OCS Report
MMS 2005-065

ISLANDS OF LIFE

A Teacher's Companion

U.S. Department of the Interior
Minerals Management Service
Gulf of Mexico OCS Region

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NOTE TO TEACHERS

This companion to the "Islands of Life" poster is for teachers wanting to introduce their students to a unique aspect of the Gulf of Mexico. While the Gulf is one of our Nation's greatest fisheries resources, it is also an important source of the Nation's energy. Several thousand oil and gas production facilities located on the U.S. continental shelf of the Gulf of Mexico make up the largest artificial island and reef system in the world, and an entire generation of Gulf Coast citizens now depends on them for energy, food, and recreation.

This packet describes the ecological relationships that have developed in association with offshore oil and gas platforms. Basic ecological principles are noted and defined. Technical terms are in **bold print** and can be found in the glossary located at the end of the document. Common names of organisms are used with scientific names provided in italics; a summary listing of organisms referenced in the text is provided. Finally, as an introduction to environmental policy, the pieces of legislation most important to the Gulf of Mexico are listed and described as to how they came about and their intended effects.

WHERE TO GET THE POSTER AND TEACHER'S COMPANION

Copies of the poster and Teacher's Companion may be obtained from the Public Information Office at the following address:

U.S. Department of the Interior
Minerals Management Service
Gulf of Mexico OCS Region
Public Information Office (MS 5034)
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394
Telephone Number: (504) 736-2519 or
1-800-200-GULF

You can also access this Teacher's Companion on line at: http://www.mms.gov/

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- ⇨ Gulf of Mexico Kid's Page from the left column

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ABOUT THIS LESSON

This lesson is designed to illustrate the ecological relationships that have developed in association with offshore oil and gas platforms in the Gulf of Mexico. These platform islands are home to marine plants and animals that are described within the packet. The material presented follows the National Science Teachers Association guidelines. You can also access this Teacher's Companion online at:
http://www.gomr.mms.gov/homepg/lagniapp/islands.pdf.

Where It Fits into the Curriculum

Topics: This lesson could be used in general biology classes to link basic ecological principles to offshore oil and gas platforms. Some material can also help students learn about offshore platforms and the rigs-to-reefs program.

Standards: The material meets the content standards for grades 6-8 as defined by National Science Education Content Standards from the National Science Teachers Association. The following content standards apply:

Science as Inquiry

- Abilities Necessary to do Scientific Inquiry
  - Identify questions that can be answered through scientific inquiry.
- Understanding Scientific Inquiry
  - Different kinds of questions require different kinds of scientific investigations, including observing and describing, collecting, experimentation, research, discovery, and making models.

Life Science

- Structure and Function in Living Systems
- Diversity and Adaptations of Organisms

Objectives for Students

1) To understand the ecological relationship between offshore platforms and marine life.
2) To examine the significance of offshore platforms for marine life.
3) To gain knowledge of laws that protect marine life and their habitat.
4) To learn alternative ways to create artificial reefs.

Materials for Students

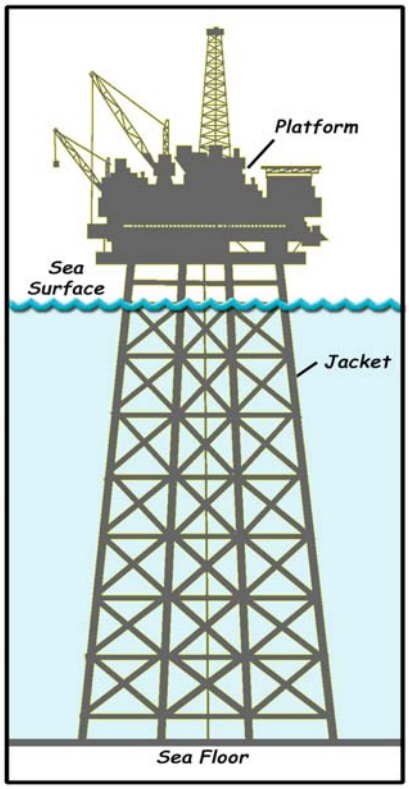
The materials in the lesson can be printed out, photocopied, and distributed to students.

WHY IS YOUR GOVERNMENT INVOLVED?

Worldwide, there are approximately 8,000 oil and gas production platforms on the continental shelves of 53 countries. Approximately 4,000 of these occur on the **Outer Continental Shelf** (OCS) of the U.S. Gulf of Mexico, where they supply nearly 25% and 30% of the U.S. production of natural gas and oil, respectively. These **petroleum** products are used to make the plastics used in safety helmets, medical instruments, and countless other items we use or come into contact with each day.

The Minerals Management Service (MMS), a bureau within the U.S. Department of the Interior, pursues research on the marine environment as part of its responsibility to manage the mineral resources such as natural gas and oil deposits on the OCS in an environmentally sound and safe manner. Various Federal laws and regulations protect the environment; the National Environmental Policy Act and the Outer Continental Shelf Lands Act cover most activities in the marine environment. The MMS funds studies looking at the possible effects of human activities on environmental aspects of the marine ecosystem. This information, combined with data that continue to be collected, will make sure that MMS has the information needed to safeguard the environment.

WHAT IS AN OFFSHORE PLATFORM?



The natural gas and oil found on our **continental shelf** are pulled from the earth using drills, pipes, and pumps, by thousands of people living offshore, often well out of sight of land. **Production platforms** are set in place by driving steel support legs (**piles**) deep into the seafloor. Supported by a steel network (**jacket**), working machinery and personnel are located far above the water's surface.

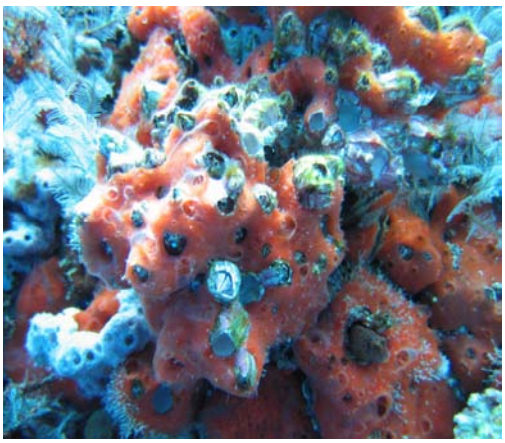
A typical production platform in the Gulf of Mexico.

Unlike mobile **drilling rigs,** which drill the initial well, offshore **production platforms** may remain in place for 20 years or more. While intended to supply our country with energy, they provide another valuable service; they have formed one of the most extensive artificial island and reef systems in the world. Here's how!

Once in place, the part of the **jacket** below the water's surface acts as an **artificial reef**, providing hard surfaces (**substrate**) for **encrusting** organisms such as spiny oysters, **barnacles**, **sponges**, and **corals**. These creatures are the basis of a food chain in what becomes a new marine **ecosystem** for numerous **species** of fish, sharks, sea turtles, spiny lobsters, and sea urchins. A spectacular and colorful marine environment results. The longer a platform is in place, the more the encrusting organisms grow and the better the underwater ecosystem flourishes.

ROCKS, VOLCANOES, STEEL, & "ISLANDS"?

The Gulf of Mexico teems with life yet, if you were to traverse mile after mile of open water looking down into its depths, you might go for hours without seeing a single creature. However, life is everywhere in the Gulf, but much of it consists of microscopic eggs, **larvae**, and the young life stages (**juveniles**) of countless species desperately searching for something to cling to -- a home, a place to grow. Up until a few decades ago, many of these creatures would drift helplessly in the currents with little hope of survival because the central Gulf had few places that extend up from the muddy depths to the sunlit surface waters. However, our Nation's offshore oil and gas platforms now provide such a home in the form of hardened steel **substrate** for a myriad of sea creatures, establishing these "Islands of Life."



The invertebrate communities of the offshore platforms are the most colorful and common sights living on the structure. Sponges (right), soft corals, and arrow crabs (left) are just a few of the inhabitants. Photos by Gregory S. Boland, MMS.

Analogous to the bare rock of volcanic islands of the Pacific, Atlantic, and Indian Oceans, islands that almost overnight extend up from the dark, cold depths, these steel platform "islands" start out as bare metal. As time passes they are soon **colonized** by many of the organisms drifting with the currents as part of the **plankton**. Plankton may be classified a number of different ways. The plant component of the plankton, such as microscopic, single-celled **algae**, is referred to as **phytoplankton**, while the animal component (e.g., small crabs and shrimp) is referred to as **zooplankton**. Plankton may also be described as either **holoplankton** or **meroplankton**. Holoplankton are those plants and animals that spend their entire lives drifting with the currents, never having to settle on a rock, a piece of shell, or a coral reef in order to grow and reproduce. Meroplankton, on the other hand, are those members of the planktonic community that are only temporary members. They include the eggs, **larvae**, and **juveniles** of organisms that must eventually settle upon some surface in order to continue their growth and reproduce. It is these plankton that benefit from a solid surface extending up from the depths, whether it be the rocky surface of an oceanic volcano or the steel of an **OCS** platform.

In the Gulf of Mexico, our offshore oil and gas platforms function as entirely new places to live, **niches**, for countless animals. In addition to harboring numerous **species** of **juvenile** fish and adult life stages, these structures serve as hunting grounds for swift, open ocean **pelagic** fishes, such as mackerel, tuna, and jacks. These species use these steel reefs as places to grab a quick meal, but also for orientation in an otherwise featureless environment, as areas to rest where the massive structure weakens or deflects currents, and as places to hide from species that may prey on them.

A LIVING MAT

The plants and animals most intimately associated with offshore oil and gas structures make up what is referred to as the **biofouling** community. (It is referred to as "fouling" because of the way similar communities "foul" the bottoms of things such as ships.) In the nearshore waters of Louisiana, for example, the biofouling community is dominated from the surface to a depth of about 25 feet by small acorn **barnacles**. This almost continuous layer of barnacles forms a living mat which is, in turn, covered by a secondary mat of **macroalgae**, **hydroids**, **bryozoans** (moss animals), and **sponges**. At deeper depths, hydroids, or bryozoans, may dominate. **Hydroids** can be rapid **colonizers** of bare surfaces and are capable of overgrowing many other colonizers -- everything is competing for space.

These living mats then serve as shelters for many other small animals living on or within them. The mats act as protection from strong currents and predators; as quiet areas where tiny hidden animals, **cryptofauna**, can feed and reproduce; and as an important food source for many of the creatures living within them.

The deep waters and muddy bottom of the Gulf are unsuitable for most corals, but these feather-like black corals, first observed in 2001, seem to do quite well on structures. Photo by Gregory S. Boland, MMS.

Depending on the location of the platform, and such conditions as temperature, salinity, and water clarity, the **biofouling** community may develop still further, following a sequence or **succession** of development found on natural reefs. The encrustation of **barnacles**, **bryozoans**, and **algae** may be followed by **mollusks,** such as spiny oysters and snails; colorful **sponges**; and disc-shaped **foraminiferans**, which are almost microscopic **calcareous** protozoa.

As the community develops further, the **larvae** of **hard** and **soft corals** may settle and attach to **mollusks** or **barnacle** shells, or on other places often inaccessible to **grazers**. While soft corals, also called **octocorals**, are commonly found on more nearshore platforms in murky water, the familiar reef-building or **hard corals** may be found growing on structures in clearer water far from shore.

As the **biofouling** communities mature, they become more consolidated, completely encasing all exposed metal, resulting in countless nooks-and-crannies providing living space or habitat that can be used by a host of other organisms. For example, the **octocoral** *Carajoa riisei* is found growing readily on pilings in many harbor areas of the Caribbean and is also often found in great abundance on offshore platforms. The skeleton of *C. riisei* is a rather rigid structure composed of **spicules**, tiny needles of **calcium carbonate,** imbedded in a fingernail-like material. This skeleton is then often colonized by a variety of other organisms. This additional layer can then be used as **habitat** by other organisms including several varieties of Caribbean tropical fishes such as the cocoa damselfish (*Stegastes variabilis*), spotfin butterflyfish (*Chaetodon ocellatus*), French angelfish (*Pomacanthus paru*), several species of blennies (e.g., *Hypsoblennius invemar* and *Hypleurochilus geminatus*), and a diverse assemblage of invertebrates such as the common Atlantic **sea urchins** (*Arbacia punctulata*), arrow crabs (*Stenorhynchus seticornis*), and **sponges** (*Haliclona* sp.).

EVEN REEF CORALS LIKE PLATFORMS!

A remarkable discovery not too long ago was finding healthy reef-building corals growing on platforms, just as you find on reefs in the Caribbean. Ever since platforms were first installed in the deeper, clear waters of the Gulf of Mexico in the 1970's, it was expected that coral larvae from the Flower Garden Banks might make it to a platform and start growing there some day. The Flower Garden Banks are very healthy coral reefs located 110 miles offshore between Texas and Louisiana. It took many years before anyone first found corals on platforms. It wasn't until 1990 that the first reef-building corals were seen on an offshore platform. Since then, an MMS study has seen corals on many platforms all over the Gulf. The best ones on which to look are more than 10 years old and located along the edge of the continental shelf. Some platforms even have unusual species of black corals on them.

Several colonies of the great star coral, a species also common on the Flower Garden Banks coral reefs, growing on a platform leg at a depth of 80 ft. The bottom depth at this platform is 375 ft. Photo by Gregory S. Boland, MMS.

SOMETHING FISHY IS DEVELOPING!

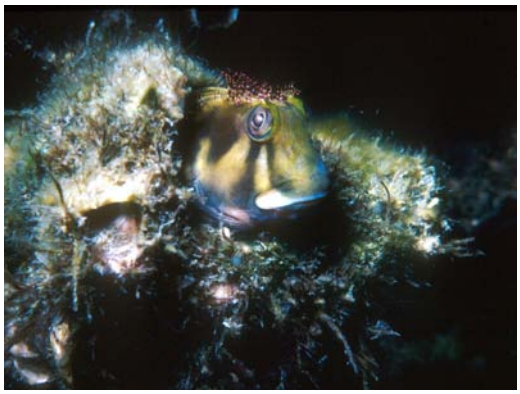
The Gulf has an abundance of deep, clear water, but few natural, shallow places for tropical reefs. The structures provide these shallow areas for a variety of colorful Caribbean fish such as these blue angelfish. Photo by Gregory S. Boland, MMS.

Nearly all marine fish species begin their lives as microscopic **larvae** afloat in the immense oceans. As they exploit the food resources in the **plankton,** they in turn are preyed upon by larger organisms. It is a continuous struggle to grow bigger and faster than their competitors. For many of these species, time spent in the plankton is also an effort to reach new territory. Known as **reef fish,** these species must have solid ground close at hand to survive as adults. In the natural scheme of life, the soft, shifting bottom of the Gulf of Mexico has little hard ground to offer reef animals. Quite by accident, the string of thousands of steel islands offers amazing amounts of the needed solid ground to reef fish in the Gulf. Platforms may serve as a place to hide and ambush prey, as elaborately colored backdrops used for **camouflage**, or quiet areas of reduced waves and currents. Reef fish use offshore oil and gas structures as they would a natural reef.

The platforms begin below the seafloor and extend upwards through the wave-slapped surface of the sea. A platform provides habitat for fishes living near the bottom (**demersal**), high-energy environments near the sea's surface for **surf-zone species,** and everything in between. As the platforms become quickly settled by **barnacles**, **sponges**, oysters, crabs, and other **invertebrates**, they acquire critical elements for fish **habitat**. Recognizing these elements, **juvenile** reef fish leave the **plankton** and settle on their new home, a platform.

Blennies, small fish that spend their lives in close contact with empty **barnacle** shells, will live in the **surf zone** of a platform for their entire lives. A red snapper may leave the safety of the platform at night to look for food, returning before dawn. Snapper are considered **demersal** because they are associated with the lowest parts of some structure on the bottom (the base of rocky areas, reefs, and the deeper parts of offshore oil and gas platforms). Atlantic spadefish seem to spread in shallow, loose schools near the perimeter of a platform during the day and move close together under the structure at night. All three species use the platform as a source of food and protection.

Blennies are little fish that spend their entire lives in contact with empty barnacle shells found on offshore structures. They graze on plants and animals growing on the outside and quickly dart back inside their barnacle shell home when they sense danger. Photo by Gregory S. Boland, MMS.



Blennies eat a wide variety of food such as **algae** and small **invertebrates**, including **barnacles**. They even use empty barnacle shells as living quarters and eventually as nesting sites during the spring, protecting their young for a short period after hatching. Blennies are true **resident** fish dependent upon the platforms.

Atlantic spadefish are **planktivorous,** which means they pick their food from the water flowing past the platform. They will, of course, feed upon the occasional tidbit that falls from the structure. Red snapper are **piscivorous** (which means they prefer to eat other fish), and **forage** (look for food) away from the structure at night. They may eat **blennies** directly off the platform or hunt in schools for baitfish that pass nearby. Red snapper and Atlantic spadefish are examples of resident species that are independent of the platforms for food but use the structure for shelter.

Atlantic Spadefish. Photo by Gregory S. Boland, MMS.

The relationships among the **resident** fish populations of an offshore platform are the same as would be found on a natural reef. Some species, such as damselfishes, establish territories within which they cultivate **algae** by keeping other **herbivores** (plant eaters) away. These same areas provide small organisms, **cryptofauna** (tiny hidden **crustaceans**, **mollusks**, and fishes), actually living in the **algae**, safe **refuge** from **carnivores**. Other resident **reef fish** species often encountered at offshore platforms include the bigeye (*Priacanthus arenatus*), whitespotted soapfish (*Rypticus maculatus*), spotfin butterflyfish (*Chaetodon ocellatus*), and nurse sharks (*Ginglymostoma cirratum*).

Baitfish, mackerels and jacks are **transient** passersby. Constantly swimming, they travel from reef to reef, platform to platform, feeding off the **resident** populations. **Pelagic**, too, these species are commonly found in the open sea far from shallow coastal areas. They likely use the large, solid structures such as platforms as **visual cues** during their treks across the Gulf (like landmarks indicated on a road map). They may stay several days around a particular platform, and then suddenly move on to another structure. Of special

benefit to **transient** species, platforms break the force of wind-driven waves and tidal and seasonal currents.

SOME FISHY DETAILS

Various snapper species (they are also a **reef fish**) remain close to underwater structures during the day, but may leave the safety of the structure at night to feed (**forage**). Snapper **spawn** offshore in groups over unobstructed bottoms adjacent to reef areas. **Juvenile** snapper form loose aggregates, while adults form schools during the day and disperse at night. Snapper do not migrate or travel too far away from their reef environment and the surrounding areas. Thus, it is not surprising that they are often found around oil and gas structures. There is a tendency for larger, older snapper to occur in deeper water than **juveniles**.

Where there are platforms there are fish. Offshore recreational fishermen made this association over 50 years ago and continue to harvest fish for food and fun wherever natural gas and oil are produced in the Gulf of Mexico.

Seasonal **spawning** patterns vary among snapper species, but generally, once they attain sexual maturity, they have a prolonged spawning period with seasonal peaks. There is a decline in spawning activity among snapper during the winter. Juveniles inhabit shallow nearshore and **estuarine waters** and are most abundant over sand or mud bottoms. Snapper feed along the bottom on fishes and **benthic** organisms such as **tunicates**, **crustaceans**, and **mollusks**. Juveniles feed on **zooplankton**, small fish, crustaceans, and mollusks.

Coastal **pelagics** are open-water fishes widely distributed throughout the Gulf of Mexico. Pelagic species, such as king and Spanish mackerel, move seasonally in response to water temperature and oceanographic conditions. Mackerel are found from the shore out to water depths of about 600 feet. Spanish mackerel frequent the coastal areas, while king mackerel stay farther offshore. King mackerel move from the eastern to the north-central and western Gulf in the spring. During cooler fall seasons, they move back into the warmer waters of the southeastern Gulf. A contingent of large, solitary, adult king mackerel can be found in a localized area of the north-central Gulf during part of the winter. Spanish mackerel spread over the northern Gulf during the summer and are found mainly in southeastern coastal areas in the fall and winter. Mackerel spawn offshore over the continental shelf during the spring and summer. Spawning may occur more than once per season. Juvenile mackerel use nearshore areas of high salinity as nurseries. Mackerel feed throughout the water column on other fishes, especially herrings, and on shrimp and squid. Mainly a schooling fish, larger king mackerel occur in small groups or singly.

WHERE THERE'S FISH—THERE'S FISHING!

Recreational fishermen and charter boat captains from Louisiana and Texas have firmly established oil and gas platforms as the most popular offshore fishing destinations in the Gulf of Mexico.

Scientific studies conducted around oil and gas platforms have found that they may harbor as many as 28,000 fishes within just a few hundred feet. Anglers who target snapper, sea trout, mackerel, croakers, amberjacks, cobia and many other popular game and food fish often catch their limits near the oil and gas platforms. Bottom fishing for **demersal** fish and trolling or drift fishing for more **pelagic** species are common techniques used by sport fishermen. For over 40 years, fishermen have been able to find excellent sportfishing opportunities around our Nation's oil and gas platforms in the Gulf.

Swift and deadly predators, several species of jacks patrol under the platforms in search of their next meal. Jacks are a prized gamefish that frequent coastal waters of the world. Photo by Gregory S. Boland, MMS.

The States of Louisiana and Alabama, in association with MMS, have developed and distribute marine recreational fishing maps to guide fishermen to safe offshore fishing around offshore platforms. The marine life concentrated near oil and gas platforms has truly fueled the expansion and enjoyment of recreational fishing in the Gulf of Mexico.

The MMS and Louisiana State University (LSU) are also documenting distribution of fish throughout the water column, seasonal variations of fish densities, and the influence of depth on platform-associated fish populations. As the normal oil and gas production life of an offshore platform seldom extends beyond 20 years, studies like those conducted by MMS and LSU are helping the Gulf States to plan and implement effective **artificial reef** programs designed to extend the fishing potential of these structures.

Fish are not the only finned animals found beneath platforms. Recreational SCUBA diving is popular along the Gulf Coast, and many dive shops offer specialized training and charter dive trips. Photo by Gregory S. Boland, MMS.

LET'S GET WET!

With such a colorful and vibrant community living just a few feet beneath the water's surface, recreational **SCUBA** diving **("rig diving")** has become popular along the Gulf Coast. Many dive shops along the Gulf Coast now offer specialized training and charter dive trips to offshore **production platforms**. Divers may simply enjoy fish watching or indulge in such activities as underwater photography and videography, collecting fish and invertebrates for their aquarium, or taking aim with a speargun in the hope of bringing home the family dinner.

SEA TURTLES

Five species of sea turtle are found in the waters of the Gulf of Mexico: the Kemp's ridley, loggerhead, green, leatherback, and hawksbill; all are protected by the Endangered Species Act. By Federal law, activities such as shrimping and oil and gas operations that could harm sea turtles must be evaluated and modified to ensure survival of the protected species.

Loggerhead sea turtle. Photo by Quenton Dokken, Texas A & M University Corpus Christi.

The loggerhead sea turtle can weigh up to 249 lbs. and its shell, or **carapace,** can measure up to 3 feet. Loggerheads are common in water depths of less than about 150 feet, but may be found in deeper water. The largest nesting concentration in the United States is on the southeast Florida coast, but some loggerhead nesting has been reported in all Gulf states. Loggerheads feed frequently offshore the central Louisiana coast and near the Mississippi Delta. Juvenile loggerheads feed on **pelagic** crabs, **mollusks**, jellyfish, and plant material; adults feed on nearshore **benthic invertebrates**.

The leatherback is the largest of the sea turtles, with a **carapace** length for adults at over 5 feet. It weighs as much as 1,550 lbs. This is the most **pelagic** and most wide-ranging sea turtle species. Leatherbacks have special deep-diving abilities and eat only jellyfish. Abundant, able to migrate for hundreds, even thousands, of miles, leatherbacks typically nest in the tropical latitudes.

The Kemp's ridley sea turtle is the smallest sea turtle, weighing just under 100 lbs. It has a **carapace** of just over 2 feet. This species is the most endangered of all the sea turtles, probably because their eggs were once considered a delicacy. Today, most eggs are laid in Rancho Nuevo, Mexico, but there are other nesting locations on Padre Island National Seashore, Texas, and most recently in Florida. The Kemp's ridley feeds on crabs and is typically associated with areas of seagrass. In the Gulf, Kemp's ridleys are found nearshore in coastal waters from Texas to Florida.

The green turtle is a large sea turtle that can weigh up to 330 lbs. and has a **carapace** just over 3 feet. Areas in Texas and Florida were important commercial turtle fisheries at the end of the last century. Today, reports of nesting in the northern Gulf are few, except on

Santa Rosa Island, Florida, and the Yucatan Peninsula. Green turtles are found primarily in coastal waters, where they feed on **seagrass**, **algae**, and associated organisms.

The hawksbill sea turtle is a small- to medium-sized sea turtle weighing up to 176 lbs. and having a **carapace** length of nearly 3 feet. Nesting in the U.S. is restricted to the southeast coast of Florida and the Florida Keys, Puerto Rico, and the U.S. Virgin Islands. Hawksbills are generally found near coral reefs, where they feed on sponges. The hawksbill is the least commonly reported marine turtle in the Gulf; Texas and Florida are the only States where hawksbills are sighted with any regularity. Of all marine turtles, the hawksbill is least understood by marine scientists.

WHY WOULD A TURTLE BE AROUND A PLATFORM?

While sea turtles are only occasionally seen around oil platforms, it is known that these artificial islands and reefs provide them **habitat,** a feeding and resting spot, as well as **refuge** from predators and stability in water currents. The most frequently seen species of turtle there is the loggerhead, but leatherbacks, greens, Kemp's ridleys, and hawksbills have also been observed. Loggerheads may stay at specific offshore structures for long periods, and have been found sleeping under platforms.

WHALES IN THE GULF OF MEXICO?

There are 28 species of whales and dolphins (**cetaceans**) that occur in the Gulf of Mexico. All marine mammals in U.S. waters have been protected by the Marine Mammal Protection Act since 1972; six of the 28 cetaceans species are also protected by the Endangered Species Act. Until recently, the most common cetacean species associated with platforms in the Gulf were the Atlantic spotted dolphin and the bottlenose dolphin, because they usually prefer the more shallow waters in the Gulf. However, technology to drill for oil and gas in deep water has been developed and now platforms can be located in the very deep areas of the Gulf. This means that any of the 28 species of cetaceans that occur in the Gulf may be found near a platform.

The bottlenose dolphin (*Tursiops truncatus*) is probably the most familiar species because of its coastal distribution and widespread use in marine parks, movies, and on television. While a Gulf bottlenose dolphin is typically 8-10 feet in length, in some areas it can reach up to just over 12 feet. Bottlenose dolphins eat a wide variety of fishes, squid, and shrimp by using a variety of feeding behaviors, including feeding behind shrimp boats and chasing fish onto mudbanks. Bottlenose dolphins live in open societies, with the strongest bonds being between a mother and her calf.

Some of the more common deepwater inhabitants of the Gulf of Mexico are the sperm whale, the spinner dolphin, the Clymene dolphin, the striped dolphin, and the pantropical spotted dolphin. The sperm whale (*Physeter macrocephalus*) is the only cetacean found frequently in the Gulf that is designated as an endangered species.

The striped dolphin is a common deepwater inhabitant in the Gulf of Mexico. Photo by Carol Roden, MMS.

WHY WOULD A DOLPHIN VISIT A PLATFORM?

Dolphins gather in areas where food is abundant and, as we know now, where there's a platform, there are fish! Dolphins probably are attracted to the platforms by the vast quantities of fish that call the platforms home.

BIRDS & BUTTERFLIES

Fish and other marine creatures are not the only animals attracted to offshore platforms. Every spring and fall numerous species of colorful **neotropical** birds and the monarch butterfly are known to cross the Gulf of Mexico. Offshore platforms sometime serve as unwitting refuge sites when adverse weather conditions interrupt normal **migration** patterns. Warblers, vireos, thrushes, flycatchers, orioles, and many other songbirds have been recognized on isolated petroleum structures throughout the Gulf of Mexico.

Migratory songbirds, like this piratic flycatcher, and monarch butterflies are unexpected visitors on offshore platforms. These winged creatures are observed during their spring and fall migrations across the Gulf of Mexico. Photo courtesy of Robert W. Russell.

Beginning in 1997, MMS and several oil and gas companies have been cooperating with the Louisiana State University Museum of Natural History to document and analyze the scope, effect, and significance of migrant bird fallout on offshore platforms. Increasing our understanding of all creatures known to associate with offshore structures will a better foundation for informed decisions to protect the cycles of life affected by oil and gas development in the Gulf of Mexico.

THE END MAY REALLY BE A NEW BEGINNING — RIGS-TO-REEFS!

While offshore oil and gas platforms can operate for decades, these steel reefs are still only temporary. Federal law and regulation require that they be removed and the seafloor returned to its original condition within one year after the platform is no longer recovering oil or gas. To date, over 2,600 platforms have been removed from the U.S. continental shelf. Generally, the platforms are detached from below the seafloor, towed to shore, and either refurbished for reuse or salvaged as scrap steel. However, this removal of obsolete offshore platforms has been found not only to be a costly operation, but also to remove an amazing marine habitat.

A jacket from an offshore platform is being lifted out of the water (left) and barged (right) to another location, where it will be placed on the seafloor. This platform will become one of many that make up the artificial reefs in the Rigs-to-Reefs program.

HOW YOUR CONGRESS HAS HELPED!

In 1984 the U.S. Congress passed a law, the National Fishing Enhancement Act, which allowed the use of offshore oil and gas platforms for permanent **artificial reefs**. This was the birth of the **Rigs-to-Reefs** program. In the last few years, the practice of converting obsolete offshore platforms to artificial reefs has gathered broad public and private support. Already over 100 former oil and gas are now permanently dedicated to fisheries enhancement as artificial reef sites. For several decades, World War II Liberty ships, old tires and cars, concrete culverts, and other "debris" have been used as artificial reef materials. However, the design, stability and, ultimately, their availability, have demonstrated the advantages of obsolete offshore platforms over the use of other reef materials.

LAWS, REGULATIONS, & LEGISLATION WE SHOULD ALL KNOW

THE NATIONAL ENVIRONMENTAL POLICY ACT

The National Environmental Policy Act (NEPA) requires that all Federal agencies protect the environment and use the natural and social sciences in any planning and decisionmaking that may have an impact upon the environment. The NEPA also requires the preparation of a detailed environmental impact statement (EIS) on any major Federal action that may have a significant impact on the environment. This EIS must include any adverse environmental effects that cannot be avoided or mitigated, alternatives to the proposed action, the relationship between short-term uses and long-term productivity of the environment, and any irreversible and irretrievable commitments of resources.

OUTER CONTINENTAL SHELF LANDS ACT

Under the Outer Continental Shelf Lands Act (OCSLA), the Department of the Interior is required to manage the orderly leasing, exploration, development, and production of oil and gas resources on the Federal OCS, while simultaneously ensuring the protection of the human, marine, and coastal environments. The Department must also ensure that the public receives a fair and equitable return for these resources, and that free-market competition is maintained. The OCSLA requires coordination with the affected States and, to a more limited extent, local governments. At each step of the process that leads to lease issuance, participation from the affected States and other interested parties is encouraged and sought.

MARINE MAMMAL PROTECTION ACT

Under the Marine Mammal Protection Act (MMPA) of 1972, the Secretary of Commerce is responsible for all **cetaceans** and **pinnipeds**, except walruses, and has delegated authority

for implementing the MMPA to the National Marine Fisheries Service (NMFS). The Secretary of the Interior is responsible for walruses, polar bears, sea and marine otters, manatees, and dugongs, and has delegated authority to the U.S. Fish and Wildlife Service (FWS). The Act established the Marine Mammal Commission and its Committee of Scientific Advisors on Marine Mammals, which are responsible for overseeing and advising the responsible regulatory agencies on all Federal actions bearing upon the conservation and protection of marine mammals.

To ensure that OCS activities adhere to MMPA regulations, the MMS must actively seek information concerning impacts from OCS activities on local species of marine mammals. Consequently, the MMS Outer Continental Shelf Environmental Studies Program continues to fund a series of studies on the distribution and abundance of cetaceans along the continental slope of the U.S. Gulf of Mexico. These studies will assess the potential effects of deepwater exploration and production on these species.

ENDANGERED SPECIES ACT

The Endangered Species Act of 1973 establishes protection and conservation of threatened and endangered species and the ecosystem upon which they depend. The Act is administered by the FWS and the NMFS. The MMS formally consults with both to ensure that activities on the OCS under MMS jurisdiction do not jeopardize the continued existence of a threatened or endangered species and/or result in adverse modification or destruction of their critical habitat. The FWS and NMFS make recommendations on the modification of oil and gas operations to avoid or minimize adverse impacts, although it remains the responsibility of MMS to ensure that proposed actions do not impact threatened and endangered species. In response to FWS/NMFS recommendations, the MMS requires adequate oil-spill contingency plans for all activities, and special protective measures for turtles and marine mammals during platform removals. It has also requested aircraft supporting offshore facilities to maintain an altitude of 2,000 feet or more above national parks, seashores, and wildlife refuges.

NATIONAL FISHING ENHANCEMENT ACT

The National Fishing Enhancement Act of 1984 mandated development of the National Artificial Reef Plan. The Plan establishes broad artificial-reef development standards and a national policy to encourage planning for the development of artificial reefs so as to enhance fishery resources and commercial and recreational fishing. The National Artificial Reef Plan identifies oil and gas structures as acceptable materials of opportunity for artificial-reef development. The MMS adopted a Rigs-to-Reefs policy in 1985 in response to this Act and to broaden interest in the use of petroleum platforms as artificial reefs.

COMMON INHABITANTS OF OFFSHORE PLATFORMS

A NOTE ON NAMES!

Scientific names used to classify animals have a long tradition all their own. For more than 200 years, it has been common for each species to have a pair of names that firmly establishes its identity and close relationships to other species. The first half of the name is the *genus*, which is usually composed of a group of closely related species. The second half of the name is the *species*, and is unique. Scientific names are derived from the Latin or Greek languages, and are often designed to reflect some aspect (physical characteristic or geographic distribution) of the species being named. It is also very common to name a species in honor of a person (most often an individual worker in that field of science).

The common blue crab, technically known as *Callinectes sapidus* (Rathbun, 1933), of the Gulf of Mexico may serve as a good example of how the naming system works. "*Callinectes*" is Greek meaning "beautiful swimmer," and "*sapidus*" is Latin meaning "tasty" or "savory." The species was described by Rathbun in 1933.

*Colorful Coca damselfish (*Pomacentrus variabilis*) and octocorals around a platform well casing. Photo by Gregory S. Boland, MMS.*

PROTISTA

Foraminifera

PLANTS

Algae (several different species)
Calcareous algae (several different species)
Macroalgae (several different species)

FISHES

African pompano (*Alectis ciliaris*)
Bigeye (*Priacanthus arenatus*)
Blennies (several different species)
Cocoa damselfish (*Stegastes variabilis*)
Creole fish (*Paranthias furcifer*)
Crevalle jack (*Caranx hippos*)
French angelfish (*Pomacanthus paru*)
Grey triggerfish (*Balistes capriscus*)
Grey snapper (*Lutjanus griseus*)
Greater amberjack (*Seriola dumerili*)
Groupers (several different species)
Lookdown (*Selene vomer*)
Nurse sharks (*Ginglymostoma cirratum*)
Queen angelfish (*Holacanthus ciliaris*)
Red snapper (*Lutjanus campechanus*)
Reef butterflyfish (*Chaetodon sedentarius*)
Scorpion fish (*Scorpaena* sp.)
Sheepshead (*Archosargus probatocephalus*)
Spanish mackerel (*Scomberomerus maculatus*)
Spanish hogfish (*Bodianus rufus*)
Spotfin butterflyfish (*Chaetodon ocellatus*)

INVERTEBRATES

Acorn barnacles (*Balanus amphitrite*)
Arrow crabs (*Stenorhynchus seticornis*)
Atlantic sea urchin (*Arbacia punctulata*)
Atlantic winged oysters (*Pteria colymbus*)
Bryozoans (several different species)
Fireworm (*Hermodice carunculata*)
Gastropods/Snails (several different species)
Hydroids (many different species)
Octocoral/Soft coral (*Carijoa riisei*)
Sponges (several different species)
Tunicate (several different species)

SEA TURTLES

Kemp's ridley (*Lepidochelys kempi*)
Loggerhead (*Caretta caretta*)
Green (*Chelonia mydas*)
Leatherback (*Dermochelys coriacea*)
Hawksbill (*Eretmochelys imbricata*)

WHALES AND DOLPHINS (CETACEANS)

Bottlenose dolphin (*Tursiops truncatus*)
Atlantic spotted dolphin (*Stenella frontalis*)

BIRDS

Warblers (Family Parulidae)
Vireos (Family Vireonidae)
Thrushes (Family Turdidae)
Flycatchers (Family Tyrannidae)
Orioles (Family Oriolidae)

BUTTERFLIES

Monarch butterfly (*Danaus plexippus*)

ACTIVITY 1

Title: Succession on a Platform Leg

Purpose: Students will learn about the basic concepts of ecology, including the process of succession.

Vocabulary: Ecology, colonization, competition, succession, barnacles, algae, sponge

Materials: Paper towel tubes or larger, beads, construction paper, tissue paper, sponges, scissors, glue

Lesson Outline:

- Explain to students that they are going to learn about ecology on a platform leg. Discuss the principles of substrate (hard vs. soft), light, temperature, water movement, colonization, competition, and succession.

- Break the students into groups of four or more. Each student will pick a species and create pieces representing their species. For example, barnacles can be represented as beads, green tissue paper can be used as algae, sponges can be used as sponges, and construction paper can be used to make different types of fish, crabs, or shrimp. Other materials may be used as appropriate.

- The students should take turns "colonizing" the platform leg. Barnacles should go first and be glued in place. Algae and sponges come next, then fish, crabs, etc. Rules should be established to determine where and when an organism can be added, for example, barnacles cannot be placed on top of algae or sponges, but must go on a hard surface. Shrimp, crabs, and fish must hide in the algae and barnacles. Fish can eat the algae and remove it. The number of pieces that can be placed on the leg at one time should represent the abundance of the organism. For example, five barnacles can be added for each fish or crab, while only three pieces of algae or sponge can be added. The students should take turns adding their creatures until the entire leg is covered.

- After the students have completed the exercise, continue the discussion about how the organisms interact with each other and the order of colonization or succession.

Extension:

Have the students prepare a food web consisting of the organisms found on a platform leg.

ACTIVITY 2

Title: Artificial Reefs: Opportunity for New Life or Alteration of the Environment?

Purpose: This lesson asks students to consider the issue of creating artificial reefs in the marine ecosystem.

Vocabulary: Artificial reef

Materials: Computer with Internet access

Lesson Outline:

- Discuss with the students what an artificial reef is and some of the consequences of putting manmade materials in the marine environment. Describe natural coral reefs to the class for comparison. Pose the following questions to the class:
    - Why are marine organisms attracted to an oil rig?
    - Does it matter how the rig is shaped or positioned as an artificial reef?
    - Do artificial reefs become more like natural reefs over time?
    - Are artificial reefs a benefit to the environment or is alteration of the environment not a good practice?
    - Why are fishermen and divers attracted to the oil rigs?
- Have the students research the issue on the worldwide web in groups of two or three.
- Have students prepare a table identifying the concerns and the rationale for either supporting or not supporting the creation of artificial reefs.
- Have the students present their position on artificial reefs to the class.

Resources:

MMS Rigs-to-Reefs site:
http://www.gomr.mms.gov/homepg/regulate/environ/rigs-to-reefs/information.html

National Geographic News article, "Artificial Reefs: Trash to Treasure":
http://www.nationalgeographic.com/news/2001/02/0201_artificialreef.html

Extensions:

Students can prepare a comparison between natural coral reefs and artificial reefs.

GLOSSARY

Algae: Any of various aquatic one-celled or multicellular plants that lack true stems, roots, and leaves but contain **chlorophyll**.

Analogous: Referring to characteristics in different organisms that are similar in function, and often similar in superficial structure, but of different evolutionary origins.

Artificial Reef: Manmade material constructed or placed in fresh- or saltwater specifically to provide long-term protection and shelter for aquatic plants and animals, to attract and augment fish resources, and to enhance fishing opportunities.

Barnacles: Sedentary **crustaceans** that secrete a protective shell; most often seen on wharves and boat bottoms.

Benthic: Refers to those plants and animals that live on the bottom of a lake or sea.

Biofouling: Large and small plants and animals that attach to the submerged surfaces of boats, pilings, and other underwater structures. May damage or "foul" the bottom of a boat.

Blennies: A small **omnivorous** fish commonly found living on and around **barnacles** and other **encrusting** organisms on offshore petroleum platforms in the northern Gulf of Mexico.

Bryozoans: Tiny, colonial animals called zooids. Zooids are polyp-like with tentacles encircling their mouth; but, unlike coral polyps, they have a complete digestive system, including an anus that lies outside the ring of tentacles. Bryozoans are sometimes called "moss animals."

Calcareous: Composed of or containing **calcium carbonate**, a limestone or chalky material.

Calcium carbonate: The chalky material that makes up bone and structural elements of many animals (e.g., shells of **mollusks** and the skeletons of **hard corals**).

Camouflage: Disguise.

Carapace: Outer hard plates that cover the internal soft parts of some animals (e.g., turtle's shell; crab's shell).

Carnivore: Meat-eater.

Cetaceans: Whales, dolphins, and porpoises.

Chlorophyll: Green pigment found in green plants and some bacteria needed for photosynthesis.

Cnidaria: A group of simple animals whose basic structure typically consists of a cup-shaped body with a single, central opening that is encircled by the tentacles. This

animal group includes several well-known organisms including corals, hydroids, jellyfish, and anemones.

Colonize: To migrate to a submerged structure and settle upon it. Examples are **barnacles** and oysters.

Continental Shelf: That portion of the sea from the shore out to a depth of about 600 feet. It is the generally shallow, flat, submerged portion of a continent, extending to a point of steep descent to the deep-sea floor.

Corals: Any one of a number of colonial animals that secrete exoskeletons. The exoskeletons may be soft or leathery as with **soft corals**, or rocklike as with **hard corals**. The rocklike skeletons of hard corals form reefs and islands.

Crustaceans: A group of freshwater and saltwater animals having no backbone, but jointed legs and a hard shell made of a fingernail-like material, chitin. Includes shrimp, crabs, lobsters, and crayfish.

Cryptofauna: Collectively, the tiny, difficult-to-see animals living on or in the biofouling mat on platforms.

Demersal: Refers to fish and animals that live near the seafloor. Examples are spotted seatrout and red snapper.

Drilling Rig: Drilling is the process of getting to the oil or natural gas that is under the seafloor. The rig is the above-water structure from which people drill. A rig can be anchored or attached to the seafloor or floating on the sea surface.

Echinoderms: A group of marine invertebrates characterized by small tube feet, radial symmetry, and a hard internal skeleton composed of **calcareous** plates. Often the plates have projections that give the body surface a spiny appearance. This group includes sea urchins, sea stars, sea cucumbers, and sand dollars.

Ecosystem: Collectively, all organisms in a community plus the associated environmental factors.

Encrusting: Those organisms that settle upon a surface and cover it with a crust or crustlike layer (e.g., **barnacles**, **oysters, sponges).**

Estuarine Waters: Those areas between freshwater (such as rivers) and the ocean that are characterized by intermediate or variable salinity levels, influenced by tides and often highly productive.

Forage: To search for and obtain food.

Foraminiferans: A specialized order of protozoa where the main bulk of the cell is enclosed within a simple or chambered and/or coiled shell usually composed of secreted **calcium carbonate**; they live almost exclusively on the sea bottom in deep water, although a few species are pelagic.

Grazers: Types of fish that feed on **algae**, small crustaceans, and sponges by scraping and nipping small areas at random throughout an entire natural or artificial reef. Examples are angelfishes and butterfly fishes.

Habitat: The specific place or type of environment in which an organism or biological population normally lives.

Hard Coral: Those **corals** with calcareous skeletons in a wide variety of shapes depending on the **species**; often form reefs and islands.

Herbivore: Plant-eater.

Holoplankton: Those plants and animals that spend their entire lives floating or drifting with the currents in fresh- or saltwater. Most organisms are microscopic but there are some larger species, for example, jellyfish.

Hydroid: The non-swimming, attached form of stalked polyps.

Invertebrate: Animal without a backbone or spinal column.

Jacket: The outermost metal supports of an offshore platform below the water's surface.

Juvenile: A young fish or animal that has not reached sexual maturity.

Larvae: Fish or animals in a very young, immature stage that looks quite different from their adult form. In most cases, a larva grows into an adult by a complicated metamorphosis.

Macroalgae: Large, usually filamentous seaweed.

Meroplankton: Those plants and animals that spend only the very early part of their lives floating or drifting with the currents in fresh- or saltwater. These organisms must eventually settle upon a surface in order to continue their growth and reproduce.

Migration: A seasonal movement of large numbers of a species over large distances.

Mollusks: A group of soft-bodied animals, terrestrial, marine and freshwater, usually partly or wholly enclosed within a **calcium carbonate** shell; snails, clams, squid.

Neotropical: Animals of the geographic region stretching southward from the Tropic of Cancer and including southern Mexico, Central and South America, and the West Indies; includes animals that migrate to and from the area.

Niche: Ecological role of a plant or animal with reference to its special place in its environment and with reference to other species associated with it.

Octocorals: **Soft corals** with eight tentacles to each **polyp**. Octocorals are also characterized by **polyps** imbedded in a gelatinous or leathery sheath, often forming fans and bushes. They do not have a **calcareous** skeleton as do **hard corals** and do not form coral reefs or islands.

Omnivore: An animal that eats both animal and vegetable substances.

Outer Continental Shelf (OCS): That part of the continental shelf beyond the jurisdiction of the coastal states (i.e., State waters). It may also be referred to as the Federal waters of the **continental shelf**.

Pelagic: Refers to fish and animals that live in the open sea, away from the sea bottom. Examples are tuna and mackerel.

Petroleum: A natural, flammable liquid hydrocarbon mixture; crude oil.

Phytoplankton: Plants that float or drift with the currents in fresh- or saltwater. Most such plants are microscopic.

Piles: Long, heavy metal pipes that are stabbed through the **jacket** legs to anchor them to the seafloor.

Pinnipeds: Seals, sea lions, fur seals, and walruses.

Piscivore: Fish-eater.

Planktivore: Plankton-eater.

Plankton: Those plants and animals that spend some part of their lives floating or drifting with the currents in fresh- or saltwater. Most such animals are microscopic but this category includes an occasional large species.

Polyp: The **sessile** variant of the body plan found in the phylum **Cnidaria**. Polyps are the main component of colonial animals such as corals.

Production Platform: Production is the process of getting oil or natural gas from far below the seafloor up to sea level. The platform is the structure that is anchored to the seabed, extends up through the water to well above the sea surface, and supports the machinery and personnel working to recover the oil or natural gas.

Reef Fish: Fish **species** always associated with reefs and banks.

Refuge: A place providing protection or shelter from the surrounding area.

Resident: An organism that lives in a given place permanently and usually for its whole life.

Rig Diving: SCUBA diving done under offshore platforms.

Rigs-to-Reefs: The placement of obsolete, non-productive offshore production platforms (platforms and rigs) in designated artificial reef sites.

SCUBA: Self-contained underwater breathing apparatus; scuba diving is a popular recreational sport.

Seagrass: Marine plants that, unlike algae, have true roots, stems, and leaves. Seagrasses often form extensive beds on sandy shallows, the beds are important breeding grounds for numerous fishes and invertebrates.

Sea Urchins: A type of **echinoderm** having a soft body enclosed in a round, symmetrical, calcareous shell covered with long, movable spines.

Sessile: Permanently attached or fixed; not free-moving.

Soft Coral: Those **corals** characterized by the **polyps** imbedded in a gelatinous or leathery sheath, often forming fans and bushes. They do not have a calcareous skeleton as do **hard corals**.

Spawn: To release and fertilize eggs.

Species: A group of organisms that can reproduce and produce offspring that can also reproduce. The same spelling, species, is used for both singular and plural.

Spicule: One of the microscopic **calcium carbonate** bodies that form the supporting skeleton of many marine **invertebrates**, including **sponges** and **soft corals**.

Sponges: A primitive marine animal that is multicellular but has no digestive, nervous, or circulatory system; usually rooted to the seafloor (i.e., **benthic**).

Substrate: The ground or any other solid object to which an animal may be attached, on which it moves about, or with which it is otherwise associated.

Succession: The progressive change in plant and animal life of an area.

Surf zone: The area where an offshore platform meets the surface and shallow water, causing waves or wave action, which creates a high-energy, specialized environment.

Transient: An animal that is passing through an area; an event lasting only a short time.

Tunicates: Highly modified marine animal; usually globular and attached to substrate. Also commonly referred to as sea squirts.

Visual cues: Underwater landmarks or individual display that is used to communicate information.

Zooplankton: Animals that spend some part of their lives floating or drifting with the currents in fresh- or saltwater. Most such animals are microscopic.

OTHER THINGS TO CHECK OUT!

MMS Rigs-to-Reefs Website

http://www.gomr.mms.gov/homepg/regulate/environ/rigs-to-reefs/information.html

The Living Gulf: A Place to Treasure - A Guide to Oil and Gas Production

http://www.offshoreoperators.com/index.html

Pros and Cons of Artificial Reefs

http://www.nationalgeographic.com/xpeditions/lessons/08/g912/artificialreefs.html

The REEF Environmental Education Foundation

http://www.reef.org/index.shtml

Bridge – Sea Grant Ocean Science Education Center

http://www.vims.edu/bridge/

National Marine Educators Association

http://www.marine-ed.org/

National Ocean Science Bowl

http://www.nosb.org/

The Department of the Interior Mission

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

The Minerals Management Service Mission

As a bureau of the Department of the Interior, the Minerals Management Service's (MMS) primary responsibilities are to manage the mineral resources located on the Nation's Outer Continental Shelf (OCS), collect revenue from the Federal OCS and onshore Federal and Indian lands, and distribute those revenues.

Moreover, in working to meet its responsibilities, the **Offshore Minerals Management Program** administers the OCS competitive leasing program and oversees the safe and environmentally sound exploration and production of our Nation's offshore natural gas, oil and other mineral resources. The MMS **Minerals Revenue Management** meets its responsibilities by ensuring the efficient, timely and accurate collection and disbursement of revenue from mineral leasing and production due to Indian tribes and allottees, States and the U.S. Treasury.

The MMS strives to fulfill its responsibilities through the general guiding principles of: (1) being responsive to the public's concerns and interests by maintaining a dialogue with all potentially affected parties and (2) carrying out its programs with an emphasis on working to enhance the quality of life for all Americans by lending MMS assistance and expertise to economic development and environmental protection.

MMS Securing Ocean Energy & Economic Value for America