

Unit II: Monterey Bay National Marine Sanctuary (MBNMS)

On the cutting edge...

Personnel at the Monterey Bay National Marine Sanctuary are working closely with scientists on several research projects. Some researchers are interested in monitoring ecosystems at the land's edge or discovering the affects of nutrient upwelling on whale distribution. Other scientists are discovering new worlds in the oceans depths. They are using autonomous underwater vehicles to explore the deep canyons of the sanctuary. These areas contain poorly understood cold seep communities. Some scientists are exploring organisms in the water column where new jellies have been discovered. All of these studies are very exciting as new technology opens the ocean frontiers to new exploration.

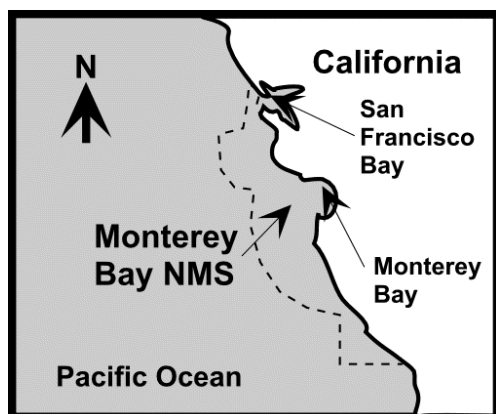
Introduction to the MBNMS

Lesson Objectives: Students will be able to do the following:

- Identify two distinguishing features of the MBNMS
- Compare and contrast the MBNMS with the CINMS
- Explain how indicator organisms are used in monitoring projects

Key concepts: sanctuary, biological diversity, interdependence, ecological stability

MBNMS Overview



Our nation's largest **marine sanctuary** is the Monterey Bay National Marine Sanctuary (MBNMS). This sanctuary is located

along the central California coast. It includes the waters of Monterey Bay and the adjacent Pacific Ocean waters. This area contains 4024 nautical miles of open ocean water, extending 348 miles north to south and an average 25 nautical miles out from shore. This sanctuary is also our nation's deepest, with a submarine canyon twice as deep as the Grand Canyon. The deepest point in this canyon is 10,663 feet below the water's surface.

The MBNMS was designated in 1992 because of its rich physical and biological diversity and its important

cultural resources. The coastal habitats range from rocky shores and steep bluffs to sandy beaches bordered by



cliffs. The underwater landscape includes geologically important features such as the North American Plate and the Pacific Plate. The junction of these two plates is marked by the San Andreas Fault. Cold, nutrient-rich water found in nearshore habitats is delivered to the surface by upwelling from lower depths. This upwelled water supports an abundance of organisms in varied habitats like the kelp forests and fields of sand and mud. The rain of deceased plants and animals falling to the seafloor supports a wealth of benthic fauna in deep canyons and on rock walls. Many types of animals use these diverse environments.



Some animals are permanent residents within the sanctuary while others travel through this region on migratory journeys. Marine mammals, seabirds, fish, sea turtles, and a variety of marine **invertebrates** use this area. Seals and sea lions

can be found along the rocky shores. Whales migrate through the ocean waters. Sea otters make their homes in kelp forests. Seabirds are found along the sandy beaches and wetland areas.

Cultural resources and artifacts give us a glimpse into the past. By studying shell piles or middens left by Native Americans, we can more clearly understand some aspects of daily life.

Other artifacts, including the remains of many wrecked ships, tell us about weather patterns and human impact on animal populations. For instance, Europeans settlers arriving in the 1700's hunted sea otters and abalones to use as trade items with the native inhabitants. In some cases, this was detrimental to the ecology of the kelp forest.



Today the sanctuary continues to protect the natural and cultural features within its boundaries while allowing people to use and enjoy the ocean. The sanctuary personnel also conduct research, monitor the habitats, and educate the public to help promote stewardship of our oceans and understanding of these **interdependent** communities.

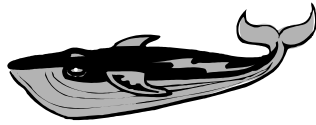
Blue Whales

The blue whale (*Balaenoptera musculus*) is the largest **mammal** on earth weighing up to 150 tons and measuring 80 feet in length. These whales are characterized by their long, slender body shapes and their

broad, flat heads. They also have ventral pleats on their throats, chests, and bellies. Their bodies are generally a blue-grey color with a light ventral surface. Sometimes **phytoplankton** called **diatoms**

attach themselves to the surface of the whale. These diatoms make the whale appear to be a yellowish color. That is why some whalers called these whales “sulphur bottoms”.

These giants of the ocean live over



25 years. They mate and breed between 6 and 10 years of age. The females have calves every 2 to 3 years. These ocean giants search the coastal waters for food. **Krill** (shrimp-like organisms) are their main food. Blue whales are **baleen** whales. They have baleen plates made of a fingernail-like material called **keratin**. These plates look like fine black hairs, but they are very tough. When a blue whale is ready to eat, it opens its mouth



and takes in enormous amounts of water. As the mouth closes the water is strained through the baleen plates leaving the food trapped in the whale’s mouth. One whale can eat up to 4 tons of food per day. That is about 40 million krill.

Originally blue whale populations were estimated to be between 200,000 and 300,000. Blue whale populations were almost completely decimated in the early 1900’s with advances in whaling technology. The recovery of this long-lived species is very slow, with their numbers estimated at 5000 today. Scientists in the MBNMS are interested in studying these creatures for several reasons. Blue whales pass through sanctuary waters on their long ocean

migrations. Unlike the Antarctic population of blue whales that travel from polar feeding grounds to temperate and tropical breeding grounds, the California blue whale population feeds year round. They migrate from their winter feeding grounds in the Gulf of California as far south as the waters offshore of Costa Rica to their spring and summer feeding grounds off central and southern California. Scientists don’t know exactly where these giants breed and give birth, but

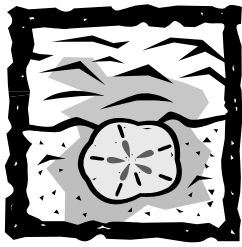


suspect that the Gulf of California is an important winter nursery grounds for growing calves. Blue whales **forage** only on krill, and the krill that the California blue whales feed upon are made available through coastal upwelling.

Scientists are interested in learning more about how the abundance and distribution of this food is affected by global weather change. In addition they are looking at how food distribution affects the migration patterns of the blue whale. This fascinating research is using the latest technology to track whales as they dive for food. Researchers hope to learn more about how this important marine food chain impacts other **food webs**. This information will help researchers identify management strategies that can protect essential blue whale habitat.



Rocky Intertidal Monitoring



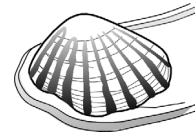
Rocky **intertidal** habitats are created as water recedes along rocky coastlines during low **tides**. Pools are left in the rock depressions along with many interesting organisms that live only in these areas. Many of the invertebrates and **algae** found here must adjust to changing environmental conditions. Some of these organisms receive food and nutrients carried by the force of incoming waves. At the same time, they must resist being swept away as these waves recede. In addition, these organisms need to remain moist when water is scarce and be protected from strong ultraviolet rays. They must also keep from being eaten by **predators** that use the **tidepools** as a seafood buffet.

Some of the rocky intertidal areas within the MBNMS are the focus of educational monitoring projects. These projects provide an opportunity for scientists to help students understand the ecological importance of these communities. These areas are ideal for study, because they are easy to get to and contain a broad array of specimens. They are located at the water's edge, so they provide a timely overview of human impact. In addition, changes taking place in intertidal life can be traced to larger

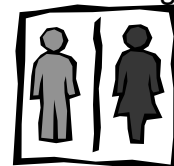


changes in the world's oceans, such as climate change.

Monitoring projects generally involve studying a few key species found within a region. These indicator species are typically important for the overall health and character of the **community**. They may also be sensitive to disturbances, such as harvesting, trampling, pollution, or changes in weather conditions. By studying these organisms, scientists can gain a broad view of the health of the oceans. Owl limpets present a good example of intertidal organisms suitable for ecological monitoring.



Owl limpets are **molluscs** with a single, cap-shaped shell that covers a large foot. This foot is used to cling to and crawl over the rocks. Owl limpets graze on diatoms at night and hide under ledges during the day as they try to escape birds that prey on them. Owl limpets are **hermaphrodites** with a very interesting life cycle. As hermaphrodites, they have both male and female reproductive parts. They start life as males and change to females when they get larger. Some of these females grow to be over three and a half inches in length. These females are also territorial. They clear sizable areas of all organisms so that a lawn of diatoms can grow and provide



them with food. Consequently, they create a patchwork of cleared farms. These farms add structure to the community.



Monitoring the numbers and sizes of owl limpets can reveal a great deal about the health of the rocky intertidal environment. In unprotected areas, people often collect the large limpets for food. This activity removes many females from the population. This

decrease in numbers simplifies the community structure, because less space is incorporated into farms. In other areas, such as state beaches, the limpets are protected. Here visitors frighten away the birds, and owl limpets can thrive in unusually high numbers. When owl limpets are common, but not too abundant, they add structure to the community with their patchwork farms. They also provide food for sea birds and other animals. When they're too abundant, their farms create large areas that exclude other organisms.

Activity: A Crushing Experience



Every habitat is impacted by a variety of factors. These conditions also affect the organisms that live within the habitat and in turn can upset the ecological balance. Scientists interested in studying these communities sometimes follow changes over time using monitoring programs. These programs can help scientists determine trends and give them an overall picture of changes within the ecosystem.

Objectives: Students will be able to do the following:

1. Observe human impact within a study area.
2. Describe the types of changes that occur within the habitat as a result of human impact.
3. Evaluate the results of human impact.

Materials:

- Markers to identify the study areas (Markers could include cones, tape, rope, flags, etc.)
- Paper and pencil for recording (Cameras could also be used for observation.)

Note to Teacher: It is helpful if students have participated in observation types of experiments prior to this activity. It may be helpful to review the senses and what they can tell us about our environment.

Procedure:

1. Designate two study areas of approximately equal size and similar habitat. Choose one in a high “human” impact area and the other in a low impact area. (A path worn by people taking a short cut as opposed to an area fenced off to foot traffic are good examples.)
2. Have students use their senses to make observations about each area. Have them compile a list of the types of organisms that they find in the study areas and their condition. Have students also make observations about the general condition of the habitat. (Encourage them to use all of their senses and look closely at the smallest portions of the habitat.)
3. After making observations, have the students answer questions about the study areas. (The following questions can be used or others can be added.)
 - How many animals were seen in each study area?
 - How many types of animals were seen?
 - What areas did the animals occupy? (Trees, shrubs, grass, soil, puddles, etc.)
 - What was the condition of the habitat? (trampled grass, litter, broken branches, etc.)

- Did students notice anything that could be hazardous to the living and nonliving parts of the study areas? (gasoline fumes, thick dust, loud noises)
4. Have students compile a class list of their observations and their answers to the questions.
 5. Have students discuss the differences found in the two study areas. Have them evaluate the human impact to the areas.
 6. Have students make observations about the study areas over a time period. (Once a day for several weeks, or once a week for several months, etc.)
 7. Have students discuss their observations. Is human impact damaging the study areas? How? To what degree? Can all the changes in the study areas be attributed to human impact? Can anything be done to lessen the effects of human impact on the study areas?

Possible Extensions:

1. Have student use their results to develop a role-play using effective arguments to convince a governing body (city council, etc.) to develop strategies for lessening human impact in certain areas.

Student Information: Sanctuary Monitoring



The Monterey Bay National Marine Sanctuary (MBNMS) is located off the California

coast. It is our nation's largest and deepest sanctuary. It is a richly diverse place where visitors can view animals in a variety of habitats. Along the coastlines are rocky cliffs and sandy beaches. These areas are home to many animals including seals, sea lions, and endangered birds. Amateur naturalists can search the **tidepools** for indicator organisms, such as limpets and sea stars. These delicate creatures alert scientists to problems in the environment. Sometimes they will be the first to be affected by pollutants or extremes in weather conditions. The tidepools are also home to **algae** used as food for other organisms and anemones that hunt for tiny shrimps with their stinging tentacles. Although these animals must be sturdy to withstand Mother Nature, they are very sensitive when it comes to humans. If you are

enjoying the tidepools, please be careful when handling these animals.

The open waters of the sanctuary are also alive with fish and marine **mammals**. The nearshore kelp forests provide habitat and food for sea otters. Transient giants, including the blue whale, can be seen as they swim through the sanctuary waters. This whale is the earth's largest mammal weighing up to 150 tons. As these animals look for food, they strain tons of **krill** or shrimp-like organisms through their **baleen** plates. These plates look like long black hairs, but they are very sturdy. The whale takes in large amounts of water and sieves out the krill. As they move through the sanctuary waters, scientists monitor them. These researchers are interested in learning more about whales in order to help them recover from overfishing. In the early 1900's, the blue whale population was almost destroyed by whalers' efficient technology. Today their numbers are slowly beginning to recover.