

MIMS OCEAN SCIENCE

VOLUME 1 ISSUE 3
MAY/JUNE 2004

THE SCIENCE & TECHNOLOGY JOURNAL OF THE MINERALS MANAGEMENT SERVICE

**Ecosystem-
Based
Management**

**Adaptive
Management**

**Sand,
Gravel &
Coastal
Erosion**

**MARINe
Network**

**Ocean
Education**

Devils Tower



MAY/JUNE 2004

Volume 1 Issue 3

MMS OCEAN SCIENCE is published bi-monthly by the Minerals Management Service to communicate recent ocean science and technological information and issues of interest related to offshore mineral recovery, ocean stewardship, and mineral revenues.



Please address all questions, comments, suggestions, and changes of address to:

Mary Boatman
MMS OCEAN SCIENCE Editor
Minerals Management Service
1201 Elmwood Park Boulevard
New Orleans, LA 70123

mary.boatman@mms.gov

(504) 736-2781

ABOUT THE COVER

Top: Green sea anemone and coralline algae in a California tidal pool. Photo by M. Hill.

Bottom: The coral *Montastrea franksi* spawning at the Flower Garden Banks with a brittle star feeding on egg bundles. Photo courtesy of the Flower Garden Banks National Marine Sanctuary - Emma Hickerson.

All photos courtesy of Minerals Management Service unless otherwise noted.

Publication services provided by
Schatz Publishing Group

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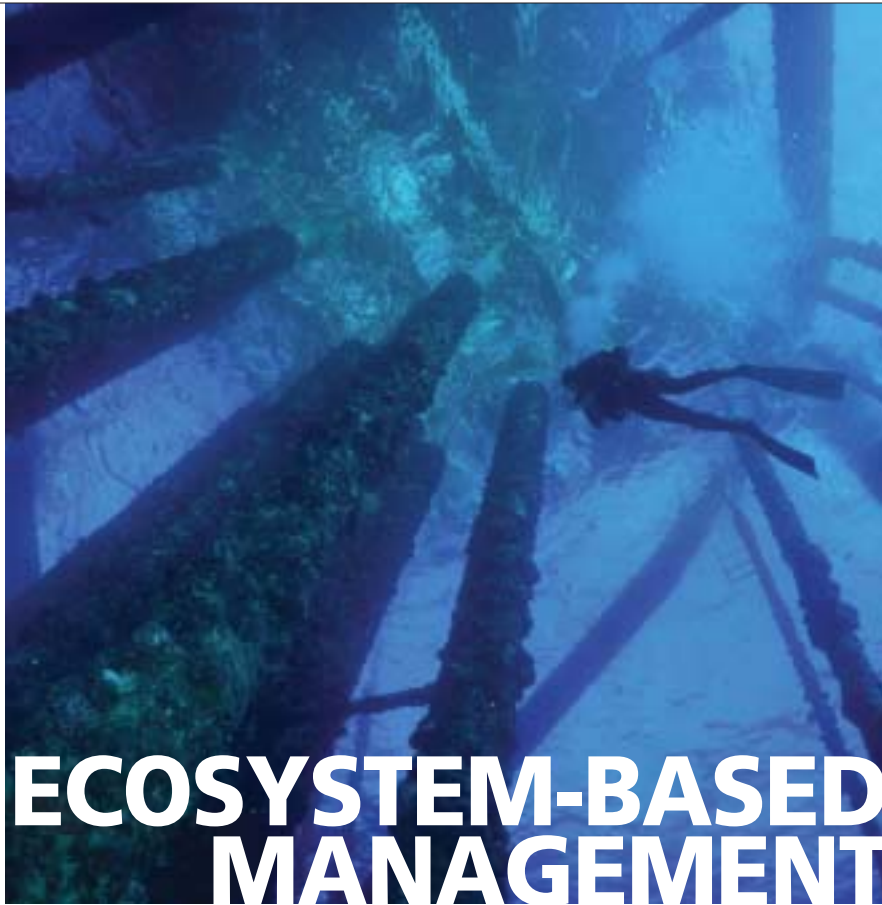
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ECOSYSTEM-BASED MANAGEMENT

“U.S. ocean and coastal resources should be managed to reflect the relationships among all ecosystem components, including humans and non-human species and the environments in which they live. Application of ecosystem-based management will require defining geographic management areas based on ecosystem, rather than political, boundaries.”

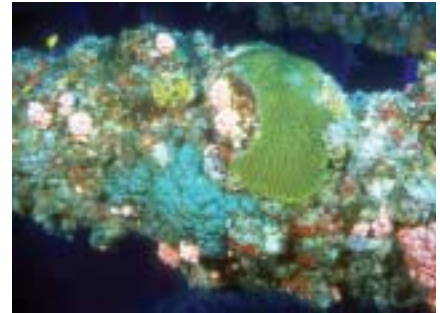
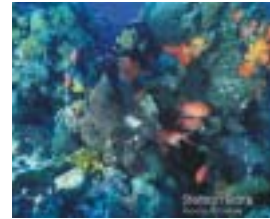
— U.S. COMMISSION ON OCEAN POLICY
PRELIMINARY REPORT, APRIL 2004

As scientists learn more and more about the ocean ecosystems, it becomes clear that the management of our natural resources must not be made in terms of a single area or species, but in terms of a complex interconnected ecosystem or ecosystems. One of the main keys to effective management is knowledge of the intricate interrelationships and interdependent components of a system. To increase that knowledge, scientists from across the Nation join with the Minerals Management Service (MMS) to gather data to build the body of information necessary to formulate objective decisions.

In a series of marine ecosystem studies conducted in the 1970's, the MMS Environmental Studies Program (ESP) supported studies with boundaries defined by habitat changes, rather than arbitrary lines on a map or chart. These studies focused on areas of perceived similar habitat type such as the South Texas Shelf, the Mississippi-Alabama Shelf, and the Southwest Florida Shelf.

Today, MMS is working with scientists from Mexico to expand our understanding of the Gulf of Mexico beyond the 200-mile Exclusive Economic Zone, a political boundary. Information is being gathered about the deepwater ocean

Left: Diver under a platform.
Below left: Fish and coral at Stetson Bank.
Below right: Diver next to a platform leg.
Bottom: The corals *Diploria strigosa* and *Madracis decactus* growing on platform.
Photos by Gregory S. Boland and James J. Kendall.



UNDERSTANDING RELATIONSHIPS IS THE KEY

currents with instruments placed throughout the Gulf of Mexico, in a cooperative effort with physical oceanographers from Centro de Investigación Científica y Educación Superior de Ensenada (CICESE).

In another effort, biologists from Texas A&M University are working with Mexican scientists to understand better the distribution of marine life that resides in or on the deep-sea sediments. Through observations and experiments conducted at sea, these scientists are integrating information about the physical environment, including the geology and chemistry of the seafloor, with the distribution of the organisms that live in this environment. The different types of sea creatures being examined span from bacteria to shrimp and crabs to fish, in order to describe the entire ecosystem.

The MMS continues to gather and use integrated information about the marine environment to evaluate the potential impacts from oil and gas and other marine mineral recovery activities on Federal lands.

THE FLOWER GARDEN BANKS



Above: Close up of Agaricia coral species. Photo by Gregory S. Boland.

Adaptive management is the process of using monitoring to adjust management and research decisions to achieve objectives better. In managing impacts to complex ecosystems, there is usually not enough information to determine the best methods to use. Through the process of adaptive management, the consequences of decisions are monitored and the methods applied may be changed according to the results. For the Minerals Management Service (MMS), research is conducted to collect the necessary information to make initial decisions and, where appropriate, monitoring is used to evaluate the decisions.

The protection of marine life is important as offshore oil and gas development activities increase in an area. Often the exact results of new

activities are not known. The MMS requires stipulations in many lease documents to ensure protection of the environment. In the Gulf of Mexico lives a thriving coral reef community known as the Flower Garden Banks. The banks are a living example of MMS's recognition of the need for protection of the ocean environment through continuous monitoring and adaptive management.

In the early 1970's, the areas of the Gulf of Mexico farther offshore became a focus of industry planning. To protect the banks, a stipulation was placed on lease agreements for the area. In doing so, the MMS goal was "the protection of this unique and possibly fragile coral reef environment." The stipulation for the Flower Garden Banks placed a no activity zone around the banks' reef communities, and a shunt zone of four miles was placed on the area

surrounding the reef. The shunt zone required that all waste matter from the drilling process must be transported through a pipe to near the seafloor to prevent the discharge from reaching the shallower portions of the banks where the corals live. The lessees were also required to monitor the environmental conditions at production sites and at the banks by using strict MMS guidelines. The monitoring included repeated sampling, observations, and measurements of various components of the reef system to determine their condition over time. Sampling of physical and chemical parameters assisted in the interpretation of biological results.

A VISIT TO THE FLOWER GARDEN BANKS

Dainty yellow fish dance in and out of the coral; alien creatures float up and down in the blue Gulf water. A colorful and imaginative world lies beneath the waters of the northern Gulf of Mexico. The Flower Garden Banks actually consist of twin banks located 100 miles southeast of Galveston, Texas, a seven- or eight-hour trip by sea. There are 12 miles between the two banks, and in some places only 60 feet of water cover the banks. Over 170 species of fish and over 300 species of reef invertebrates inhabit the nearly 400 acres of reef that covers the two banks.

The reef is watched over carefully by many eyes. The MMS oversees the protection of the reef from surrounding oil and gas activities through co-sponsorship of a monitoring program. The U.S. Coast Guard works with the National Oceanic and Atmospheric Administration to fly sanctuary staff 150 feet from the ocean surface so that they can observe the reef conditions. Even when sanctuary staff is not aboard, the pilots in the area keep an "eagle's eye" watch over the coral reefs.

Oil platform personnel and dive boat operators in the area also keep an eye on the activities at the reef.

The following activities are prohibited within the Flower Garden Banks National Marine Sanctuary:

- Anchoring or mooring within the sanctuary a vessel greater than 100 feet in length.
- Anchoring a vessel in the sanctuary where a mooring buoy is located.
- Oil and gas exploration and development in most of the sanctuary.
- Possessing, injuring, or taking corals or other marine organisms.
- Altering the seabed, building or abandoning structures, discarding or depositing most substances or materials, using explosives, and releasing electrical charges.



...a living example of MMS's recognition of the need for protection of the ocean environment ...

As more was learned about the banks through the studies program and monitoring, the Flower Garden Banks stipulation was modified to reflect the best information. After several years of monitoring, MMS ascertained that no damage was being done to the banks or the coral habitat. The MMS then demonstrated management flexibility and reduced the stipulation for compliance monitoring at production sites.

At the same time, MMS recognized the need to continue monitoring the condition of the living reefs because it became clear that the banks were being damaged from other activities such as fishing and vessel anchoring. Marine scientists from the Gulf Reef Environmental Action Team (GREAT), an environmental group, conceived of a way to prevent anchor damage while not discouraging visitors to the Flower Garden Banks. The MMS provided personnel to help GREAT install 12

anchor moorings at the banks so vessels could tie up easily and not drop anchor.

In 1992, the Flower Garden Banks were designated a National Marine Sanctuary. The MMS continues to share in the protection of the reef, working with the National Oceanic and Atmospheric Administration (NOAA). The Flower Garden Banks National Marine Sanctuary is responsible for monitoring programs, research, education, surveillance, and the uses of the resources. In 1994, the NOAA National Marine Sanctuary Program presented a recognition award to MMS for over 20 years of protection and research of the Flower Garden Banks.

Adaptive management is not inexpensive; the total cost of the Flower Garden Banks program from the 1970's to date has been over \$3 million. In return for that investment, MMS has helped to ensure that a reef that is the

home to spectacular marine wildlife will continue to remain healthy and protected.

FOR MORE INFORMATION ON THE FLOWER GARDEN BANKS:

Flower Garden Information

Website: http://www.gomr.mms.gov/homepg/regulate/environ/flow_gar/flowgard.html

Long-Term Monitoring at the East and West Flower Garden Banks National Marine Sanctuary, 1998-2001 (MMS Publication 2003-031)

Website: <http://www.gomr.mms.gov/homepg/regulate/environ/studies/2003-031.pdf>

Flower Garden Banks National Marine Sanctuary

Website: <http://www.flowergarden.nos.noaa.gov/>



Upper left: (1) Brain coral. Above: (2) Whaleshark. Far left: (3) Scientist monitoring coral at the Flower Garden Banks. Middle left: (4) Brittle star feeding on egg sacs from the spawning coral. Left: (5) Conch shell. Photos 2, 3, and 4 by Gregory S. Boland.

CREATES NEW CHALLENGES

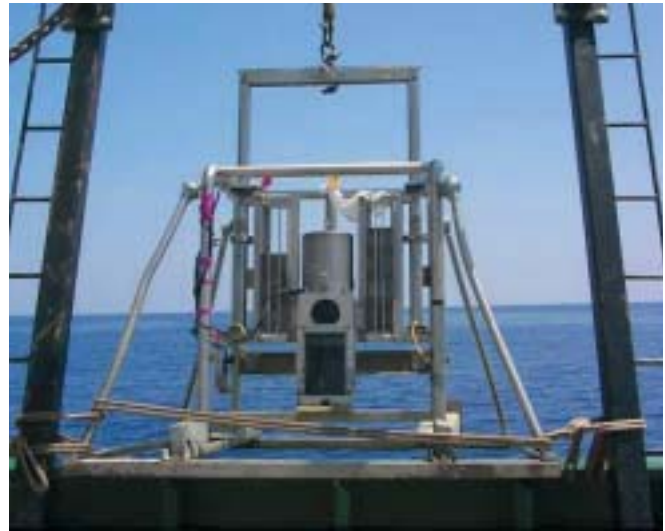
According to the U.S. Geological Survey, approximately 75% of our coastal shoreline is eroding. The States of Alabama, California, Delaware, Florida, Louisiana (eroding almost 7 feet per year), Maine, Maryland, New York, New Jersey, North Carolina (which averages 5-10 feet of erosion per year), and Texas have programs established for the reclamation of severely eroded beaches in their States. In each case, offshore shoals and ridges are seen as a potential resource for replenishing the shoreline.

But what impact will the development of the sand and gravel resources located in Federal waters have on the region? Studies have shown that the consequences of operations such as dredging cannot effectively be measured in terms of its effect on a single area. They must be evaluated with respect to the larger environment – how the development of a single area affects the entire seafloor topography of a region, its biological inhabitants, and the complex relationship between the two.

The Minerals Management Service (MMS) has been at the forefront of examining the complex relationships

between benthic organisms, fish populations and their bottom habitats, and changes in those populations should the bottom topography of an area be physically altered through dredging. Since the first field effort was initiated to support the MMS sand and gravel program, the concept of a larger ecosystem has been at the forefront. Although the environmental field investigations focus on the collection of information at discrete sand borrow sites, particularly an initial benthic ecological characterization of these frontier areas, all of the efforts have been interdisciplinary in nature, focusing on the relationship of biological components with the physical environment.

To understand those relationships, studies are now being conducted off the shores of Maryland and Delaware that examine the intricate link between the physical seascape of the ocean floor and its associated fish populations in the shoals of the mid-Atlantic. In these studies, scientists are analyzing whether the shoals serve as orientation features for migrations or population movements, if they serve as a staging ground for those migrations, whether they provide much needed physical habitat in a relatively flat seafloor, and whether the shoals help maintain the diversity of the surrounding physical habitat. The answers to these questions will help scientists and regulatory agencies plan ecologically responsible development.



Above: A sediment profile imager or camera that is used to penetrate the seafloor and take pictures of the upper layer of sediment with a resulting profile image illustrated below.

In addition to raised shoal sand and gravel deposits, studies are being conducted on buried channel deposits and flat sand sheets to ascertain the effects that dredging might have on the very different biological communities that reside in these areas. The process of dredging creates a substantial dip or depression in the seafloor that could potentially affect wave action and sedi-



Left: Scientists sift through sediments, collecting the organisms that live in and on the sand shoals. Right: A sediment profile image or photo of a hermit crab and the layers of sand below the surface.





Above left: Distributing dredged sand along the beach at Patrick Air Force Base, Florida. Above right: Aerial view of beach nourishment at Patrick Air Force Base, Florida. Bottom: Sand entering a hopper dredge.

ment transport in the area. Some buried channel deposits are overlain by fine silts and muds. In these cases, the technique used for dredging results in the side-casting or overspill of excess materials. The long-term consequences of dredging, such as potential recolonization rates and successes, have yet to be determined but are being studied.

Studies in coastal State waters suggest that the dredging operations conducted close to shore might in fact be increasing, rather than decreasing, the rates of coastal erosion. Computer models have shown that changes in shoals and ridges, in some areas, may negatively affect the patterns of sediment

transport, wave motion, and beach erosion. The biological composition of the area could also be affected. Other scientists, however, point out that the reclamation projects mean the protection of fragile wetland habitat, including Louisiana's wetlands which, according to the U.S. Geological Survey, are disappearing at a rate of almost 25 square miles a year. In addition to their value as storm protection for coasts and wetlands, the projects protect historic archaeological sites and economically valuable coastline.

The sand and gravel studies will continue to examine the interrelationship between the regional physical environment and the benthic environments in new sand borrow areas identified through the MMS/State geological cooperative efforts. This concept has been widely endorsed by the National Research Council, which advocates an ecosystem-based approach to reduce potential dredging impacts below critical thresholds. The MMS is also studying available dredging technologies and methodologies to

understand better its interaction with the marine environment to develop strategies to mitigate or reduce dredging impacts.

Effective management of our Nation's coastal sand and gravel resources is dependent on a thorough understanding of the effects of reclamation on the complex ecosystems of which they are a part. The determination of MMS and its governmental, industry, and academic partners to supplement that understanding will help ensure the development of a prudent response to the crisis of coastal erosion.

FOR MORE INFORMATION ON SAND, GRAVEL, AND EROSION ISSUES, VISIT:

Sand and Gravel Program

Website: <http://www.mms.gov/sandandgravel/>

Conducting Sand and Gravel Research

Website: <http://www.mms.gov/sandandgravel/EnvironmentalStudies.htm>

Hurricane Impacts on the Coastal Environment

Website: <http://marine.usgs.gov/fact-sheets/hurricane/hurricane-txt.html>





**MINT • MMS' INTERTIDAL TEAM and
MARINe • MULTI-AGENCY ROCKY INTERTIDAL NETWORK**

MONITORING

INTERTIDAL ENVIRONMENTS

The rocky intertidal habitats of the California coast are teeming with life. Mussels, barnacles, seastars, and anemones are just a few of the diverse forms of life that can be found. Minerals Management Service (MMS) research seeking to identify the species that inhabit the intertidal sites, their numbers, and their habitat has been ongoing. The MMS is currently involved in rocky intertidal research through the efforts of two organizations: MARINe, the Multi-Agency Rocky Intertidal Network, and MMS' Intertidal Team (known as MINT).

MARINe is a network of 55 monitoring sites along the Pacific Coast stretching from central to southern California on the mainland and the offshore islands. An additional 15 sites

being monitored in northern California will be added to MARINe next year. Twenty-three partners participate in MARINe, including local, State, and Federal government agencies, universities, and private groups. This special partnership meets regularly to compare data, develop new scientific approaches, and communicate the information to the public through joint publications. MARINe believes that long-term monitoring of the rocky intertidal habitat is essential to the continued management of these important coastal resources.

Information about 13 target species, including the California mussel, ochre seastar, black abalone, acorn barnacle, rockweed, turf algae and surfgrass, is collected by nine teams of biologists spread throughout the State during low



Top: Photo of MARINe monitoring site near Malibu, California, during test of a remote-controlled model-helicopter photoshoot. Photo by M. Hill. Above: Refining its monitoring approaches, MMS is now utilizing a blimp to take vertical pictures of intertidal sites.

MONITORING RESOURCES

The MMS Intertidal Team (MINT) has actively studied rocky intertidal communities since 1992. MINT continued the long-term study of four rocky intertidal communities in Northern and Central California through the 1990's to determine the recovery time needed for mussel beds following a major disturbance. In addition to participation in Multi-Agency Rocky Intertidal Network (MARINe) field data collection at MMS-funded rocky intertidal sites, MINT continues to conduct special projects in support of MARINe. These include development of new MARINe photography protocols and development of oil-spill response protocols for rocky intertidal habitats. MINT also sponsors Annual Taxonomic Workshops for MARINe biologists. MINT is funded directly by MMS as an inhouse study.

The MMS goal of monitoring resources that neighbor ongoing oil and gas activities blends well with the objectives of the other Federal, State, and local agency partners who participate with MINT in MARINe. This goal supports the MMS mandate to monitor the environment where there are ongoing operations as required by the OCS Lands Act.



Above left: Photo of Maurice Hill, MINT Team member, (left), and contractor testing a remote-controlled model-helicopter's ability to photograph a MARINe site. Above center: Rectangular photoquadrats placed over *Endocladia muricata*, a turf alga, at a Southern California MARINe site near Los Angeles. Above right: Dr. Mark Pierson, MINT team member, counts small motile invertebrates as part of a MINT study at a site in Northern California.

tide periods in the fall and spring. One of these teams is MINT, a group of MMS biologists who have been involved in rocky intertidal studies since 1992. Procedures for collecting information about these species have been standardized so that data can be shared by the partners through a common database.

Because MARINe includes information over broad areas and includes data from many years, trends in the species as a result of large changes can be identified. Monitoring of the sites serves as an early warning of possible abnormal conditions, increasing the possibility of reducing or eliminating environmental damage. Monitoring has already yielded important findings, such as the decline of the black abalone caused by a disease known as withering foot syndrome. MARINe scientists have been able to track and record the



Right: Photo of the rockweed *Silvetia compressa*. Photo by M. Hill.

disease's progress from its first appearance in the mid 1980's. This led to State and Federal protection of the species.

MINT and MARINe are testing a new photographic technique—taking aerial photos using a blimp. A camera is attached to the underside of the blimp to take vertical pictures of the site at different heights. It is hoped that this new technology will enhance mapping of MARINe sites and enable extrapolation of MARINe data to the site. It may also become a useful approach to monitoring unstudied sections of habitat.

FOR MORE INFORMATION, VISIT:

Multi-Agency Rocky Intertidal Network

Website: <http://www.MARINe.gov>

EDUCATING RESPONSIBLE CARETAKERS OF TOMORROW

*“The great aim of education is not knowledge, but action.”
– Herbert Spencer*

And one action is the goal of teaching children about the Nation’s natural resources. If we expect future generations to handle the legacy of physical and biological riches we will pass on to them, we must teach them how to act responsibly and why those actions are so important.

So why is the Minerals Management Service (MMS), a regulatory agency, interested in ocean education? The agency serves as the trustee of America’s offshore energy resources, archaeological treasures, and marine environment and plays a vital role in the Nation’s financial stability, environmental health, and energy future. To carry out this job, MMS needs an ocean-literate public able to make choices and influence decision-making based on information and knowledge. The MMS also needs ocean-literate employees to carry out this mission – not just current employees but future ones. As a result, MMS has an

active and growing marine education program for the general public, educators, and students to

- Ensure wise offshore minerals decision making through an informed public
- Enhance ocean literacy, and
- Introduce students to the professions that study and protect ocean life and resources.

Our marine education program draws largely from research results of our Environmental Studies Program (ESP). The ESP was established in 1973 to provide scientific and technical information needed to predict, assess, and manage impacts in the human, marine, and coastal environments from the offshore oil and gas program.

As a part of current education efforts, the MMS has developed excellent teaching aids, posters, lesson plans, and other educational materials to help schools teach ocean science, science, and math principles in ways that involve and inspire young minds. In fact, MMS biologists Mary Elaine Dunaway and Fred Piltz were recognized by the Secretary of the Interior with a 4 Cs for Excellence Award for their development of Tidepool Math, which teaches basic math and science principles as students explore a tidepool. They recently presented the award-winning curriculum at the 2004 National Science Teacher Association Conference in Atlanta, GA.

Examples of programs available free from the MMS website include Ocean Energy, Whales and Dolphins, Chemosynthetic Communities, Historic Shipwrecks of the Gulf of Mexico, and Ocean’s Sand – a Natural Resource. These programs include games, puzzles, and lab experiments to introduce technology such as semisubmersible platforms. Colorful posters are available for each program. In addition to the programs, there are stories such as “Stacy visits an oil rig,” and “What is crude oil?” along with a fascinating explanation of how to build an ice island!

Future MMS programs will emphasize even greater student and teacher involvement. Increased hands-on activities and new topics such as gas hydrates and deep-sea oil leasing will help students understand the decisions that must be made today and the consequences they must live with tomorrow.

FOR ADDITIONAL INFORMATION ON RESOURCES FOR KIDS OF ALL AGES, VISIT:

MMS Kids' Pages

Website: <http://www.mms.gov/mmskids/>

MMS Kids – Alaska Region

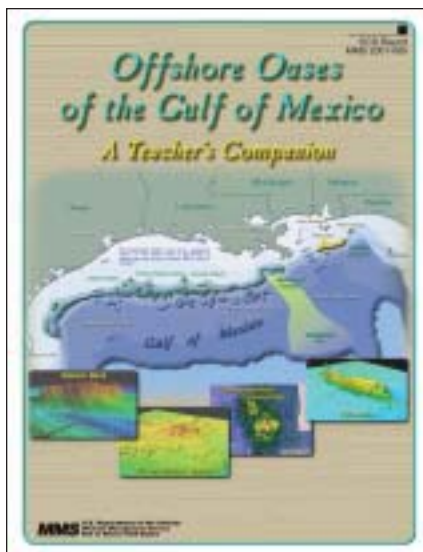
Website: <http://www.mms.gov/alaska/kids/index.htm>

Educational Resources

Website: <http://www.gomr.mms.gov/homepg/lagniapp/lagniapp.html>

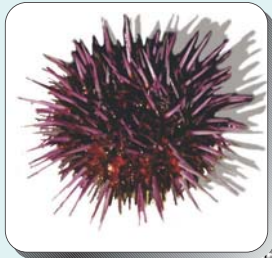
MMS Pacific Region

Website: <http://www.mms.gov/omm/pacific/kids/educate.htm>

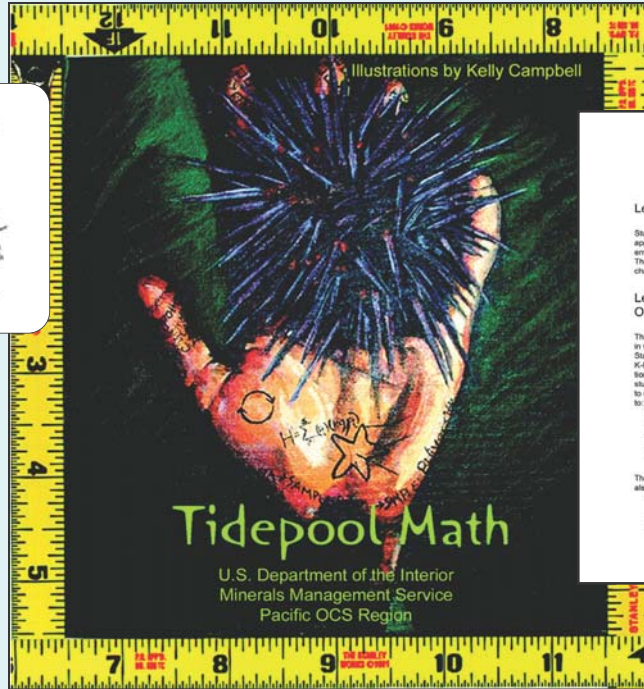


OCEAN EDUCATION RESOURCES

Tidepool Education for All Grade Levels



Lesson Plans & Flash Cards are Among the Resources Enhancing the Education Experience



Tidepool Math
K-8

Lesson Summary

Students use a plot of a mussel bed to better understand the scientific applications of counting and estimating. They will also learn that their environment is constantly changing, both physically and biologically. Through classroom exercises, they will also learn ways to monitor change in the environment.

Learning Objectives

This curriculum ties in with the CA Math Standards for Grade K-8. Upon completion of this lesson, students will be able to use a mussel bed to:

- Estimate
- Count
- Determine the mean
- Identify Outliers
- Sample

This curriculum also helps students:

- Describe a specific environment
- Define variables in an experiment

Process Skills Used in this Lesson

1. Be able to sample animals by counting and multiplying.
2. Describe their classroom environment.
3. Observe changes in their local environment.

Material developed by:
Mary Elaine Dunsmuir and Kelly Campbell
Minerals Management Service
770 Pinnac Canyon
Camarillo, CA 93010
Illustrations by Kelly Campbell

Photos adapted from materials developed by Minerals Management Service

OCS OIL & GAS DISCOVERY NEWS

DEVILS TOWER FIELD PRODUCTION



Dominion Exploration & Production, Inc., a subsidiary of Dominion Resources, announced the start of production from the Devils Tower field, located about 140 miles southeast of New Orleans on Mississippi Canyon Block 773 in the deepwater Gulf of Mexico. Dominion expects Devils Tower will produce 60 billion cubic feet of natural gas equivalent net to Dominion over the first 12 months of production. Oil and gas production from Devils Tower flows through a spar floating production facility owned by a unit of The Williams Companies, Inc.

"The startup of Devils Tower is a significant milestone for Dominion," said Duane Radtke,

president and chief executive officer of Dominion E&P. The Devils Tower project also adds to our record of outstanding exploration, production, and safety success offshore."

The spar (pictured to the left, photo courtesy of Dominion Exploration & Production, Inc.) is designed to handle 60 thousand barrels of oil and 110 million cubic feet of gas per day. Located in 5,610 feet of water, the facility is the world's deepest dry-tree spar. In addition to the Devils Tower wells, a three-well subsea development is currently under evaluation to connect the adjacent Triton and Goldfinger discoveries to the host platform.

Securing Ocean Energy and Economic Value for America



Spar platform for the Holstein development being towed to location. Photo courtesy of BP Exploration & Production.

NEW WAVES Late-breaking News & Information

Minerals Management Service to Host International Workshop

IMEMS 2004 7th International Marine Environmental Modeling Seminar
Washington Plaza Hotel, Washington, D.C. • October 19-21, 2004

Impact Assessment, Resource Management, and Mitigation Modeling Applications and Modeling Development Papers Accepted Worldwide with Focus on North American Coastal Waters

Papers are sought describing development or application of numerical models that could be useful in North American waters. Application areas may therefore range from tropical to Arctic.

Guest Speakers: Professor Emeritus Don MacKay, Trent University; Professor Eileen Hofmann, Old Dominion University; Professor Kisaburo Nakata, Tokai University; Dr. Hans Dahlin, Director, EuroGOOS; Professor Antonio Baptista, Oregon Health & Science University; and Mr. Robert LaBelle, Deputy Associate Director, Offshore Minerals Management, MMS

See the website for more detailed information: <http://www.sintef.no/imems2004/>

Abstract Deadline June 30, 2004

E-mail abstracts of 300 words or fewer to may.ditlevsen@sintef.no or telefax to +47-73597051

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