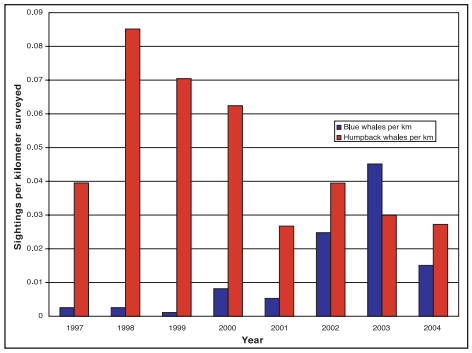


Figure courtesy of K. Newton/CIMT.

Figure 7. *Total blue and humpback whale sightings per kilometer surveyed by the Wind to Whales program from 1997 to 2004.*

- There is some indication that blue whales are using Monterey Bay more since the 1997-98 El Niño event (Figure 7).

The Wind to Whales surveys are part of a collaborative ocean observation program conducted by 5 partners in the Center for Integrated Marine Technologies. Recently information from CIMT has been used to develop regulations on krill harvesting in the Monterey Bay National Marine Sanctuary.

NOTHERN ELEPHANT SEALS

Once thought to be extinct, northern elephant seals *(Mirounga angusistrosis)* have rebounded from less than 100 individuals in the late 1800's to a population of over 150,000 today. While these animals spend most of their life at sea, they do come to shore twice a year: once in the winter to give birth and mate, and once in the summer to shed their skin (molt). Año Nuevo is a favorite 'haul out' site for a large part of the elephant seal population. Since the 1960's researchers at the University of California, Santa Cruz (UCSC) and colleagues have been studying this remarkable recovery of the northern elephant seals in Año Nuevo. Findings from this program include:

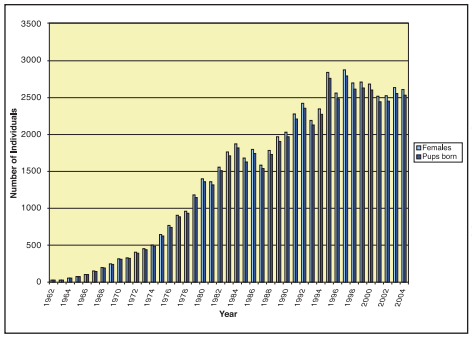


Figure created by SIMoN with permission from B. Le Boeuf.

Figure 8. *Number of female elephant seals and pups born at Año Nuevo from 1962 to 2004. Note the incredible increase over the 30 year study.*

- In the early 1960's only a handful of pups were born per year, yet there were over 2,500 born in 2003 (Figure 8).
- 1997 was the best year for pups: with close to 3,000 born.
- More than 95% of the females that arrive in winter give birth.

The local increase in Northern elephant seals at Año Nuevo is consistent with other colonies in central California, indicating a steady rise in the regional population.

SOUTHERN SEA OTTERS OF POINT LOBOS

Tracking changes to the population of southern sea otters *(Enhydra lutris)*, is a state-wide effort involving many institutions and agencies. Since 1989 a group of volunteer docents at the Point Lobos State Reserve in Carmel have conducted monthly counts of southern sea otters. This group has documented changes in their local otter population and has contributed to an annual state-wide census. Findings from this on-going study include:

- Otters inhabit the Point Lobos Ecological Reserve year-round.
- Otters are most abundant from May through July.
- From 1992 to 1998 an average of 66 otters was observed in each monthly survey.
- During the last few years the number of otters seen has decreased slightly at Point Lobos while the state-wide otter population has increased over the past two years.

While the state trends show an increase in the southern sea otter population, long-term outlook on the recovery of the otter is uncertain. Currently there are approximately 2,800 sea otters in the state, down significantly from historic levels. Data from the Point Lobos surveys will be made available on the SIMoN web site in spring of 2005 (www.mbnms-simon.org).♻

Photo courtesy of L. Ellis.

Southern sea otter in kelp at Point Lobos Ecological Reserve.

WHAT YOU CAN DO

- View wildlife respectfully and keep your distance. If wildlife appears nervous, slowly back away.
- Become a member of the Oiled Wildlife Care Network and volunteer to help in the event of an oil spill. Call (530) 754-5481 for more information.
- Report stranded marine mammals to the Marine Mammal Center by calling (415) 289-SEAL.
- Go to the SIMoN web site for more information on the movements and population statistics of marine mammals (www.mbnms-simon.org).

COASTAL WATER QUALITY

Run-off entering the Monterey Bay National Marine Sanctuary from urban and agricultural sources is consistently monitored for pollutants by a variety of agencies and institutions. The Central Coast Long-term Environmental Assessment Network (CCLEAN) is one group with a long-term monitoring program that seeks to determine the sources, amounts, and effects of contaminants that enter our nearshore waters. CCLEAN collects effluent samples in municipal discharges, monitors the nearshore waters off central California, and uses satellite imagery to evaluate phytoplankton blooms associated with periods of high nutrient discharges. Findings from long-term CCLEAN monitoring of central California rivers include:

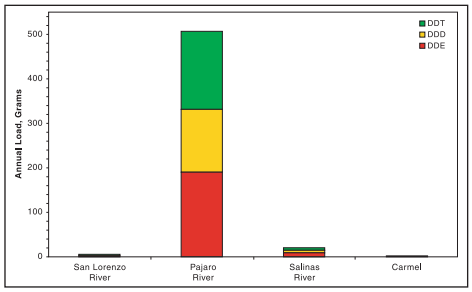


Figure 9. *Annual levels of DDT, DDD, and DDE in the San Lorenzo, Pajaro, Salinas, and Carmel rivers. Note the high levels of all three chemicals in the Pajaro River. Figure taken from the CCLEAN 2002-2003 Annual Report.*

- The Salinas and Pajaro Rivers typically have the highest concentrations of nutrients.
- The Pajaro River typically has the highest concentrations of DDT (Figure 9).
- The San Lorenzo River usually has the highest annual load of E. coli and enterococcus bacteria.

FOCUS ON TECHNOLOGY

The **SIMoN web site** has an interactive mapping feature specifically tailored to water quality issues. This tool allows you to build custom maps showing monitoring stations, watershed boundaries, outfalls, and view related information from various water monitoring groups. Go to www.mbnms-simon.org and click on the Interactive Maps button.

CCLEAN shares these and other findings with local and state governments to better inform management decisions on water quality issues such as beach closures on the central California coast.

HARMFUL ALGAL BLOOMS

Single-celled toxic algae are found in Sanctuary waters and periodically undergo a period of rapid growth, creating what is called a harmful algal bloom (HAB). One particular type of toxic algae, *Pseudo-nitzschia australis*, has been found to produce domoic acid, a neurotoxin that damages the brains of marine mammals and seabirds. In the Monterey Bay, levels of

Photo courtesy of R. Robison.

Dr. Mary Silver collecting a surface water sample during a CIMT survey.

Pseudo-nitzschia are monitored by Dr. Mary Silver of the Center for Integrated Marine Technologies (CIMT) program. Findings from monthly CIMT surveys in the Monterey Bay include:

- There is no clear pattern of geographic distribution of HABs in Monterey Bay.
- There are multiple toxic species of algae present in Monterey Bay.

Not all algal blooms are toxic and species that are able to produce toxins do not always do so, which makes the timing and location of HABs variable.

MOSS LANDING POWER PLANT THERMAL DISCHARGE

In 2002, SIMoN initiated a study to monitor the ecological effects of thermal discharge into Monterey Bay from the Moss Landing power plant. During the energy production process, seawater is used for cooling turbine engines; that water is pumped back out through a discharge pipe offshore of Salinas River State Beach. The impacts of this discharge on the nearshore

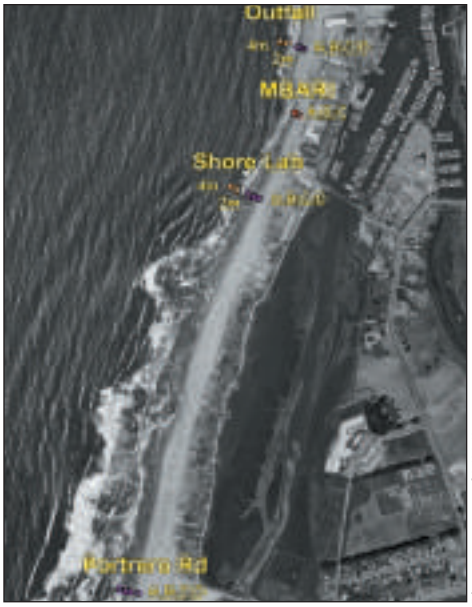


Photo courtesy of MLML.

Figure 10. *Locations of intertidal and subtidal sampling stations at Moss Landing.*

ecosystem are the focus of an on-going study by researchers at Moss Landing Marine Laboratories. Preliminary findings include

- Sea surface temperature at the outfall site is higher than areas 500 meters away from the outfall.
- Bacteria measurements at the outfall site are higher than those measured 500 meters away.

Other components to this project include the monitoring of benthic invertebrate populations, planktonic communities, and birds to assess impacts to the nearshore ecosystem. Future findings will be made available on the SIMoN web site (www.mbnms-simon.org).♻

WHAT YOU CAN DO

- Do not dump waste into storm drains. Storm drains flow into creeks, rivers, and ultimately, the ocean.
- Monitor water quality in your area by joining the Citizen Watershed Monitoring Network. Call (831) 883-9303 for more details.
- Visit the Water Quality section of the SIMoN web site for more information on water monitoring activities (www.mbnms-simon.org).

DEEP SEA SURVEYS

Since the early 1970s, faculty and students at Moss Landing Marine Laboratories (MLML) have participated in class cruises aboard several research vessels to survey the fishes and invertebrates of Monterey Bay. The purpose of this monitoring program is to characterize, and document changes to, shallow (0 to 200 meters), midwater (200 to 700 meters), and deep-benthic (700 to 1000+ meters) habitats in Monterey Bay. Findings from this on-going project include:

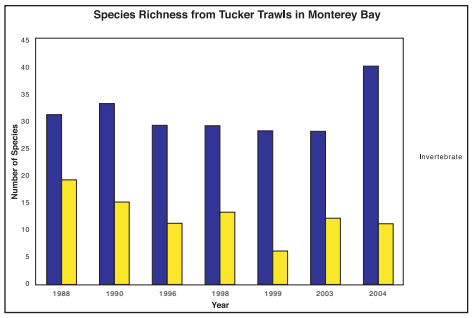


Figure courtesy of S. Lonhart with permission from G. Cailliet

Figure 11. *Counts of species for invertebrates and fishes collected during Moss Landing Marine Laboratories class cruises. A Tucker trawl was used at depths ranging from 150 to 1900 meters for 30 to 145 minutes. Trawls were made in Monterey Bay at a location within 15 miles of Moss Landing.*

- Since 1972, scientists have collected 231 fish species and 158 distinct invertebrates. An additional 55 fishes and 358 invertebrates could not be identified to species, suggesting there is still a great deal to learn about the organisms living in the depths of Monterey Bay.
- During the seven years in Figure 11, the northern lampfish *(Stenobrachius leucopsarus)* was the most abundant fish caught in Tucker trawls. This fish is typically found at depths of 300 to 600 meters during the day, then migrates up at night to depths as shallow as 50 meters.

This project allows researchers to examine important and valuable historical data from one of the least described and understood ecosystems, the coastal demersal and deep–sea midwater and benthic habitats. This work also helps resource managers understand the impacts of bottom trawling on populations of deep sea organisms. In 2004, SIMoN funded Dr. Greg Cailliet and his research group at MLML to develop a database with over 30 years of data from this project. This database, now hosted on the SIMoN web site (www.mbnms-simon.org), will continue to grow as future MLML classes add their newly collected data.

DEEP SEA COMMUNITIES IN MONTEREY BAY

The deep sea is among the least understood habitats in the Monterey Bay National Marine Sanctuary. Since 1994, scientists from the Monterey Bay Aquarium Research Institute (MBARI) have monitored changes within invertebrate and fish populations associated with the soft-bottom habitat of Smooth Ridge,

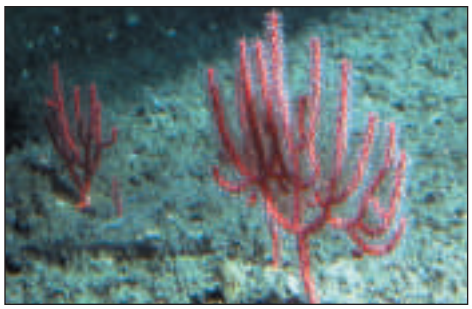


Photo courtesy of SIMoN/MBNMS.

Gorgonian species typically seen in surveys of the Sanctuary ocean bottom.

an area of the continental shelf that slopes into the deep sea. Using a remotely operated vehicle (ROV) outfitted with video cameras and a laser measurement system, this study identifies animals and calculates population densities at depths of 200, 400, 600, 800, and 1000 meters. Findings from this study include:

- The structure of the slope community is variable from year to year, particularly in the shallower depths (200 meters).

Results from this study have implications for management of these deep areas of the Monterey Bay National Marine Sanctuary. As an example, information from this project was recently used to develop mitigation options for fallen shipping containers in the Smooth Ridge area.

WHALE FALL IN MONTEREY CANYON

In 2002, researchers from MBARI discovered the remains of a gray whale *(Eschrichtius robustus)* while exploring the deep Monterey Canyon with an ROV. This 'whale fall' provides an opportunity to study the effects of organic enrichment by the decomposing whale at extreme depths as well as the unusual animals that rely exclusively on this food source. Findings from this on-going study include:

- A whale fall is a significant source of nutrients for a variety of deep sea animals that live in a generally nutrient poor environment.
- A whale-fall will typically be covered with hundreds of thousands of worms, crustaceans, and mollusks, many not found in the adjacent mud and sand.
- Two new species of worms were discovered that appear to exclusively live on the bones of dead whales.

At a depth of almost two miles, this whale fall is the deepest ever to be studied. MBARI scientists plan to return to the site 4 times per year for the next several years. Their work helps to increase the scientific understanding of these virtually inaccessible, deep sea regions within the Monterey Bay National Marine Sanctuary.♻

Photo courtesy of MBARI.

Image of the whale fall taken by the ROV Tiburon.

WHAT YOU CAN DO

- Put trash in its place. Refuse left on beaches or deposited into our rivers and streams can wash into the Sanctuary and sink to the deep ocean bottom.
- Visit the MBNMS web site (http://montereybay.noaa.gov) to learn about and participate in public policy forums on submerged cables and ocean dumping.
- Find more information on the deep sea environment by visiting the SIMoN web site (www.mbnms-simon.org).

The SIMoN web site (www.mbnms-simon.org) is an online information resource for educators, scientists, students, and the general public. The web site 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 SIMoN web site is structured so users can quickly find a wealth of information on topics of interest.

TOPICS COVERED ON THE SIMON WEB SITE

- Rocky shores
- Kelp forests
- Beaches
- Sandy floors
- Open ocean
- Estuaries
- Deep sea
- Oceanography
- Geology
- Water quality
- Fisheries
- Seabirds
- Marine mammals
- Marine reserves
- Invasive species
- Threatened species
- Ocean observatories

MONITORING INFORMATION

On the SIMoN web site you can discover information on over 75 different monitoring projects. Each project page includes an overview of the project, who the researchers are, the methods used, and a summary of findings including figures, images, and downloadable documents.

These monitoring projects provide unique insight on the general trends and health of the Sanctuary.

HABITATS AND ISSUES

The SIMoN web site provides information on over 15 different habitats and issues in the Sanctuary. This information includes natural history of habitats and species as well as updates on resource management issues. The information available on SIMoN is presented in an accessible format and highlights the incredible and diverse marine environment of the Monterey Bay National Marine Sanctuary.

OTHER FEATURES OF THE SIMON WEB SITE

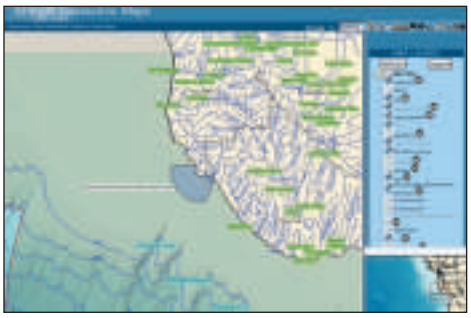
- Links to over 200 relevant web sites
- Bibliographic database of 11,000 journal articles
- Links to real-time data sets
- Web site search function
- Comprehensive glossary of terms
- Consistent update of information
- Interactive Maps

www.mbnms-simon.org

Home page of the SIMoN web site.

INTERACTIVE MAPS

The SIMoN interactive map feature displays Sanctuary monitoring data in the form of high-end geographic information systems (GIS) and maps. These spatial data are available in a regular browser window and do not require software downloads or plug-ins. The user-friendly interface of the SIMoN interactive map viewer makes it easy to:



Map produced by the interactive map feature.

- Show or hide any combination of available data layers
- Use various tools such as zoom, pan, and identify features
- Print custom-built maps from the browser
- Download GIS data for desktop use

YOUR THOUGHTS ON SIMON SAYS

SIMoN is interested in hearing your thoughts about this publication. Submit your comments online by going to www.mbnms-simon.org and clicking the *Comments* link (bottom of webpage).

ABOUT SIMON

SIMoN is a regional 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 Monterey Bay Aquarium. For more information please call (831) 647-4209 or visit www.mbnms-simon.org.♻

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.