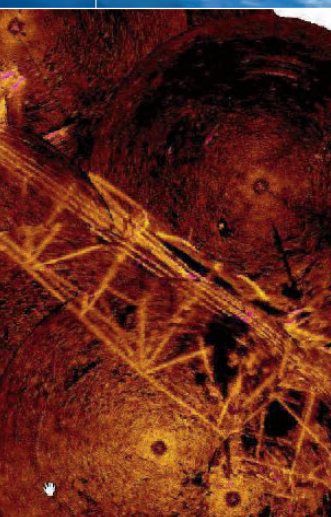


MMS

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OCEAN SCIENCE

THE SCIENCE & TECHNOLOGY JOURNAL OF THE
MINERALS MANAGEMENT SERVICE



**Reporting on 30 Years of Social
Research in the Land
of the Midnight Sun**

The Elusive *Architeuthis*

**In Pursuit of Prey:
The Sperm Whale Acoustic
Prey Study**

**Learning from Experience:
Assessing Hurricanes
Gustav and Ike's Damage to
Offshore Structures and Pipelines**

**Studying Potential Conservatism
in Foundation Design for Offshore
Platform Assessment**

**MMS Shares Expertise
with the West African
Gas Pipeline Authority**

**In Memoriam:
Dr. Rezneat M. Darnell, Jr.**



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



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ON THE COVER

Top left: A sidescan-sonar image of a destroyed platform on the Gulf seabed.

Top right: Squid and other prey caught during the SWAPS pilot cruise aboard the NOAA research ship *Gordon Gunter*.

Bottom: The first taste of the whale, the *uunalik*, is being prepared by a crew member to feed all who assisted. *Photo by M. Galginaitis used with permission of the Nuiqsut Whaling Captains' Association (NWCA); not to be reproduced without permission from the NWCA.*

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A New Year, Continued Commitment

The Minerals Management Service (MMS) owes its success to the people it hires to carry out its work. These people range from administrative assistants to petroleum engineers, and from biologists to leasing specialists, and contractors, as well.

Balanced, responsible decisionmaking is possible only when it is based on the best available science and information. In the management of the Outer Continental Shelf (OCS) energy resources, MMS is proud of the experts and specialists that ensure the soundness—and the advance—of needed scientific and technical information.

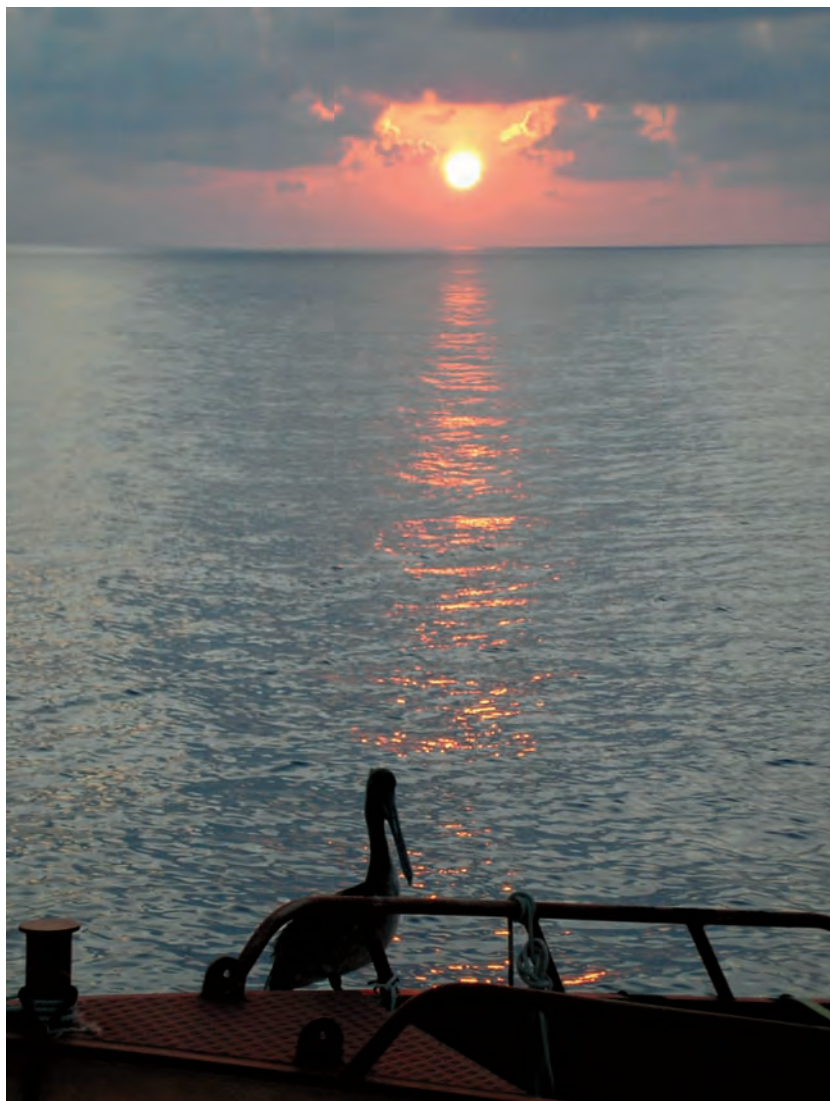
Two key programs bringing about this rigorous research are the Environmental Studies Program (ESP) and the Technology Assessment & Research (TA&R) Program.

Environmental studies include studying not only the potential effects of energy activities on the natural environment but also those on the human environment. This includes economic, social, and other measures that could be easily overlooked.

The MMS's sociocultural work has sometimes been under-reported, though it has made substantial contributions to the field itself. In fact, in Alaska, MMS has been involved with sociocultural research for over 30 years (even before its OCS responsibilities were moved from the Bureau of Land Management to MMS). Numerous studies on such topics as subsistence, social organization, and social indicators—among the first to be conducted in the U.S.—have illuminated the sociocultural systems of rural Alaskan coastal peoples. The MMS was also on the forefront of conducting sociocultural studies on the effects of the *Exxon Valdez* oil spill.

The ESP works closely with other agencies at the State and Federal levels, pooling resources and complementing strengths. A logical result of the Sperm Whale Seismic Survey has recently begun; the Sperm Whale Acoustic Prey Study is underway in the Gulf of Mexico, gathering data that will help MMS and others better protect endangered sperm whales and the prey upon which they rely.

The TA&R Program helps to better protect people and the environment, as well as offshore infrastructure. People who live and work in the Gulf of Mexico area prepare for hurricane season year-round, and so does MMS. Analyzing damages caused by hurricanes leads to new technologies and practices that make the offshore environment safer.



A brown pelican and the sunset from the NOAA research vessel *Gordon Gunter* in the Gulf of Mexico during the Sperm Whale Prey Study pilot cruise, 2009.

The data that we gather, analyze, evaluate, and share is not only valuable for MMS's mission but also for moving forward the fields of study themselves.

MMS Mission Statement

The MMS's mission is to manage the ocean energy and mineral resources on the Outer Continental Shelf and Federal and Indian mineral revenues to enhance public and trust benefits, promote responsible use, and realize fair value.

Reporting on 30 Years of Social Research in the Land of the Midnight Sun

To some people, 30 years is a long time. To others, what matters is not the number of years but how wisely the time is spent.

From 1975 through 2004, the Department of the Interior funded more than \$768 million nationwide through the Environmental Studies Program (ESP) to produce environmental studies in support of sound decisionmaking about oil and gas leasing on the Outer Continental Shelf (OCS).

In that time, approximately \$286 million was directed into the ESP in the Alaska OCS Region, with \$24.5 million to social science research efforts.

The social component of the ESP was initiated in 1976 by the Bureau of Land Management. When the Minerals Management Service (MMS) assumed responsibilities for OCS planning and development from the Bureau of Land Management in 1982, it also took on responsibility for managing the ESP.

Since 1975, the social research component of the Alaska OCS Region's ESP has produced more than 200 scientific reports, including 167 technical reports and 9 special reports, and at least 30 multivolume titles.

The Alaska OCS Region's ESP social research is a distinctive aggregation of social science literature, and its value for monitoring social change will extend far into the future. But as more studies are conducted, the sheer volume of the material has made it more difficult to use.

To improve access to three decades of social research, MMS commissioned a peer-reviewed report to synthesize the highlights of its research efforts in Alaska. Experts in Alaskan socioeconomic and sociocultural research studied and evaluated the vast body of work. They summarized key findings and highlights within various categories of research topics.

The result was recently released: *Synthesis: Three Decades of Research on Socioeconomic Effects Related to Offshore Petroleum Development in Coastal Alaska* (OCS Study MMS 2009-006), edited by Stephen R. Braund and Jack Kruse. (The report includes, on DVD-ROM, 167 technical reports and 9 special reports.)

The synthesis report captures the breadth and range of socioeconomic work conducted in Alaska from 1975 to 2004.

More than a collection of findings, the report is an index of historical efforts.

The report is especially valuable for its reflective assessment of the design, development, and execution of a 30-year social research program. The report also documents the evolution of the Federal Government's management of the OCS.

The report not only provides evaluative summaries of key research during this crucial period in Alaska but also evaluates the work as applied research.

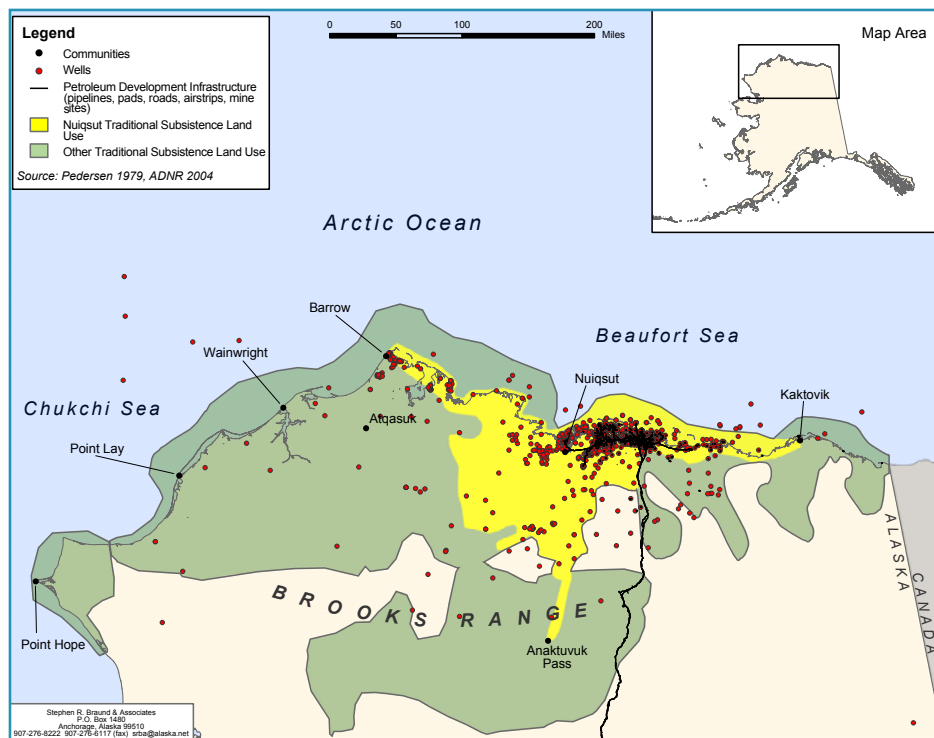
As a synthesis of applied research findings and a chronicle of a social research program, the report offers a view of Alaska and the Alaskan Native communities during a period of tremendous change.

Uncharted Territory

Sociocultural and socioeconomic research is crucial to understanding how possible energy development activities may impact local communities. The National Environmental Policy Act of 1969 and amendments to the Outer Continental Shelf Lands Act passed in 1978 mandated the Federal Government to prepare an environmental impact statement before any offshore lease sale if the action could have significant environmental effects. These Acts also mandate



Native Peoples of Alaska.



Traditional subsistence land-use areas and oil development.

that the Federal Government consider the effects of major Federal actions on the *human* environment.

In Alaska, 1975-2004 was a time of significant social, economic, and environmental change: the discovery of a large onshore oil field at Prudhoe Bay in 1967, the energy crisis of the 1970's, and the development of the Trans-Alaskan Pipeline. In the mid-1970s, the Federal Government accelerated its leasing program. The *Exxon Valdez* oil spill in 1989—though it did not involve the OCS—had effects that are still felt.

Where and how to start in fulfilling its mandate to assess potential effects of offshore oil development in Alaska was a challenge. Conducting social research of effects on coastal communities in Alaska was uncharted territory. Alaska's coastline is immense; weather severely restricts travel. Little current information was available, such as who lived in coastal communities, how they earned their living, and the communities' social and political structures.

Alaska's Native communities were the focus of the social research component of the ESP. Because they were not a part of mainstream U.S., the range of potential effects and the research needed to understand them called for multiple disciplines and innovative applications of research methods and tools. Building a social component to the ESP began almost from scratch.

The Synthesis Report

Each of the synthesis report's 11 chapters focus on a research topic

or subject addressed by the studies over the 30-year period.

A brief economic history of Alaska includes a history of petroleum exploration and development in Alaska. Examining effects of petroleum development on the Alaska economy, one chapter reviews ESP's work to design development scenarios and technology assessments. It also describes the development of statewide economic, demographic, and fiscal models. The models that formed the basis of economic and demographic impact projections have broader applications, beyond the ESP itself.

A review of community effects of OCS development traces the conceptual approach to modeling, development of the models, and the results of modeling efforts and baseline studies.

A chapter on sociocultural studies addresses social indicators, institutional monitoring, subsistence-based economies, subsistence harvests, harvest disruptions,

bowhead whaling, and traditional knowledge. The chapter also evaluates the ESP's record as applied social science.

The effects of the *Exxon Valdez* oil spill (EVOS) on subsistence activities and on coastal communities are the focus of two chapters. A discussion of the long-term consequences of EVOS focuses on harvest and use levels, harvest areas, sharing, and traditional knowledge. The chapter also reviews sociocultural core studies and harvest disruption studies. Community and individual impacts of the EVOS are the focus of another chapter, which includes data on the chronic community impacts of the EVOS.

An examination of relationships between petroleum development and subsistence uses the North Slope as a case study. It describes traditional subsistence patterns, the history of petroleum development on the North Slope, contemporary settlement patterns, land status, and regional economy. The chapter also examines planning and mitigation activities.

The MMS recognizes that Alaska's coastal communities are special places. As the 30 years summarized in the synthesis report indicate, through its ESP, MMS will continue to learn and share knowledge in support of sound decisionmaking.

FOR MORE INFORMATION

"Synthesis: Three Decades of Research on Socioeconomic Effects Related to Offshore Petroleum Development in Coastal Alaska," OCS Study MMS 2009-006

www.mms.gov/alaska/reports/2009rpts/2009_006/2009_006.pdf

The Elusive *Architeuthis*

The elusive giant squid (*Architeuthis* spp.) has fed the imagination for thousands of years. They are described by Pliny the Elder and by Aristotle. In Herman Melville's *Moby-Dick* (1851), Ishmael's description of a giant squid notes the squid's relationship with sperm whales. The giant squid in Jules Verne's *Twenty Thousand Leagues Under the Sea* (1870) is an aggressive man-eater.

Architeuthis is the largest known cephalopod and the largest known mollusk. Except for the Colossal squid, it is probably the largest invertebrate ever to exist.

These deep-ocean dwellers are found around the world, usually near continental and island slopes, where they feed on deep-sea fishes and other squid species. Sperm whales and some sharks are the only known predators of adults.

The little that we know about *Architeuthis* is based on stranded animals, animals caught in trawling nets, or from sperm whale stomach contents. With few complete specimens for comparisons, the taxonomy of *Architeuthis* is as vague

as the animal. Some species were named based only on body parts.

Twenty nominal species have been described. With only incomplete specimens for comparison, eight genera were created; all considered synonyms for *Architeuthis*. Some scientists believe that there are three valid species: *A. dux* in the North Atlantic Ocean, *A. martensi* in the North Pacific, and *A. sanctipauli* in the Southern Ocean.

Like all squid, *Architeuthis* has a mantle (torso), eight arms, and two tentacles. Adults are believed to average 11-14 meters (m) (36-46 feet [ft]) long. Males are smaller than females.

Giant squid have a sophisticated nervous system and a complex brain. To better detect light in the deep, the brain has two large optic lobes; 80 percent of the brain is given to processing visual information. *Architeuthis* has the largest eyes of any living creature: over 1 ft (30 centimeters) in diameter (volleyball size).

Steve O'Shea holding the tentacle of an *Architeuthis* sp. ©1996 Martin Hunter, *New Zealand Herald*.



TAXONOMY

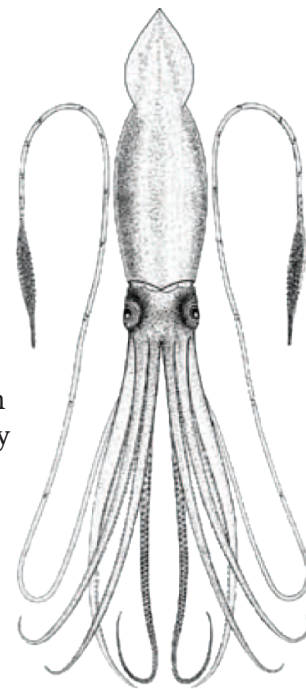
Kingdom:	Animalia
Phylum:	Mollusca
Class:	Cephalopoda
Order:	Teuthida
Family:	Architeuthidae
Genus:	<i>Architeuthis</i>

Like other cephalopods, giant squid are jet-propelled: they push water through their mantle cavity through the funnel.

Architeuthis shares an unusual feature with some other squid species: the fluid in their flesh is ammonium chloride. To maintain neutral buoyancy, they rely on the low density of ammonia in relation to seawater (fish have gas-filled swim bladders that serve this purpose).

Hundreds of suction cups line the inside surfaces of the arms and tentacles. These suckers are lined with sharp, finely-serrated rings of chitin. The perforation of these teeth and the suction of the cups attach the squid to its prey. Sperm whales often bear circular scars from their encounters with giant squid.

In the Gulf of Mexico, off the coast of Louisiana, in July 2009, a giant squid was caught during a research cruise for the Minerals Management Service's (MMS) "Sperm Whale Acoustic Prey Study." Scientists from MMS and the National Oceanic and Atmospheric Administration's National Marine Fisheries Service caught a 19.5 ft (6 m) long, 103-pound (47-kilogram) giant squid while trawling in waters over 1,500 ft (457 m) deep. The squid was sent to the Smithsonian Institution's National Museum of Natural History for study. This find, and continued study, will help MMS better protect this species and the endangered sperm whales that rely on squid for food.



"*Architeuthis princeps*," modified from Verrill, A.E. 1879. *The cephalopods of the north-eastern coast of America. Part I.*

FOR MORE INFORMATION

"MMS Study Positively Identifies Giant Squid Presence in Gulf of Mexico," MMS press release

www.gomr.mms.gov/homepg/whatsnew/newsreal/2009/090921.pdf

"Search for the Giant Squid," Smithsonian Institution

www.mnh.si.edu/natural_partners/squid4/

Protected Species Marine Biologist:

Carol Roden

The employees of the Minerals Management Service (MMS) are central to its success. In each issue of *Ocean Science*, we talk with a specialist or scientist about their work. This issue's focus is on Carol Roden, a protected species marine biologist with the Environmental Sciences Section in the Gulf of Mexico OCS Region.

1. How did you come to work for MMS?

My love of studying marine mammals was firmly established at an early age. Growing up on the Indian River in Florida, I often skipped out of kindergarten and rode my bike to the local park to count bottlenose dolphins swimming into the Eau Gallie Harbor. I got caught, eventually.

I started working for MMS in 2002 after spending 17 years with the National Marine Fisheries Service (NMFS) in Pascagoula, Mississippi.

The MMS and NMFS have a long history of partnering on protected species research. That collaboration led to GulfCet I and II, the first comprehensive offshore aerial and shipboard marine mammal study program in the Gulf of Mexico. I was involved in the joint effort from the beginning in the early 1990's and spent several years doing aerial and shipboard marine mammal and sea turtle surveys in the Gulf, the Atlantic Ocean, and the Caribbean Sea.

I enjoyed being a field biologist, but the regulatory process of using the best information to protect the environment was also of interest to me. When a job at MMS was announced that would afford me that opportunity, I applied for it.

My MMS career has been particularly rewarding because the knowledge and experience I gained during my earlier field years is extremely helpful in my regulatory duties. That field perspective is invaluable in developing mitigation and monitoring programs that are both effective and practical. I also get to combine my office duties with field time, so I spend time at sea studying marine mammals.

2. What makes the work you do interesting to you?

My work allows me to be a part of an important and meaningful effort. Protection and preservation of the marine environment is a must; many laws mandate this. The MMS strives to allow and support offshore industrial activities while implementing mitigation and monitoring needed to minimize impacts to the environment and to ensure the continued existence of endangered and protected species.

My job is to help find and maintain the balance between



Carol Roden at work during the Bowhead Whale Aerial Survey, 2006.

environmental preservation and the use of offshore energy resources. I'm very proud of the work that we have done.

3. What do you do, specifically?

My duties and responsibilities are in two areas, and they support each other. First is my participation in National Environmental Policy Act (NEPA) activities. I'm a subject matter expert for protected species, primarily marine mammals and sea turtles. It is my responsibility to stay current on matters affecting these resources and to write portions of required environmental documents that pertain to them. I also initiate Endangered Species Act (ESA) consultations with NMFS and the U.S. Fish and Wildlife Service for actions proposed by MMS, and participate in the petitioning process with NMFS under the Marine Mammal Protection Act.

My other primary responsibility is to support the MMS Environmental Studies Program. The MMS funds a range of projects, and MMS scientists suggest study ideas and review project proposals. Findings from these studies contribute to our environmental documents. My two responsibilities are linked toward a common goal. I am also a Contracting Officer's Representative and currently have two studies in progress.



Bringing in the trawl catch, SWAPS pilot cruise, June 2009.

It's my participation in research projects that gets me out on the ships. So, I have the best of both worlds!

4. What project or projects are most exciting to you?

We've been doing field research on the sperm whale in the Gulf of Mexico since 2000 and, hands down, this is my favorite project! The sperm whale is the only commonly occurring, offshore marine mammal listed as endangered in the Gulf of Mexico. Working with these whales for several years, I have come to realize how truly spectacular and interesting they are. There are several variations between the Gulf sperm whales and those around the globe, so we have some very special whales right here in our own backyard!

This winter I participated in an MMS/NMFS sperm whale acoustic prey survey (SWAPS) research cruise to determine what the sperm whale eats. We were pulling a huge net in very deep water and then taking tissue samples from the various species that were caught. Analyses of these samples and comparisons with sperm whale tissue samples will tell us what the sperm whales prey on. In other areas they're known to eat primarily squid and we suspect that's their food in the Gulf, too. But little is known about squid in the areas where the Gulf sperm whales are found.

The reason to do this work is to better protect the sperm whales. We need to know what they eat in order to make sure that the activities that MMS regulates are not adversely impacting their prey.

During the 2 weeks I was on this cruise, we had several rough days, which made spotting whales difficult. We heard their "clicks" on the acoustic array that we towed. In fact, in those 2 weeks we had only one marine mammal sighting . . . but it was incredible: about 20 orcas (killer

whales)! Seeing those beautiful, powerful animals is always a thrill and it's not common in the Gulf. Though the quantity of sightings was small, the quality was excellent! We also caught dozens of species of deepwater creatures, generating hundreds of samples for analyses.

5. You probably work with some interesting people. True?

Very, very true! That may be the very best part of my job . . . working with and learning from such a broad range of scientists. I certainly have contact with numerous people from many disciplines in my office work.

But when I think of the "people" aspect of my job, I think of my ship time. I have had the privilege of sailing with scientists and top experts from the U.S. and abroad in the fields of marine mammal biology, acoustics, and oceanography, and also brilliant young people on their first cruises who have wonderful ideas, great enthusiasm, and bright futures. The unique shipboard environment allows so much sharing of knowledge, experience, humor, and friendship!

For me, very few things match the satisfaction of working with a group of deeply respected colleagues toward the shared pride of a successfully completed project. I've been very lucky to know that great feeling many times!

6. What's coming up next?

My next step is a gigantic leap but one that I'm looking very forward to! I am retiring this spring. I'm looking forward to developing skills in the glass arts. But I do hope to participate on research cruises from time to time. I can't imagine not being "out there" every now and then!



Carol, reflecting during the Sperm Whale Seismic Study.

In Pursuit of Prey:

The Sperm Whale Acoustic Prey Study



Trawl net in use during SWAPS pilot cruise aboard the NOAA research vessel *Gordon Gunter*.

The northern Gulf of Mexico is home to a resident, and genetically unique, population of about 1,665 sperm whales (*Physeter macrocephalus*), an endangered species.

The Gulf is also one of the most heavily industrialized waterbodies in the world. Intensive energy operations carried out in the Gulf—increasingly in deepwater areas—typically include seismic airgun arrays. These high-intensity, low-frequency sounds may result in behavioral or physiological impacts to marine animals, including sperm whales and their prey.

Since the 1990's, the Minerals Management Service (MMS) has been sponsoring and participating in studies of sperm whales in the northern Gulf of Mexico. Previous MMS studies have gathered much-needed data on sperm whale and marine mammal abundance, spatial distribution, and habitat.

In 2008, the synthesis report for the Sperm Whale Seismic Study (SWSS) was released. The 6-year project provided new and important information about the northern Gulf's resident sperm whale population. It developed baseline

information on the whales' behavior and biology, social organization, physiology, and how they respond to some underwater sounds.

But SWSS findings also raised new questions, such as “What does this genetically unique population of sperm whales eat?” “What are the connections among the whales' distribution, their prey, and the Gulf's physical features?” and “Is there a relation between this population's smaller size and the abundance of their prey?”

We know that most sperm whales feed on squid and small fish, but we aren't certain what this unique population eats. We also don't know if squid, which live in deep water, may be affected by anthropogenic sounds associated with energy activities.

Studies have shown a strong correlation between the sperm whales' location and the physical features of the Gulf, such as Loop Current eddies and high concentrations of surface chlorophyll. That connection suggests that the whales feed on prey that feed in certain areas. But what are those prey and what conditions do they favor?

The Sperm Whale Acoustic Prey Study (SWAPS) will begin answering these questions. Part of a cooperative agreement between MMS and the National Oceanographic and Atmospheric Administration's (NOAA) National Marine Fisheries Service-Southeast Fisheries Science Center (NMFS-SFSC), SWAPS began in the summer of 2009 with a pilot study to test methodology.

The goal of the \$550,000 MMS-funded study is to characterize the forage base for sperm whales in the Gulf of Mexico.

During the 2009 pilot cruise, an unexpected event took place off the coast of Louisiana. A special trawl net captured a giant squid (*Architeuthis* sp.) at a water depth of more than 1,500 ft (457 meters [m]). Deepwater dwellers, giant squid are rarely caught, but they are known to be a preferred food source of sperm whales. The 19.5 ft (6 m) long, 103-pound (47-kilogram) squid was sent to the Smithsonian Institution's National Museum of Natural History.

On January 27, 2010, scientists from MMS and NOAA set out on the first of the SWAPS survey's three legs.

The primary objectives of SWAPS are

- to conduct quantitative sampling of the mid-water pelagic community within the foraging depths of sperm whales;
- to examine the relationships between acoustic backscatter and prey taxonomic composition; and
- to compare sperm whale distribution and prey composition across habitats of the northern Gulf of Mexico.

Time permitting, researchers will also collect data about a small, isolated population of Bryde's whale (*Balaenoptera edeni*). This is the Gulf's only resident baleen whale and, though it has been observed in the northern Gulf for decades, little is known about it.

SWAPS is the first full-scale survey to be conducted aboard NOAA's new, state-of-the-art fisheries survey vessel, *Pisces*. Featuring quiet-hull technology and carrying a crew of 21 and up to 15 scientists, the 209-ft (64-m) *Pisces* is the third of four sophisticated fisheries survey vessels built for NOAA.

The whales are dependent on their prey; changes in the prey's habitat and conditions may, in turn, affect the whales. Understanding more about the sperm whales' prey species can help MMS provide better stewardship and protection through monitoring and mitigation measures.



NOAA researchers examine the *Architeuthis* caught in a trawl net during the SWAPS pilot cruise, July 2009. *Photo courtesy of NOAA.*



The NOAA Ship *Pisces*, the third of four newly constructed fisheries survey vessels, is homeported in Pascagoula, Mississippi. *Photo courtesy of NOAA.*

FOR MORE INFORMATION

"Sperm Whale Acoustic Prey Study," MMS study profile

www.gomr.mms.gov/homepg/regulate/envIRON/ongoing_studies/gm/GM-09-05.html

Sperm Whale Seismic Study website, Texas A&M University

<http://seawater.tamu.edu/swss/>

"MMS Study Positively Identifies Giant Squid Presence in Gulf of Mexico," MMS press release

www.gomr.mms.gov/homepg/whatsnew/newsreal/2009/090921.pdf

"NOAA Scientists Catch Rare Giant Squid," NOAA press release

www.noaanews.noaa.gov/stories2009/20090921_giantsquid.html

Learning from Experience:

Assessing Hurricanes Gustav and Ike's Damage to Offshore Structures and Pipelines

Each year, from June to November, energy operators in the Gulf of Mexico face hurricane season. The Minerals Management Service's (MMS) Technology Assessment & Research (TA&R) Program regularly conducts hurricane research to continually learn from past experience and studies and apply what we've learned to new hurricane standards.

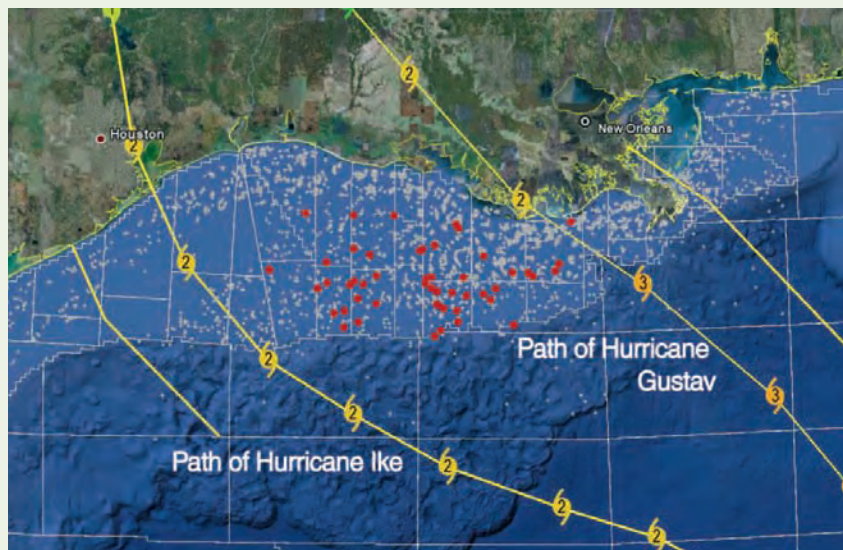
When they swept through the Gulf of Mexico in August and September 2008, Hurricanes Gustav and Ike affected approximately 3,000 platforms and thousands of miles of pipelines. While most platforms and pipelines performed adequately, 60 platforms were destroyed and 31 sustained extensive damage. Gustav and Ike caused no loss of life offshore.

To better protect personnel, structures, and the marine environment—and to minimize disruptions to production—the MMS's TA&R Program contracted an assessment of the damages resulting from Gustav and Ike. Conducted by Energo Engineering of Houston, Texas, and The University of Texas at Austin, "Assessment of Damage and Failure Mechanisms for Offshore Structures and Pipelines in Hurricanes Gustav and Ike" catalogs details about the damages that Gustav and Ike caused to platforms (fixed and floating) and pipelines. It also evaluates reasons for the damage, identifies areas needing further investigation, and suggests possible modifications to design codes to prevent future problems on new structures.

Data collected from MMS and offshore operators included configuration data, inspection and engineering reports, and hindcast data. Data from similar evaluations done after previous hurricanes was, in some cases, used in comparisons.

Gustav and Ike presented different storm behaviors. Fast-moving Gustav caused little platform damage but resulted in mudslides that damaged several pipelines. Slow-moving Ike, on the other hand, damaged a number of platforms and pipelines in its wide path.

A number of platforms were exposed to design level loads or less and were destroyed or sustained substantial damage. The study recommends consideration of additional platform design analyses to afford engineers a better understanding of the probable performance of these structures and analyzing the platforms a second time. Deepwater floating structures performed well in both hurricanes; only one sustained major damage (because of a toppled drill rig).



Paths of Hurricanes Gustav and Ike and destroyed platforms (red dots). All platforms were destroyed by Ike, except for one.

Pipelines and risers sustained considerable damage. In fact, more risers were damaged during Hurricane Ike than during Hurricane Katrina, possibly because bottom currents were larger than predicted. The most common cause of riser damage was toppling of the platform. The most prevalent cause of pipeline damage was movement that can rupture pipelines, pull them from risers, and pull risers from clamps. To improve riser load prediction and potential damage estimates, the study recommends new modeling and calibration.

Many leaning platforms were observed, several with suspected pile foundation failures. The majority of the observations were of recent vintage platforms. Certainty of pile foundation failure is rare, as forensic examination often requires removal of the platform.

After carefully reviewing the report and its recommendations, MMS will update design guidelines or regulations, as appropriate, to improve the safety of Gulf energy personnel and production facilities.

FOR MORE INFORMATION

"Assessment of Damage and Failure Mechanisms for Offshore Structures and Pipelines in Hurricanes Gustav and Ike," TA&R Project 642 report

www.mms.gov/tarprojects/642.htm

Technology Assessment & Research Program, MMS Offshore Structures

www.mms.gov/tarprojectcategories/structur.htm

Studying Potential Conservatism in Foundation Design for Offshore Platform Assessment

The Gulf of Mexico holds significant natural resources for domestic energy. But seasonal hurricanes are also a natural feature of the Gulf; several have been especially powerful and destructive. The Minerals Management Service's (MMS) ongoing, hurricane-related research helps ensure the safety of offshore operators and structures, and the marine environment.

A common thought in the oil and gas industry is that foundation failure in fixed platforms is rare. This may indicate that foundation design methodology may be conservative. In order to evaluate this hypothesis, the MMS's Technology Assessment & Research (TA&R) Program contracted a study with the Offshore Technology Center at The University of Texas at Austin and Texas A&M University.

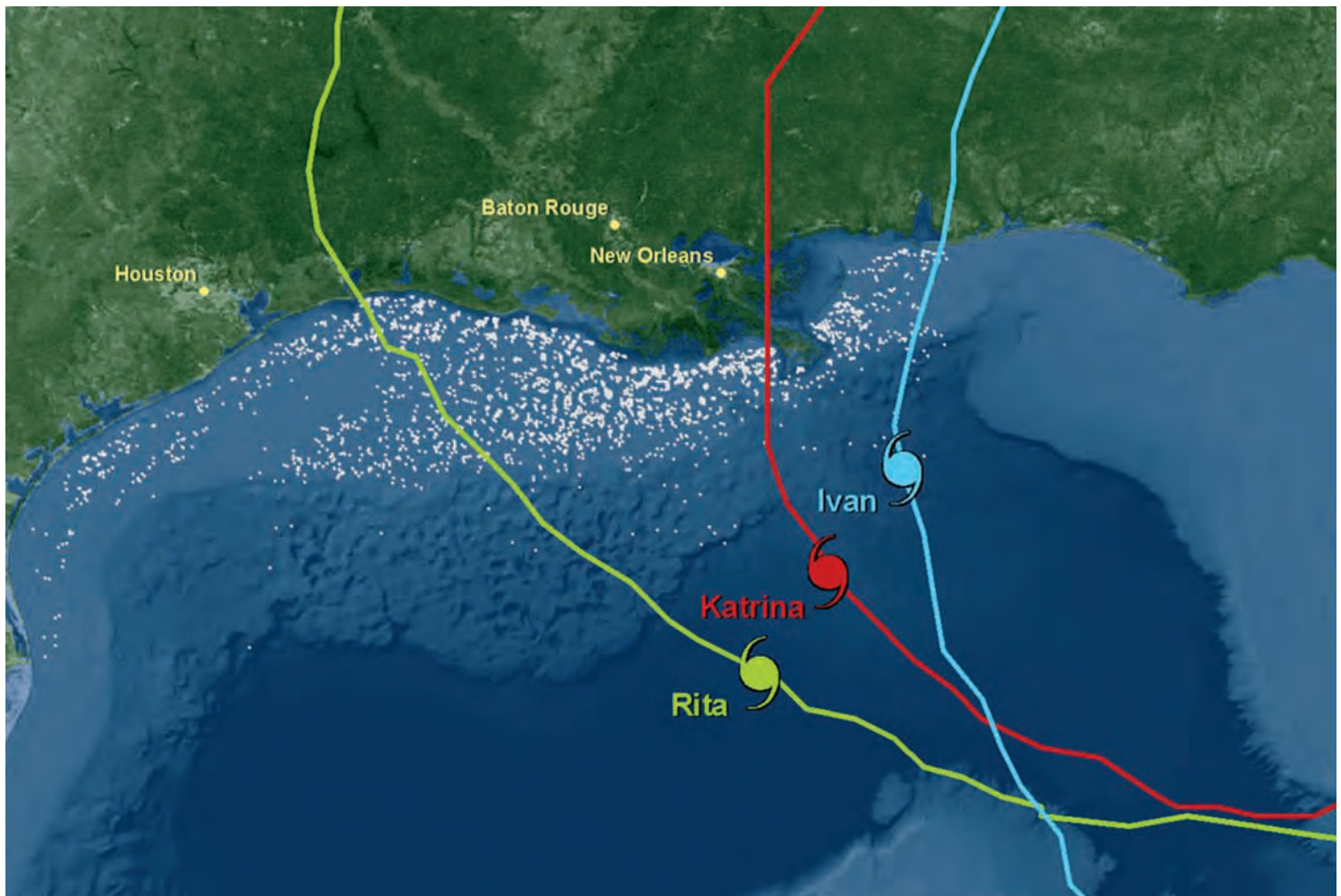
The objectives of "Analysis of Potential Conservatism in Foundation Design for Offshore Platform Assessment" were to identify and analyze factors that may contribute

to perceived conservatism in foundation design and assessment, and also to recommend how this information may be incorporated in the structural assessment of existing platforms.

Many of the oil and gas platforms in the Gulf are fixed structures; most are in relatively shallow water (typically less than 500 feet [152 meters] deep). These structures are usually supported by driven, open-ended steel pipes.

Reportedly, data from the performance of jacket platforms in major hurricanes indicates that pile foundations performed better than expected in major hurricanes: Andrew (1992), Roxanne (1995), Lili (2002), Ivan (2004), and Katrina and Rita (2005). Also, assessments of jacket platforms that were subjected to environmental loads greater than their original design loading showed that the pile foundation often governs the structural system's capacity.

The study included four tasks: (1) qualitative analysis



The paths of Hurricanes Rita, Katrina, and Ivan, and northern Gulf platforms (grey dots).

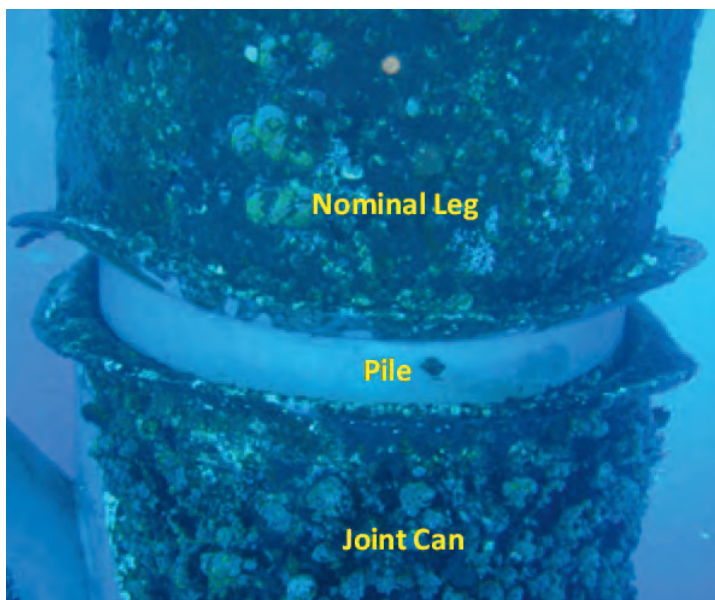


A buckled underwater brace of a platform.

on the data from platforms whose foundations survived; (2) quantitative analysis on selected foundations and the forces to which they were subjected during hurricanes; (3) design and assessment implications; and (4) review, input, and suggestions from experts in industry, MMS, and consultants.

The qualitative analysis of the platforms found considerable variations in foundation design, based on such factors as the site's water depth; the type, age, and location of the structure; and the stresses it received during hurricanes.

The quantitative analysis was done on information from 12 of 30 platforms that had experienced hurricanes. Each foundation was analyzed for such factors as hurricane exposure, number and length of piles, age, the site's water depth, soil, ratio to maximum wave height, and expected mode of failure. Using structural analysis software,



The pancaked leg of a platform.



A platform with wave-in-deck damage.

Using structural analysis software, researchers subjected computer models of the foundations to environmental loads and stresses.

researchers subjected computer models of the foundations to environmental loads and stresses. A plasticity model was used to better understand the foundation's behavior and design sensitivity.

The study concluded that there is no quantifiable evidence of conservatism in fixed platform pile foundation design.

The study provides recommendations about modeling pile foundations in platform assessments and general guidance for improving the overall practice of platform assessment.

The MMS has neither approved the use of this study's recommended modifications to modeling procedure nor its recommended adjustment to design guidance on sand and clays.

Researchers found that studying only platforms that had not been destroyed likely restricted the study's conclusions. Little information was available about platforms or foundations that had been completely or partially destroyed.

The researchers recommended further studies, including partially destroyed foundations, to better identify potentially conservative design elements.

FOR MORE INFORMATION

"Analysis of Potential Conservatism in Foundation Design for Offshore Platform Assessment," final report and project profile
www.mms.gov/tarprojects/612.htm

MMS's Technology Assessment & Research Program
www.mms.gov/tarphome/

MMS Shares Expertise with the West African Gas Pipeline Authority

The Minerals Management Service (MMS) has cradle-to-grave oversight of energy operations on the Outer Continental Shelf (OCS) and has been managing and regulating these resources since the 1950's, when its functions were shared by the U.S. Geological Survey and the Bureau of Land Management. This cumulative expertise is especially valuable to other offshore energy producing nations that are developing or refining regulatory standards and practices.

The MMS was invited by the U.S. Agency for International Development to share its expertise with the newly established West African Gas Pipeline Company and its regulatory body, the West African Gas Pipeline Authority (WAGPA). The WAGPA includes state regulatory authorities from Ghana, Togo, Benin, and Nigeria.

The aims of the conferences and MMS's participation were to help develop the regulatory capacity necessary for managing the pipeline and also build the capacity of West African law enforcement, maritime, and fisheries officials to improve security and regulation of offshore resources.

The conferences, with support from several Federal agencies, were held in Accra, Ghana, and Lomo, Togo, September 23-30, 2009. The MMS discussed regulatory practices and methods for enforcing regulations and provided a comprehensive overview of its pipeline inspection program, the use of industry standards, a review of current regulations, and pipeline research.

The MMS staff also conducted a needs assessment in the area of offshore development regulations. The MMS Deputy Regional Director John Rodi and Field Operation's Pipeline Section Chief Alex Alvarado, both of the Gulf of Mexico OCS Region, supported the MMS Office of International Activities in the seminars and needs assessment.

The West African Gas Pipeline is the first regional natural gas transmission system in sub-Saharan Africa. The 421-mile-long (678 kilometers [km]) pipeline stretches from Nigeria, where natural gas is sourced from the Niger Delta, across Benin and Togo to Ghana. It has a capacity of 177 billion cubic feet of natural gas per year. The offshore portion is 354 miles (mi) (570 km) long and about 9-12 mi (15-19 km) off the coast in waters 98-250 feet (30-76 meters) deep.

FOR MORE INFORMATION

MMS International Activities Program Overview
www.mms.gov/international/InternationalBrochure.htm

Interest in a West African regional gas pipeline began in the 1980's, with a proposal of the Economic Community of West African States to stimulate the region's economy while lowering the cost of power. In 1998, a feasibility study determined that the project was commercially and technically viable; the result was a Memorandum of Understanding signed in 1999 by the governments of Ghana, Togo, Benin, and Nigeria. The pipeline was commissioned in May 2008 and operations are expected to begin in 2010.

The MMS continues to work with offshore energy-producing nations to promote international standards of offshore development and safety. Enforcing these standards helps countries benefit from lower costs, improved safety, and better environmental protection.



L-R: Kevin Kunkel, International Programs, MMS; Immanuel Boah, Deputy Minister of Energy, Ghana; Cheri Hunter, Chief, International Programs, MMS; John Rodi, Deputy Regional Director, Gulf of Mexico OCS Region, MMS; Alex Alvarado, Field Operations, Gulf of Mexico OCS Region, MMS.

The MMS takes an active approach to identifying and working with international initiatives that promote better integration of safety and environmental concerns into offshore development decisionmaking. To do this we focus on:

- monitoring, developing, and refining safety and environmental standards;
- exchanging technical skills and information with our international regulatory counterparts; and
- providing technical advice to the U.S. Department of State.

In Memoriam:

Dr. Rezneat M. Darnell, Jr.

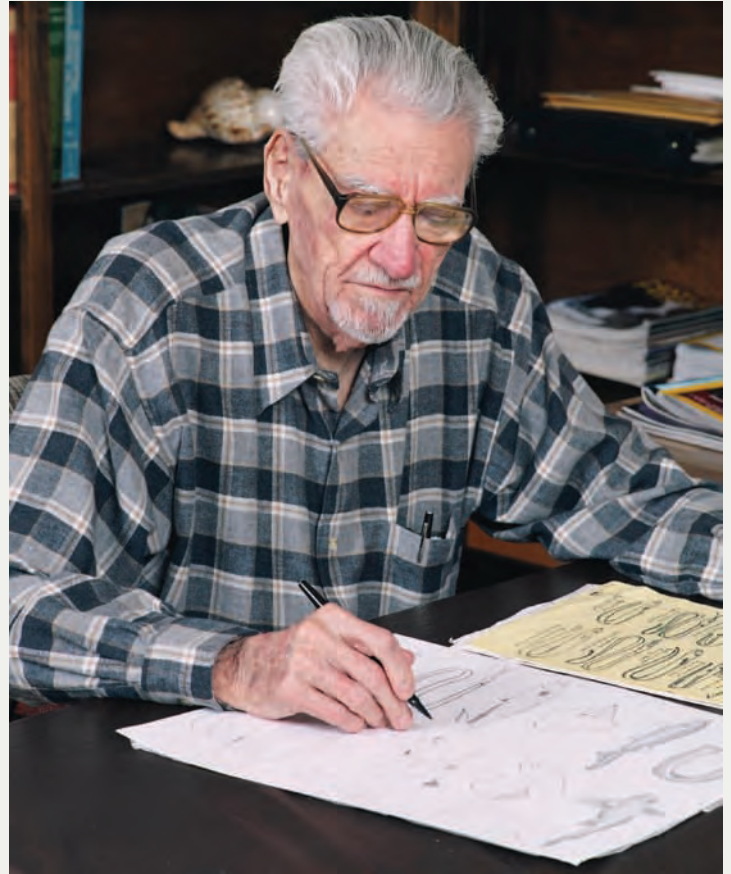
On December 22, 2009, the community of ecologists and marine biologists lost one of their most respected and accomplished experts on the ecology of the Gulf of Mexico. Dr. Rezneat Milton Darnell, Jr. died in Minneapolis, Minnesota, after a brief illness.

“Rez” was Professor of Oceanography at Texas A&M University from 1968 until 1995, when he retired as Professor Emeritus. A favorite mentor of many graduate students and a nationally recognized scientist, Rez was admired for his seminal scientific research and publications.

Born in Memphis, Tennessee, in 1924, Rez graduated from Southwestern College (now Rhodes College) in Memphis, Tennessee, with a Bachelor’s degree in Zoology in 1946. He received his Master’s degree in Biology and Genetics from Rice University in 1948 and his Ph.D. in Ecology from the University of Minnesota in 1953. Before his move to Texas A&M University, Darnell was an instructor at Tulane University in New Orleans, Louisiana, and an assistant professor at Marquette University in Milwaukee, Wisconsin.

Rez’s areas of expertise included Gulf of Mexico estuarine and continental shelf ecology, Gulf of Mexico fish and crustacean life history and ecology, and food relations and the trophic structure of marine ecosystems. His research included studies of blue crab populations, the effects of dimethoate on small mammal populations, the ecological history of Lake Pontchartrain, and mapping the biological resources of the continental shelf.

A friend and colleague of Dr. Darnell, Dr. Linda H. Pequegnat, co-editor of *Biota of the West Flower Garden Bank*,



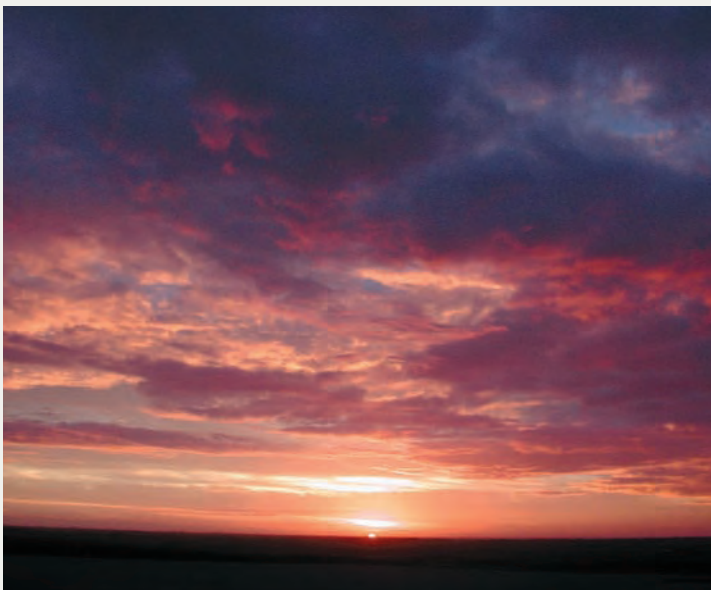
Dr. Rezneat “Rez” Milton Darnell, Jr.

said, “Rez has been called ‘The Great Synthesizer’ because of his ability to take detached scientific information and organize it into meaningful overviews that explain the ‘big picture’ of ecological relationships in the natural world. He was also a ‘Renaissance Man’ with extensive knowledge and experiences in such diverse areas as music, languages, and history—in addition to his vast scientific knowledge.”

His forthcoming book, *The American Sea: A Natural History of the Gulf of Mexico* “pulls together more information about the Gulf than has ever before been amassed in one volume.” It will be published by Texas A&M University Press.

Dr. Darnell’s works remain key resources for biologists. Among the most cited are

- Darnell, R.M. and R.E. Defenbaugh. 1990. Gulf of Mexico: Environmental overview and history of environmental research. *American Zoologist*. 30(1):3-6.
- Giammona, C.P. and R.M. Darnell. 1990. Environmental effects of the strategic petroleum reserve program on Louisiana shelf communities. *American Zoologist*. 30(1):37-43.
- Darnell, R.M. and T.M. Soniatt. 1979. The estuary/continental shelf as an interactive system. Pages 489-525 In: R.J. Livingston (ed.), *Ecological Processes in Coastal and Marine Systems*. Plenum Press. New York, New York.



Sunset over the Gulf of Mexico, from Padre Island, Texas.

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New Waves

Late-Breaking News & Information

Atlantic Renewable Energy Office Plans Announced

Secretary of the Interior Ken Salazar announced in December 2009 that the Minerals Management Service (MMS) will establish a new regional office in 2010 to support renewable energy development on the Outer Continental Shelf (OCS) off the Atlantic seaboard.

The Atlantic OCS Region will be responsible for evaluating permits for renewable energy activities in an effective, efficient, and consistent manner, while being responsive to the States, developers, and other stakeholders.

The new office will implement and manage the offshore renewable energy program, including leasing, environmental programs, the formation of task forces, State consultation, and postlease permitting in Federal waters off the East Coast.

The MMS's Renewable Energy Program is administered by the Office of Offshore Alternative

Energy Programs, within the Offshore Energy and Minerals Management.

The first-ever regulatory framework for offshore renewable energy development was released in April 2009 by the Department of the Interior. The MMS also worked with the Federal Energy Regulatory Commission to clarify their role in offshore hydrokinetic renewable energy projects. The first leases for offshore wind data collection on the OCS offshore New Jersey and Delaware were recently awarded by the Secretary.

FOR MORE INFORMATION

Renewable Energy Program, MMS
[www.mms.gov/offshore/
RenewableEnergy/index.htm](http://www.mms.gov/offshore/RenewableEnergy/index.htm)