

MARINE MAMMAL CHAPTER

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Abernathy, S.A., M.T. Baer, C.S. Benner, M.S. Brody, D.K. Francois, J.K. Gilliam, L.K. Good, C.J. Ohara, and J.V. Martin. 1989. Atlantic Outer Continental Shelf: Description of the Mid-Atlantic Environment. Abernathy, S. A. (ed.). U.S. Department of the Interior, Minerals Management Service, Atlantic OCS Region, Environmental Assessment Section. Herndon, VA. 167 p.

*This document discusses the major issues and areas of concern for the mid-Atlantic environment that are considered in the planning process for oil and gas leasing and operations on the Outer Continental Shelf (OCS). The issues are addressed with respect to the potential environmental consequences of mid Atlantic oil and gas exploration, development and production. A section discussing The Physical Environment (e.g., geology, non-petroleum minerals, physical oceanography, chemical oceanography and water quality, ocean dumping, meteorology, air quality), Biological resources (e.g., plankton, benthos, fishery resources, marine reptiles, marine mammals, marine and coastal birds, estuaries, wetlands, sensitive coastal habitats, canyon areas), Socioeconomic Environment, and other issues (e.g., archaeological resources, marine vessel traffic, National Aeronautics and Space Administration/ Department of Defense activities, oil and gas infrastructure, marine sanctuaries, and estuarine research reserves) is included. Most of the figures showing fisheries resource distribution are taken from fisheries data compiled for bottom-trawl and shellfish surveys of the National Marine Fisheries Service, Northeast Fisheries Center, Woods Hole, MA.

Bowen, W.B., III. 1989. Marine Mammals and Drilling. p. 62. In: Crawford, K. (ed.). Proceedings: 1989 Marine Expo: The Natural Resources Associated with Mobil's Proposed Drill Site. NC Outer Continental Shelf Office, NC Department of Administration. Raleigh, NC.

There are approximately seven species of whales and dolphins that frequent the North Carolina coastal waters from the 100 fathom mark to the inner bays and sounds. Of these seven, three are baleen whales and four are toothed whales and dolphins. The Right Whale (*Eubalaena glacialis*), Atlantic Bottlenose Dolphin (*Tursiops truncatus*) and the Pigmy Sperm Whale are the most dominant. Of these, the Right Whale is the most endangered. Right Whales utilize southern migration routes in the fall to Florida and South Carolina, with many of them remaining along the South Carolina coast where calving and females with calves feed. Then they proceed north in the spring utilizing routes from as near as 500 yards of the shoreline past to the Gulf Stream. There is little known about their habits in vicinity of drilling sites or how they react to heavy boat traffic. Dolphins in the Gulf of Mexico are known to leave drilling sites for weeks to months. The reason may be due to disturbance of the site causing changes to the food source or from sound disturbance. Much can be learned from this type of operation, before, during, and after the fact. By so doing, this will allow all parties to correct or eliminate future problems.

CETAP: Cetacean and Turtle Assessment Program. 1979. A Characterization of Marine Mammals and Turtles in the Mid- and North- Atlantic Areas of the U.S. Outer Continental Shelf: Annual Report for 1979, Cetacean and Turtle Assessment Program, University of Rhode Island. 68 p.

Published reports of sea turtles in the region from Cape Hatteras to Nova Scotia are limited primarily to records of strandings of dead or dying individuals (Bleakney, 1965, Brongersma, 1972). Schwartz (1967) reported the occurrence of sea turtles in near-shore and bay waters of Maryland and Lazell (1976) reported records around Cape Cod, Massachusetts, with added comments and questions about

sea turtle in the area. Babcock (1919) summarized information on sea turtles in the Northeast, including locality data, but his work did not include Kemp's ridley turtle, which may have been mistakenly identified at the time as the hawks-bill. While sea turtles have long been known from the region, no comprehensive studies of the temporal distributions and relative numbers were made prior to this study. This chapter addresses data generated in the first year of a study on marine turtles in United States waters up to 200 n.mi. offshore from Cape Hatteras, North Carolina to Nova Scotia as part of the CETAP (Cetacean and Turtle Assessment Program) funded by the Bureau of Land Management. This chapter includes all 1978 and 1979 data collected on Turtle Watch Group (TWG) field efforts, all other CETAP field efforts, and analyses of the data generated by these groups. Additional information contributed by other observers is included as well.

All sea turtles in the area are classified as endangered or threatened. The purpose of this ongoing project is to provide basic information on sea turtles for resource management. Completion of the entire project may change certain data interpretations, ideas, or suppositions presented herein.

Crawford, K. (ed.). 1989. Proceedings: 1989 Marine Expo: The Natural Resources Associated with Mobil's Proposed Drill Site. NC Outer Continental Shelf Office, NC Department of Administration. Raleigh, NC. 64 p.

*This report contains abstracts from each presenter. Chapter topics include: Mobil's Proposal, Geologic Overview -- Introduction and Potential for Oil and Gas Discovery, Oceanographic Conditions, Comments on Last MMS Modeling, Biological Production Near the Bottom (invertebrates), Fisheries Resources, Commercial and Recreational Marine Fisheries, Winter Storm Effects on Spawning and Larval Drift of Pelagic Fish, Marine Birds, Sea Turtles in North Carolina, Marine Mammals, Plenary Session, Summary. Each chapter also cited individually when appropriate.

Hoss, D.E. 1992. Research at the Beaufort Laboratory. pp. 51-54. In: Department of the Interior, Minerals Management Service. Proceedings of the Fourth Atlantic OCS Region Information Transfer Meeting, September 1991. U.S. Department of the Interior, Minerals Management Service. Herndon, VA.

The Fourth Atlantic Outer Continental Shelf (OCS) Regional Information Transfer Meeting (ITM) was held on 24-25 September, 1991, in Wilmington, NC. The focus of the meeting was on the OCS off North Carolina, specifically on activities related to a proposed exploratory well for oil and gas by Mobil on Block 467 a site 40 miles off the coast of North Carolina. The area of industry interest is known as the Manteo Prospect, while the activities surrounding the proposed drilling are referred to collectively as the Manteo Project. The wildcat wellsite is in 2,690 ft. (857 m) of water near the edge of the Gulf Stream. It is also near a fishing ground known locally as "The Point." The area is believed to be gas prone rather than oil prone. The estimated size of the resource could be as high as 5 trillion cubic feet of gas.

The purpose of the meeting was to exchange information on the leasing background, legislative activities, scientific results, and socioeconomic studies. Legislative-related reports include descriptions of the Oil Pollution Act of 1990, the Outer Banks Protection Act, the Environmental Studies Review Panel, and the North Carolina Physical Oceanography Panel. Reports of studies on marine life include benthic diatoms, benthic fauna, pelagic seabirds, sea turtles, and right whales. One report describes the use of airships (blimps) for ocean research a capability relevant to North Carolina because of the east coast airship facility is located in the state. Local marine science facilities

described include NOAA's National Undersea Research Center at the University of North Carolina at Wilmington (NURC/UNCW) and the National Marine Fisheries Service laboratory in Beaufort.

Developments in oil spill cleanup technology and capabilities are described by both the Coast Guard and the industry. A socioeconomic report describes the effects of the oil and gas activities on the tourist industry. Lastly, research on the restoration of salt marshes indicates that rehabilitation of an area is possible when development or an accident has occurred. While the emphasis of the meeting was on oil and gas, two reports described the results of projects related to offshore sand mining. The appendix lists the names and addresses of speakers. Individual chapters are cited individually when appropriate.

*This section describes the ongoing research at the National Marine Fisheries Laboratory in Beaufort, NC. A description of North Carolina marine reptile, marine mammal, coastal, and fishery research is included.

Kraus, S.D. 1992. Right Whales Along the Southeastern United States. pp. 119-25. In: Department of the Interior, Minerals Management Service. Proceedings of the Fourth Atlantic OCS Region Information Transfer Meeting, September 1991. U.S. Department of the Interior, Minerals Management Service. Herndon, VA.

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*This section describes the importance of coastal North Carolina (and the entire Southeastern United States) as a migratory corridor for right whales (*Eubalaena glacialis*).

Lee, D.S. 1985a. Marine Mammals off the North Carolina Coast with Particular Reference to Possible Impact of Proposed EMPRESS II. Appendix G. In: U.S. Department of the Navy. EMPRESS II: Supplemental Draft Environmental Impact Statement for the Proposed Operation of the Navy Electromagnetic Pulse Radiation Environment Simulator for Ships (Empress II) in the Chesapeake Bay and Atlantic Ocean. United States Navy. Environmental/Intergovernmental Section. Atlantic Division. Naval Facilities Engineering and Command. Norfolk, VA.

*This report documents the marine mammals known to occur in North Carolina's offshore waters. The southern portion of the VACAPES EMPRESS II Area of North Carolina overlaps with the northern portion of the defined study area for the Data Inventory Related to the Hatteras Middle Slope (The Point) Area.

———. 1991a. Offshore Research of NC State Museum in Area of the Point. pp. 2-3. In: Shepard, A. (ed.). NURC--UNCW 1991 Undersea Research: Informational Meeting. National Undersea Research Center, University of North Carolina at Wilmington. Wilmington, NC.

Although the current information on the biology, distribution, and season of occurrence of seabirds, marine mammals, and marine turtles in North Carolina is still incomplete, it is better than what is available for most other areas of the world. A 15- year extensive study conducted by the NC State Museum (NCSM) is perhaps the longest and most intensive ocean study of seabirds and marine mammals conducted anywhere. The Hatteras area has long been regarded as a biological "Mason-Dixon Line" between boreal and tropical maritime elements. North Carolina is at a latitude usually associated with temperate seas; however, boreal, temperate, and tropical species are transported, or follow prey items transported by converging oceanic currents to the outer continental shelf area at Hatteras. This, in part, explains the diversity. North Carolina has the largest documented marine bird (over 50 species) and marine mammal (28 species) fauna of any geographic unit in the North Atlantic. Much of what has been added to fauna of the state is the result of studies in the area known as "The Point." It is primarily the location of the state in general, and "The Point" in particular, in relation to tropical and subtropical areas, migration routes and oceanic currents that account for the diversity of species. The relatively rich diversity is offset by comparatively low densities, but many of the species found here are tropical ones with small populations, so densities are naturally low. For a tropical - subtropical environment the densities are really quite high. The *Sargassum* community is also discussed.

Lee, D.S., and M.C. Socci . 1989. Potential Effects of Oil Spills on Seabirds and Selected Other Oceanic Vertebrates Off the North Carolina Coast. North Carolina Biological Survey and the North Carolina State Museum of Natural Sciences. Occasional Papers of the NC Biological Survey. 1989-1. Raleigh, NC. 64p.

*The main purpose of this report is to delineate the possible detrimental effects of an offshore oil spill on the marine fauna of North Carolina. Understandably, there is concern about oil reaching North Carolina's beaches and coastal fauna. Unfortunately, the effects of oil on the offshore ecosystem may be even more devastating and less obvious. Many of the offshore fauna, particularly birds, exist at low populations or have such low reproductive output that population recovery in the event of a spill would be difficult. Large portions of the total populations of many of these species assemble regularly or seasonally in deep waters off the Outer Banks of North Carolina. These species would be particularly

vulnerable to oil pollution, and adequate strategies must be developed to protect them if a spill should occur.

Since 1975, the North Carolina State Museum (NCSM) has been studying the marine birds, mammals, and, to a lesser extent, turtles off the coast of North Carolina. By chance, the principal study site has been in the general oil-lease area and centered near "The Point", a well-known deep-sea area for sport and commercial fishing southeast of Oregon Inlet. Much of what is presented in this report has been compiled from unpublished information collected during the studies and is on file in the NCSM. (Figure 1 illustrates the current oil-lease sites, and Figures 2-13 show various monthly observation points recorded during the 14 years of study. Collectively, these figures illustrate the general area of the surveys. Table I provides the total number of field days per month devoted to offshore surveys.)

Anyone interested in oil exploration or drilling off North Carolina must consider the state's unique position in the Atlantic ecosystem. North Carolina has the largest documented marine bird and mammal fauna of any geographic unit in the North Atlantic. In part, the documented diversity is a result of intensive field research. Studies by the NCSM have provided extensive long-term surveys available for any oceanic area. More than one-third of the birds known from the state's offshore waters were first documented by these studies. However, it is primarily the location of the state in relation to tropical and subtropical areas, migration routes, and oceanic currents that accounts for the diversity of species. For example, the winter avifauna is composed essentially of boreal species that winter in or migrate through North Carolina waters. The summer avifauna consists mainly of foraging tropical and subtropical birds or vagrants of species that normally migrate in the eastern Atlantic. Many of these birds, and others, appear to reach either the northern or southern limits of their known or expected ranges in NC waters.

Another reason that oil companies must give special consideration to North Carolina's marine avifauna is that most birds have relatively protracted periods of occurrence here. There are several factors that account for this, the more obvious of which include: (1) local oceanic currents and upwellings that provide important foraging areas for both low and high latitude species, (2) extended migratory periods for particular species, and (3) a typically long adolescence in some species during which subadults may linger in local waters for extended periods before returning to nesting areas. Therefore, an oil spill in any season could affect a large number of birds.

Several endangered species occur off the North Carolina coast. In addition, many species in the area represent populations of special concern, i.e., they are species whose global populations could be damaged by an oil spill. Although many of the organisms, particularly birds, have not been regarded as endangered by the US Fish and Wildlife Service, present data suggest possible oversights. Before the NCSM studies, it was not known that significant portions of certain populations concentrate off the Outer Banks, making them particularly vulnerable to spills occurring there. Furthermore, before the threat of oil spills, nothing in their marine environment could be considered immediately harmful.

Appendix I and Appendix II provide complete lists of the marine birds, mammals, and turtles presently known from North Carolina.

Lee, D.S., W.A. McLellan, R. Boettcher, and W.H. Lang. 1998. Habitat and Living Resources Review: Recent Information on Pelagic Seabirds, Marine Mammals, and Sea Turtles of the North Carolina Outer Continental Shelf and an Evaluation of Effects of Proposed Offshore Oil and Gas Exploration.

pp. 53-63. In: Vigil, D.L. (ed.). North Carolina/Minerals Management Service Technical Workshop on Manteo Unit Exploration: February 4-5, 1998. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA.

*These are the proceedings from a workshop/meeting (conducted on February 4-5, 1998) between the North Carolina Department of Environment and Natural Resources, and the U.S. Department of the Interior's Minerals Management Service (MMS). The geographic area being discussed is approximately 45 miles east-northeast of Cape Hatteras, NC, referred to as the Manteo Unit. This workshop reviewed environmental and socioeconomic information known and needed on the Manteo Unit. The MMS's Gulf of Mexico OCS Regional Director gave an MMS perspective on history and status of the area. Chevron gave a presentation on how the exploratory well would be drilled. The scientific characterization was presented in greater detail by a number of scientific experts who spoke on the following disciplines physical environment, habitat and living resources, seabirds, marine mammals, sea turtles, and social and economic issues. Specific chapters are cited individually, when appropriate.

During the late 1980's, the state of North Carolina responded to a proposal by the Mobil Oil Corporation to undertake exploratory gas/oil operations in Federal lease blocks on the Outer Continental Shelf (OCS) known as the Manteo Unit. One of the products resulting from the permit request was a report that addressed potential biological effects from offshore drilling activities as related to sea birds and other fauna of the region (Lee and Socci 1989). Chevron USA now proposes an exploratory well on one of the same Manteo blocks originally leased to various oil companies by the Minerals Management Service (MMS). Since 1989, additional information concerning the seabirds, marine mammals, and sea turtles on the North Carolina OCS has been obtained, and new research is planned or underway. This paper is intended to highlight recent development and briefly mention some concerns associated with offshore oil and gas activities that may affect these animals (e.g., Pelagic Seabirds: Globally Endangered Species, Seabirds of Concern; Marine Mammals; Sea Turtles; Potential Effects From Drillship Operations).

Lee, D.S., and W.H. Lang. 1998. Biological Environment: Surface Biota. pp. 84-86. In: Vigil, D.L. (ed.). North Carolina/Minerals Management Service Technical Workshop on Manteo Unit Exploration: February 4-5, 1998. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA .

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Surface biota during this session was defined as a catch-word phrase to refer to a combination of seabirds, cetaceans, (whales and dolphins), and sea turtles. The group was tasked to discuss immediate concerns that could result from one exploratory drillship's activities on the surface biota in the Manteo Unit. Once potential effects of the exploration well were discussed, remaining time was spent on additional concerns, assuming further development and production were to occur.

Orbach, M. 1989. Plenary Session: How Could These Resources be Affected By the Proposed Drilling and What Mitigation Measures Might be Used to Prevent Irreversible Damage. pp. 63-64. In: Crawford, K. (ed.). Proceedings: 1989 Marine Expo: The Natural Resources Associated with Mobil's Proposed Drill Site. NC Outer Continental Shelf Office, NC Department of Administration. Raleigh, NC.

*The following is a summary of the plenary session.

There appears to be a good deal of baseline information available about Mobil's proposed drill site area. However, there was a general consensus that there are serious gaps in our understanding of the relationships and functions of the many communities found in and around the exploration area known as the "Manteo Prospect". Some major areas of concern include protection of area benthos, impacts on community ecology, and effects of drilling discharges.

There was almost unanimous support for a monitoring program of the drilling operations and their impacts. Programs should be devised to examine: 1) The fate of drilling discharges, including dispersion (range and extent) and accumulation along fronts and the ocean bottom; and 2) The effects (both chemical and mechanical) of drilling discharges on the benthos, the indigenous fisheries (including eggs/larvae), prey species, forage strategies, and the sargassum communities.

Concerns were also raised regarding the effects the ship and anchor system might have on the biota as a result of displacement, noise, or collisions, and the impacts of exploration activities on the commercial and recreational fisheries found at "The Point. "

Because of previous scientific work done at or near the proposed drill site, this area may be well suited to such monitoring programs. Not only would information from these programs be vital for developing mitigation measures, but it could also serve as a critical database on which to build a management framework for future development. In addition, data already collected on local fish resources, marine birds, the benthos and bottom conditions, and physical oceanography could provide an excellent base for further research.

*This text also mentions marine mammals and Threatened and Endangered species (marine reptiles).

Ross, S.W. 1985a. A Summary of Biological Processes in the Proposed VACAPES EMPRESS II Area Off North Carolina Relating to Plankton Communities, Pelagic Macroinvertebrates, Ichthyofauna, Sea turtles, Marine Mammals, and Sea Birds. Appendix B. In: U.S. Department of the Navy. EMPRESS II: Supplemental Draft Environmental Impact Statement for the Proposed Operation of the Navy Electromagnetic Pulse Radiation Environment Simulator for Ships (Empress II) in the Chesapeake Bay and Atlantic Ocean. United States Navy. Environmental/ Intergovernmental Section. Atlantic Division. Naval Facilities Engineering and Command. Norfolk, VA.

*This technical report is Appendix B in the "EMPRESS II: Supplemental Draft Environmental Impact Statement for the Proposed Operation of the Navy Electromagnetic Pulse Radiation Environment Simulator for Ships (Empress II) in the Chesapeake Bay and Atlantic Ocean" report. The report is a Summary of Biological Processes in the Proposed VACAPES EMPRESS II area off North Carolina Relating to Planktonic Communities, Pelagic Macroinvertebrates, Ichthyofauna, Sea turtles, Marine Mammals, and Sea Birds. Technical reports supporting this summary were written by authorities in each discipline and are included in Appendices. These supporting technical reports are cited individually. The southern portion of VACAPES EMPRESS II Area of North Carolina overlaps with the northern portion of the defined study area for the Data Inventory Related to the Hatteras Middle Slope (The Point) Area.

Shepard, A. (ed.). 1991. Undersea Research at The Point. NURC/UNCW 1991 Undersea Research: Informational Meeting. National Undersea Research Center, University of North Carolina at Wilmington. Wilmington, NC. 9 p.

*This handout provides a summary of research being conducted at "The Point" area (Manteo Lease Block 467).

The National Undersea Research Center at the University of North Carolina at Wilmington, funded by a grant from the National Oceanic and Atmospheric Administration's (NOAA) Office of Undersea Research, was established in 1980 to promote, facilitate, and conduct research in the Southeastern United States utilizing undersea techniques, including advanced wet diving and manned and unmanned submersibles. A main Center goal is to provide information to NOAA that will assist the agency in fulfilling its charter to explore, understand, conserve and manage the U.S. marine environment and associated resources. To help meet this goal, the Center supports and conducts interdisciplinary oceanographic research projects studying continental margin processes, particularly the interactions and linkages between estuarine, continental shelf, and slope (including submarine canyon) environments.

U.S. Department of the Interior, Minerals Management Service. 1990. Atlantic Outer Continental Shelf: Final Environmental Report on Proposed Exploratory Drilling Offshore North Carolina, U.S. Department of the Interior, Minerals Management Service, Atlantic OCS Region, Environmental Assessment Section. Herndon, VA.

*Topics include: fisheries, birds, marine mammals, physical oceanography, chemical oceanography, geology, gas and oil production. The proposed action is to drill a single exploratory well approximately 72 km (45 mi) east-northeast of Cape Hatteras, NC in 820 m (2,690 ft) of water. Total depth for the proposed well is 4,267 m (14,000 ft) and the location is on Block 467 on the Minerals Management Service Protraction diagram NI 18-2. The proposal has been submitted by Mobil for itself and 7 partners to drill the well on the approved 21-block exploration unit.

U.S. Department of the Interior, Minerals Management Service. 1992. Proceedings of the Fourth Atlantic OCS Region Information Transfer Meeting, September 1991. U.S. Department of the Interior, Minerals Management Service. Herndon, VA. 198 p.

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*This is a National Environmental Policy Act document characterizing the proposed EMPRESS II project. Appendix B contains a Summary of Biological Processes in the Proposed VACAPES EMPRESS II area off North Carolina Relating to Planktonic Communities, Pelagic Macroinvertebrates, Ichthyofauna, Sea turtles, Marine Mammals, and Sea Birds. Technical reports supporting this summary have been written by authorities in each discipline and are included in Appendices. The technical reports are cited individually. The southern portion of VACAPES EMPRESS II Area of North Carolina overlaps with the northern portion of the defined study area for the Data Inventory Related to the Hatteras Middle Slope (The Point) Area.

Vigil, D.L. (ed.). 1998. North Carolina/Minerals Management Service Technical Workshop on Manteo Unit Exploration: February 4-5, 1998. U.S. Dept. of the Interior, Minerals Management Service. Gulf of Mexico OCS Region. New Orleans, LA. 168 p.

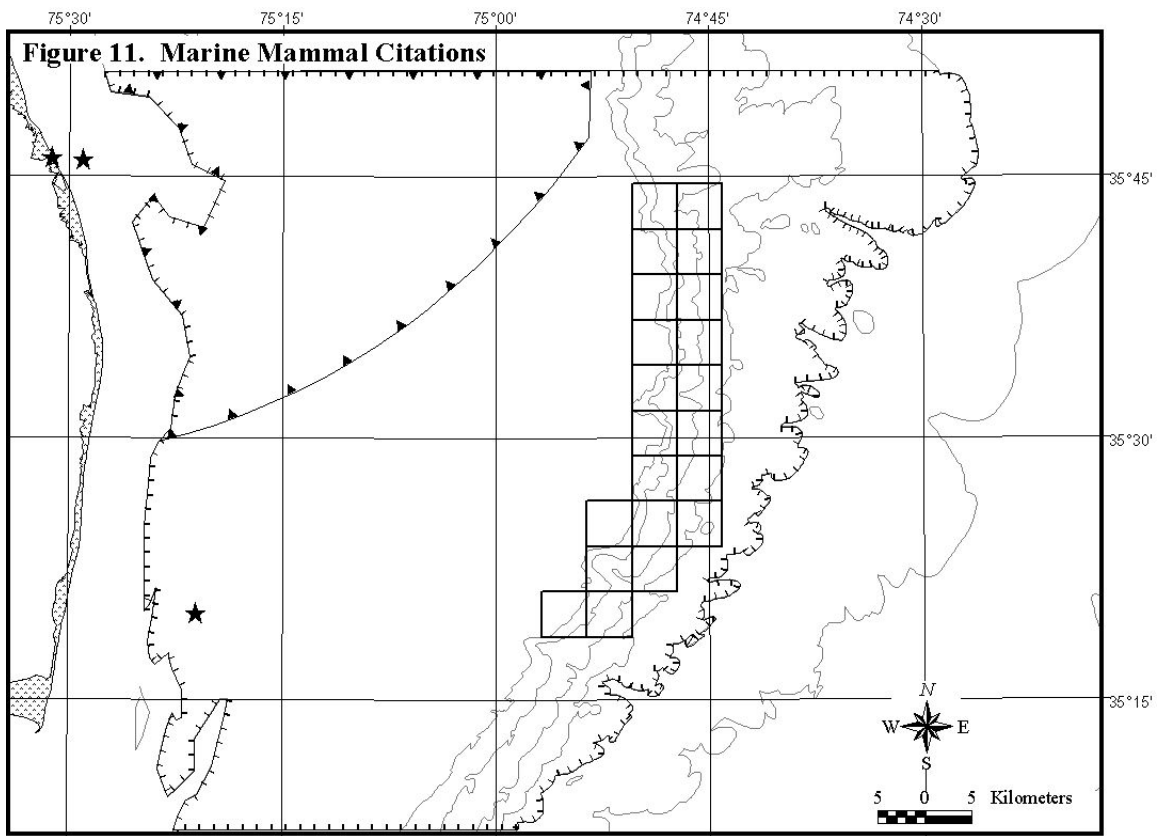
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miles east-northeast of Cape Hatteras, NC, referred to as the Manteo Unit. This workshop reviewed environmental and socioeconomic information known and needed on the Manteo Unit. The MMS's Gulf of Mexico OCS Regional Director gave an MMS perspective on history and status of the area. Chevron gave a presentation on how the exploratory well would be drilled. The scientific characterization was presented in greater detail by a number of scientific experts who spoke on the following disciplines physical environment, habitat and living resources (invertebrates and fish), seabirds, marine mammals, sea turtles, and social and economic issues. Specific chapters are cited individually, when appropriate.

Wiley, D.N., R.A. Asmutis, T.D. Pitchford, and D.P. Gannon. 1994. Stranding and mortality of humpback whales, *Megaptera novaeangliae*, in the mid-Atlantic and southeast United States, 1985-1992. Fishery Bulletin 93: 196-205.

Marine mammal strandings are a result of, or result in, mortality that may be attributed to natural or anthropogenic factors. As such, stranding data can provide insight on spatial distribution, seasonal movements, and mortality factors pertaining to marine mammal populations (Woodhouse, 1991; Mead).

The general distribution and migratory movements of humpback whales, *Megaptera novaeangliae*, in the western North Atlantic are well known from numerous studies based on the identification of individual animals and on other techniques. Humpbacks feed in high latitude areas during the summer months, including waters of the Gulf of Maine, eastern Canada, West Greenland, and Iceland (Hain et al., 1982; Martin et al., 1984; Perkins et al., 1984; Katona and Beard 1990). In the winter, whales from all populations migrate to breeding grounds in the West Indies (Balcomb and Nichols, 1982; Mattila and Clapham, 1989; Mattila et al., 1989; Katona and Beard 1990). Between these migratory end points, little is known of the distribution of the species. In recent years, however, there has been an apparent increase in the frequency of sightings of humpback whales off the mid-Atlantic coast of the United States (Swingle et al., 1993). Furthermore, a considerable number of strandings have been documented along the mid-Atlantic and southeast coasts, many in midwinter, a time when the majority of humpbacks are thought to be located in tropical waters. In this paper, we analyze data from these strandings, discuss implication regarding distribution and possible spatial segregation by age class and examine apparent causes of mortality.



Key to Marine Mammal Citations (Figure 11).

⚡ Study Area Boundary

□ Lease Blocks

Mapped Citations

⚡ Ross, S. (1985a); U.S. Dept. Navy (1985)

★ Wiley et al. (1994)

Studies that Focus on the Manteo Lease Blocks

Bowen (1989)

Crawford (1989)

Lee & Lang (1998)

U.S.D.O.I.-Minerals Mgmt. Service (1990, 1992)

Vigil (1998)

Studies that Cover the Hatteras Middle Slope Area ("The Point")

Lee (1991)

Lee et al. (1998)

Orbach (1989)

Shepard (1991)

Broad Regional Studies

Abernathy et al. (1989)

CETAP (1979)

Hoss (1992)

Kraus (1992)

Lee (1985a)

Lee & Socci (1989)