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Workshop on Environmental Research Needs in Support of Potential Virginia Offshore Oil and Gas Activities

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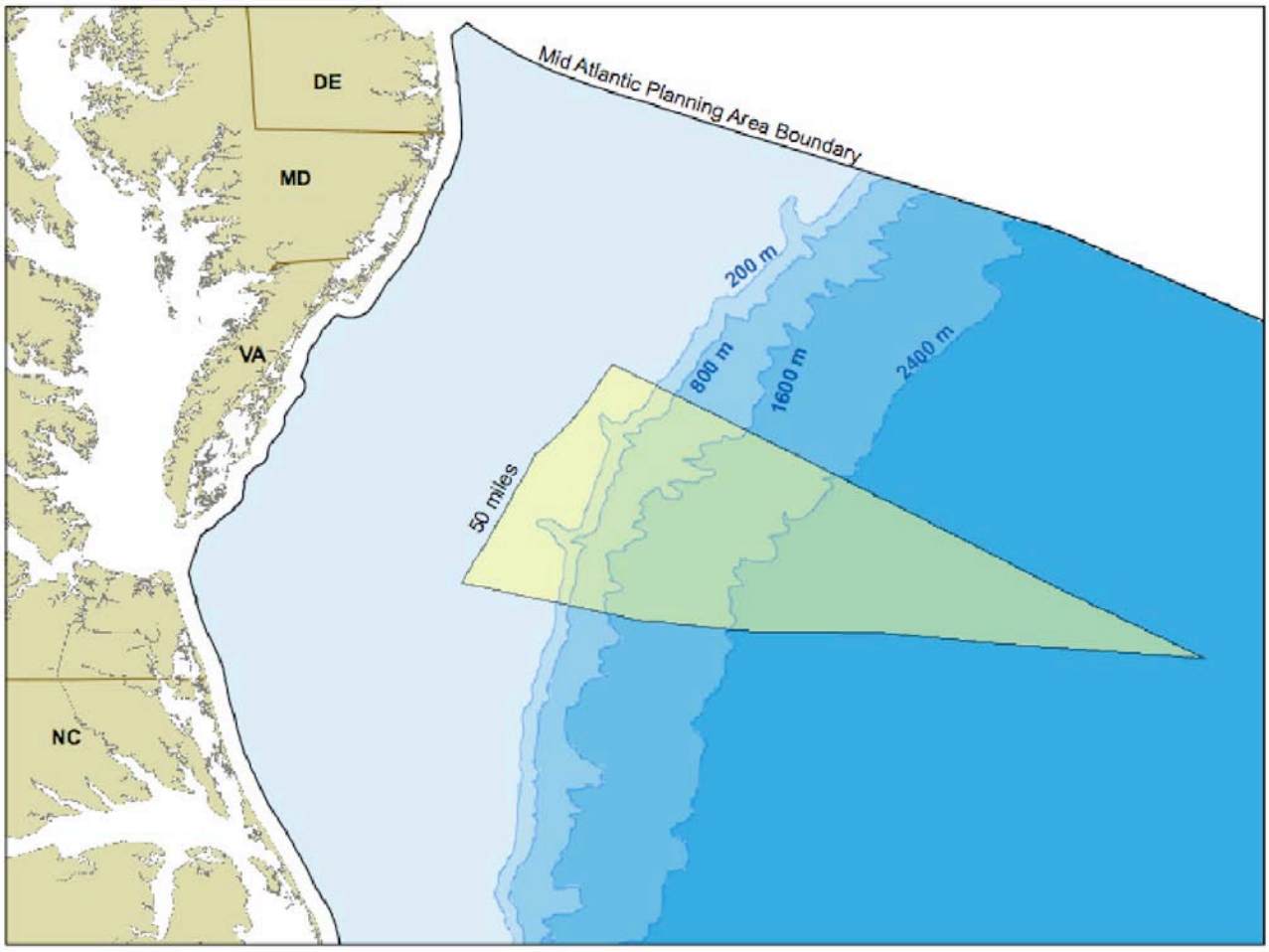

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Workshop on Environmental Research Needs in Support of Potential Virginia Offshore Oil and Gas Activities

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ABOUT THE COVER

The graphic on the cover depicts that location of the potential lease sale area off the coast of Virginia within the Mid-Atlantic outer continental shelf planning area, which extends from Delaware to North Carolina.

Workshop on Environmental Research Needs in Support of Potential Virginia Offshore Oil and Gas Activities

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Workshop on Environmental Research Needs in Support of Potential Virginia Offshore Oil and Gas Activities

Executive Summary

The Minerals Management Service (MMS) has the responsibility for leasing and overseeing oil and gas development on the outer continental shelf. This oversight includes ensuring exploration and production are done in an environmentally responsible manner. In planning for a potential lease sale in the Mid-Atlantic outer continental shelf (OCS) Area offshore Virginia, MMS sponsored a workshop on the environmental research needs in support of potential Virginia offshore oil and gas activities 3 and 4 December 2008, in Williamsburg, Virginia. The focus of the workshop was to assess the existing scientific knowledgebase along the Virginia Coast and the information gaps that need to be addressed should a lease sale for oil and gas activities be held for the Virginia outer continental shelf. This report summarizes the outcome of the workshop.

The first lease sales in the Mid-Atlantic region in the 1970s and 1980s lead to a series of environmental studies to collect baseline data on physical and biological conditions. These studies ranged from the Canadian border to Florida. Several were close to or included parts of the Virginia OCS within the planned lease sale. The principle recommendation from all breakout groups was to assess existing data in a thorough and systematic manner. This effort would include all MMS sponsored studies, other Federal and State agency reports and databases, and the peer-reviewed literature. This data assessment needs synthesize all disciplines. The exception may be socioeconomic, where there is little in the way of existing data to synthesis. New studies that focus on socioeconomics or monitoring could be started, but directed studies need to be informed by the results of the existing data synthesis.

Given the complexity of the OCS and developing management strategies that focus on ecosystem based views of living and mineral resources, a cross-disciplinary effort between biology, fisheries, and physical studies is needed. It will be essential that synthesis efforts incorporate water column and bottom processes data. Geohazards also need to be integrated with the living resources data. Special attention needs to be given to the possibility of chemosynthetic organisms within the Virginia OCS lease sale area.

MMS should develop a comprehensive and integrative plan to assess the cumulative impacts of multiple energy uses on the OCS and adjacent ocean areas. MMS should work with other relevant agencies, states and stakeholders to develop consistent standards to assess the geographic extent of potential impacts and the consequent range of requisite studies.

Overview

The MMS, a bureau within the Department of the Interior, sponsored a workshop on the environmental research needs in support of potential Virginia offshore oil and gas activities 3 and 4 December 2008, in Williamsburg, Virginia. The focus of the workshop was to assess the existing scientific knowledgebase along the Virginia Coast and the information gaps that need to

be addressed should a lease sale for oil and gas activities be held for the Virginia outer continental shelf. This report summarizes the outcome of the workshop.

The MMS has the responsibility for leasing and overseeing oil and gas development on the outer continental shelf (OCS). The OCS comprises the portion of the submerged seabed adjacent to all US coasts whose mineral estate is subject to Federal jurisdiction (Figure 1, MMS 2006). In addition, MMS's oversight includes ensuring exploration and production are conducted in an environmentally responsible manner.

The MMS is planning for a potential lease sale in the Mid-Atlantic OCS Area offshore Virginia (Figure 2). The Mid-Atlantic Planning Area, which extends from Delaware to North Carolina (Figure 3), encompasses approximately 112.83 million acres and has had the most lease sales (5), the largest number of leases awarded (238), and the most wells drilled (32 exploratory, 2 COST) (Table 1). The offshore Virginia lease sale (designated number 220) is scheduled for 2011 under the current OCS leasing Program 2007-2012 and will cover about 2.9 million acres starting 50 miles offshore Virginia (Figures 3, 4, and 5, http://www.mms.gov/5-year/). The Gulf of Mexico (GOM) MMS region will be responsible for administering the Atlantic OCS area. The GOM region is the largest and manages more than 7,000 active leases covering more than 39 million offshore acres, with over 3,850 producing and 200 drilling facilities for some 160 qualified operators.

The Atlantic OCS area is divided into four planning areas along the Atlantic seaboard: the North Atlantic, Mid-Atlantic, South Atlantic, and the Straits of Florida (Figure 2). Between 1976 and 1983, nine oil and gas lease sales were held for the Atlantic OCS planning area. Straits of Florida was transferred from the Gulf of Mexico OCS Planning Area to the Atlantic OCS Planning Area in 1985 and has had only one lease sale (Lease Sale #5) in 1959 that resulted in three exploratory wells (Table 1). A total of 433 blocks were leased in all the Atlantic OCS lease sales and 49 exploratory wells and 5 COST wells were drilled. Within the Mid-Atlantic Planning Area 32 exploratory wells and two COST wells were drilled (Table 1, Figure 3). On November 17, 2000, the interests in the last remaining 8 natural gas and oil leases active in the Federal waters offshore North Carolina were relinquished by Conoco, Shell Offshore and OYX USA. The last oil and gas lease sale within the Atlantic Region occurred in 1983. On November 17, 2000, the interests in the last remaining eight natural gas and oil leases active in the Federal waters offshore North Carolina were relinquished. There are now no oil and gas leases in existence off the Atlantic Coast.

Workshop Objectives and Format

The objectives of the workshop on environmental research needs in support of potential Virginia OCS oil and gas activities were to:

- Review the status of the environmental and socioeconomic information for Virginia's inner and outer continental shelf.
- Develop recommendations for a coordinated plan of environmental and socioeconomic research need prior to oil and gas activities.
- Explore for the potential of coordinated interdisciplinary and interagency research programs.

Emphasis at the workshop was directed toward assessing what is known and unknown within the area. The workshop format included presentations and breakout groups. Oral presentations by local and regional scientific experts in the areas of physical oceanography, fish and fisheries, marine mammals, socioeconomics and other relevant science topics of concern covered existing data and major environmental concerns. After the plenary presentations, attendees formed into disciplinary breakout groups and focused on identifying the key issues of concern should oil and gas activities occur off the coast of Virginia, and the important scientific information gaps that need to be addressed. The agenda for the workshop is in Appendix A and a list of attendees in Appendix B. Copies of the oral presentations are in Appendix C.

The first of four breakout sessions was spent on discussing what is known and brainstorming where information gaps exist. Topics and gaps were discussed and framed in terms of being able to address key issues for future studies. The second session was spent prioritizing the ideas and studies. The third session was spent expanding on the one or two substantive ideas from each disciplinary group to provide background for potential studies, and information about what each study would be about and how it would be executed. The fourth session was spent preparing a brief summary that was presented to the entire workshop by the disciplinary facilitators. Emphasis was placed on MMS environmental information needs in planning for oil and gas activities on the Virginia OCS.

Virginia OCS Description

Studies conducted in the Atlantic OCS Region (Figures 1and 2) from 1974 to 1995 have resulted in over 450 published reports. Of these about 200 reports related to the Mid-Atlantic OCS Area (Figure 2, Appendix D). Information on these studies and reports can be obtained from the MMS, Environmental Studies Program Information System (ESPIS): https://www.gomr.mms.gov/homepg/espis/espismaster.asp?appid=1

The majority of the Mid-Atlantic studies were baseline or benchmark studies, with many being the first systematic scientific studies of the inner and outer continental shelf along this area of the US Atlantic coast. Many were large-scale, multidisciplinary investigations designed to characterize the nature, abundance, and diversity of biological communities, the physical characteristics of the seafloor and overlying water column, and concentrations of certain trace metals and hydrocarbons in the water, sediments, and endangered species prior to OCS oil and gas activity (Table 2).

Environmental Resources

Each of the disciplinary breakout groups reviewed what is known, identify gaps in our knowledge, and discussed datasets, reports and published works. Topics focused on being manageable and able to address issues in future environmental studies.
The main considerations that the breakout groups were asked to consider fell into two categories:

- Short term to support the upcoming lease sale.
- Long-term, to meet future needs should oil and gas development occur.

Possible funding partners identified as having an interest in the OCS included the following Federal agencies: National Science Foundation (NSF), Office of Naval Research (ONR), National Aeronautics and Space Administration (NASA), National Oceanographic Partnership

Program (NOPP), United States Geological Survey (USGS), National Oceanic and Atmospheric Administration (NOAA).

Endangered and Protected Species

Facilitator: Scott D. Kraus

The endangered and protected species group addressed the data gaps and issues pertaining to marine mammals, sea turtles, and sea birds in the waters of and around the potential Virginia OCS lease sale area.

Summary of Discussion Points

Although there has been a substantial amount of survey effort, only a limited amount of it has occurred in the lease sale area (Figure 7). Survey effort is particularly low in the offshore portions. Most of the region-wide survey effort dates from the late 1970's and early 1980's, for example the Cetacean and Turtle Assessment Program (CeTAP). Subsequent surveys have been focused on areas of specific interest (i.e., Navy training ranges), and have not covered the entire region. The CeTAP surveys collected data on marine mammals and sea turtles (http://gcmd.nasa.gov/records/GCMD_seamap284.html) and most subsequent surveys have done the same. Some NMFS surveys were focused only on sea turtles. No surveys for pelagic birds have been conducted in the region, and data on their distribution and abundance is anecdotal. Most of this survey effort is also aerial. Both the effort data and sighting maps presented are cumulative maps of all data collected from 1979 to 2005. Data was not analyzed for seasonality, which would be required to evaluate the seasonal use patterns of this region by different species.

Sightings Data

The marine mammal and sea turtle data shows a high use of Atlantic waters of Virginia by multiple species of sea turtles and cetaceans (Figures 8 to 12). The maps show all documented sightings, but they have not been corrected for survey effort, so they do not represent an unbiased view of distribution. The lack of survey effort in most of the offshore region, and in specific areas inshore, means that sightings data shown here is biased according to where people looked.

Sea turtle data was not separated by species, partly because species identifications from aircraft are difficult or impossible (except for leatherbacks). Figure 8 shows that sea turtles are found wherever surveys have been conducted. Sightings are reduced offshore, probably due to a lack of survey effort. All sea turtles are classified as endangered under the Endangered Species Act.

As a general rule, right whales have been sighted in coastal waters (with a few exceptions at the shelf break), humpbacks have been seen on the shelf from shore to the shelf break, and sperm whale sightings are almost entirely found near the shelf break and in deeper waters (Figure 9). All of these generalizations are weakened by the lack of consistent survey effort throughout the region. Although the seasonality of humpback and sperm whales is not well known here, right whales probably occur from early-November to the end of April, as Virginia is a migratory path for right whales going to and from the winter calving ground off the southern U.S. Atlantic coast. All three of these species are classified as endangered under the Endangered Species Act, and right whales can be considered at risk of extinction due to human activities (Caswell et al., 1999; Fujiwara and Caswell, 2001).

Sightings of the balaenopterid whales are shown in Figure 10. With the exception of minke whales, all species are listed as endangered under the Endangered Species Act. Although all species of balaenopterids are included in this map, blue and sei whales are relatively rare in the region. Finback whales are fairly common, and are usually seen along the outer shelf and shelf break, with occasional sightings further offshore. Like the other species, these generalizations are weakened by the lack of consistent survey effort throughout the region. The seasonal distribution patterns for these species is not well known, although records include sightings from the region throughout the year.

All dolphins, porpoises, and pilot whales are protected under the Marine Mammal Protection Act, but none are listed under the Endangered Species Act. The coastal assemblage in this region is composed primarily of the coastal bottlenosed dolphin (*Tursiops* spp), (Figure 11). The near shelf edge assemblage is dominated by pilot whales (*Globicephala* spp), striped, spotted, and spinner dolphins (*Stenella* spp.), Rissos dolphins (*Grampus griseus*), and common dolphins (*Delphinus delphis*). Like all cetaceans in this region, seasonal distribution and abundance patterns are not well known due to the lack of consistent survey effort throughout the region. Nevertheless, records include dolphin and pilot whale sightings throughout the year.

All beaked whales are protected under the Marine Mammal Protection Act, but none are listed under the Endangered Species Act. All beaked whales are primarily deep-water species and their distribution is off the shelf edge in this region (Figure 12). Beaked whales are long divers (up to two hours) so they are frequently missed by surveys. Also, because they occur in the offshore portion of this region where survey effort is sparsest, information on seasonal distribution and abundance patterns is completely lacking.

Potential Environmental Issues

We classified the consequences of drilling activities into three categories relative to their potential to affect individual animals, localized groups of individuals, and stocks or populations. Three areas of concern included the discharges accidentally or chronically released during the course of drilling activities, increases in vessel traffic associated with both exploration and rig maintenance, and production activities, and underwater noise associated with seismic exploration, drill rig operations, and from associated vessels.

Discharges

The stereotypical concern of the American public with regard to offshore drilling is the catastrophic large-scale oil spill typified by 1989 Exxon Valdez disaster off the coast of Alaska (Figure 13). However, extensive advances in drilling technology and a lot of historical data from the Gulf of Mexico suggests that the probability of an oil spill from drilling operations is extremely low. There are other drilling related discharges, which require consideration, including drilling muds, rig waste, and air pollution. The direct consequences of these on marine mammals, sea turtles, and seabirds are likely to be low, with potential effects limited to a few individuals or local groups.

This is not to say that the probability of damage is non-existent. As Geraci and St. Aubin (1990) have pointed out, " When oil is drawn from the seabed or transported along oceanic routes, some

inevitably escapes." However, for marine mammals, those at highest risk are fur-bearing animals (pinnipeds, polar bears, and sea otters). Only pinnipeds occur in this part of the Atlantic, and they are rarely found in the region. Manatees occasionally travel this far north, but tend to be coastal and rare, and are therefore unlikely to be at risk form discharges or spills. For cetaceans the data suggests that cutaneous exposure to oil, inhalation, and ingestion, have minor and/or temporary consequences (Geraci, 1990). With regard to the potential for baleen fouling, perhaps the most worrisome of the potential oil spill threats for large whales, the evidence indicates that these species have the potential to clear 95% of all oil within 24 hours of exposure. The final concern, the ingestion of the toxic chemicals associated with oil spills remains in need of further study, although preliminary information indicates some metabolic and de-toxifying capabilities in cetaceans (Geraci, 1990).

Vessel Traffic

Many scientific studies have been done to assess the role of speed in ship kills of large whales, and five studies have specifically evaluated this for right whales. Various studies (Vanderlaan and Taggart 2007, Pace and Silber 2005, Laist et al. 2001, Kite-Powell et al. 2007, Vanderlaan et al. 2008) used different analytical approaches, but all reached the same conclusion that vessel speed plays a role in the level of severity of a strike. In addition, Knowlton et al. (1998) concluded that in none of their simulations did a slower moving ship increase the risk of collision. A slower ship has lower hydrodynamic forces and is thus safer for a whale trying to take avoidance action. The cumulative results of these multiple studies are conclusive – no matter which technique is applied, increased shipping speed carries increased risk of death and serious injury to all large whales. The entrance to Chesapeake Bay is one of the busiest shipping areas along the East Coast, serving several commercial ports and military facilities (Figure 14). This high level of shipping crosses the migratory routes of right whales and probably humpbacks. All species of baleen whales have been reported killed by ships (Jensen and Silber 2004, Laist et al. 2001), and finbacks, humpbacks, and right whales are most frequently reported. Existing data suggests that vessel traffic out of the Chesapeake Bay area has been responsible for at least five right whale mortalities in the last 15 years (Knowlton and Brown, 2007).

Vessel traffic associated with the lease site will be dependent upon the oil and gas activities (seismic, drilling, maintenance, and production) and how the site is eventually developed if oil or gas is found and transported. Nevertheless, all vessels over 65 feet in length will be subject to seasonal speed restrictions implemented by NOAA on December 9, 2008. Under 50 CFR Part 224, NMFS established regulations to implement speed restrictions of no more than 10 knots to reduce the likelihood of deaths and serious injuries to endangered North Atlantic right whales that result from collisions with ships.

Noise

Cetaceans live in an environment that at best has visibility of 200 ft, and in most ocean regions far less. They have therefore evolved into highly acoustic animals, using sound to find food, communicate, and in some cases to navigate. As human activities in the ocean have increased, noise from commercial and recreational vessels, sonars, seismic exploration, dredging, and construction have all increased dramatically. A large portion of this noise comes from vessel engines and propellers, and those sounds occupy the low frequencies used by most large whales. Acousticians have estimated that the chance of two whales hearing each other today has been

reduced to 10% of what it was 100 years ago (Parks and Clark, 2007) due to the masking of communication sounds by the ambient ocean noise created by multiple industrial activities (see Figure 15).

Oil and gas development within the lease site will involve seismic exploration (loud, broadband low frequency pulses), hazards surveys sonar (mid-to high frequency pulses), drilling (low frequency broadband noise), and vessel traffic (loud broad spectrum sounds, frequency dependent upon the ship size). While some military sonars have been shown to cause deaths in beaked whales (by mechanisms that are still being studied), within the activities related to oil and gas development, only seismic exploration has the sound source levels that are capable of inflicting serious damage to cetaceans if suddenly exposed.

Although there is no uncertainty that these noises are cumulatively affecting the ocean environment for cetaceans, there is some uncertainty about both the behavioral responses of cetaceans to many of these sounds and the population consequences of those sounds (National Research Council, 2005). Almost all animals within a broad region will be exposed to the sounds of seismic exploration. Human technology can detect seismic exploration across ocean basins, and there is ample reason to believe that many whale species can do as well or better. The subsequent activities are more likely to affect local groups of animals, although large shipping (if that proves to be the mode of transport) can create sounds audible from over 100 miles away. The cumulative impacts from all of these activities are adding to the ambient noise levels in the ocean and are steadily eroding marine mammal's abilities to communicate (See Figure 16). At some point this acoustic smog (Clark et al., 2007) will start to affect the abilities of whales to find food and mates. When that happens (and that point may be near), human noise pollution in the oceans will have significant, long-lasting, population level consequences on the survival of some marine mammals. Because the bulk of human industrial sounds in the oceans are low frequency, it is likely that the large baleen whales will be those that will be affected first.

Noise mitigation is possible, and there may be some seasonal restrictions that would minimize impacts on highly endangered species such as right whales. However, because of the potential for large-scale widespread impacts, underwater noise should be the primary consideration in environmental mitigation strategies around any leased sites in this region.

Knowledge Gaps for Endangered and Protected Species

Data gaps have been identified throughout the previous sections and are summarized in Table 4.

Care needs to be taken in synthesis of existing data as the quality and original sources of data need to be assessed. Thus caution is needed in using previous data synthesis efforts as there may be redundancy in the unpublished and gray data. Age of existing data could be an issue for mammals and turtles, as much of it is 20 to 30 years old.

A comprehensive data inventory and synthesis from original sources for marine mammals, sea turtles, coastal and marine birds (pelagic & onshore) is needed. Included in this would be published peer-reviewed literature and various gray literature sources such as MMS reports (Appendix D), NMFS turtle surveys and stock assessment reports, and Navy surveys. Unpublished data held by States, universities-theses and dissertations, and NGOs also needs to

be included, for example, the Nature Conservancy, Virginia DEQ, National Marine Sanctuary proposal for Norfolk Canyon, Right Whale Consortium, UNCW, and Virginia Aquarium humpback data, VIMS sea turtle data. Finally, on-going studies that are yielding data of interest and not yet published should be included. Metadata file associated with these studies needs to look at season, geographic extent, etc.

Seasonal and annual data are needed that include:

- Passive acoustics for broad sounds to get all animals. For lifetime of the project.
- Residents vs. migrants, sperm whales may be residents and fin whales migrants.
- Joint industry program on noise needs to be integrated into other programs.
- Controlled experiment with sonic tags. To see how animals behave when seismic work starts.

Pelagic and Demersal Fish and Fisheries

Facilitators: Ken Able and Rich Brill

There are several databases and many reports and publications that are relevant for assessing fish and fisheries in the proposed Virginia OCS lease sale area. These sources need to be reviewed and summarized. Efforts to summarize and synthesize these existing sources should be divided into two broad categories: short-term and long-term assessments. For example, fish migration patterns could be analyzed in the short-term with relevant existing National Marine Fisheries Service (NMFS) data. Information available in the NMFS database includes fish species and abundance, physical habitat mapping, seasonality, and vessel trip reports that include gear type, effort, etc. To meet future needs, should oil and gas development occur, longer-term studies of the fish situation at the shelf break, slope, and canyons would be needed as the data density declines further offshore at the shelf break and abyssal plain.

Summary of Discussion Points

Synthesis of existing data should be the primary task. A number of fish and fisheries databases include at least part of the Virginia lease sale area. New surveys for canyons and upper slope habitats may be needed as these areas have not received as much sampling effort. The long-term nature of several datasets needs to be explored for patterns in fish populations. This would include examining many of the peer reviewed articles on fish and fisheries of the region. Published syntheses that used these databases, or are currently being conducted, have looked at fish migration and population dynamics, oilrig attraction, acoustic ecology, larval abundance, fisheries timing, location, effort, and landings. For example, the shelf wide Northeast Fisheries Science Center Oceanography Branch (NEFSC) EcoMon plankton survey (http://www.nefsc.noaa.gov/epd/ocean/MainPage/shelfwide.html) conducts six, shelf-wide plankton surveys per year and the ichthyoplankton data from more recent surveys (1999-present) are currently being added to NEFSC databases. Other examples relevant to specific areas of the Virginia area would be NMFS zooplankton database and the Norfolk Canyon shark database of the National Shark Research Consortium and Shark Research Program at the Virginia Institute of Marine Science (http://www.flmnh.ufl.edu/fish/sharks/nsrc/vims.htm). Particular attention needs to be given to analysis of toxic effects and hydrocarbon databases. This will address risks from drilling and also from spills.

A portion of the existing information contained in these databases may be outdated and will need to be updated with new focused studies. For example, how will climate change species distributions? Care will need to be taken in comparing fisheries information to ensure that techniques are comparable. Assessment of how differences in gear affect broad regional summaries may need to be done. An assessment of how relevant data collected from the other MMS regions, particularly the Gulf of Mexico for fish and fisheries impacts from oil and gas development needs to be conducted.

Specific factors that need to be considered for fishes include population dynamics of various life stages. More data are needed on larval stages and spatial scales of egg distributions. Synthesis of existing data with some additional seasonal sampling linked with physical transport models will be required (cross linked with physical oceanography section). Temporal scales from short-term to long-term patterns in fish abundance need to be assessed relative to the spatial scales of oil and gas development sites (for example, platform or pipeline) to larger scale effects (for example, circulation patterns). Impacts of seismic surveys on fishes must be specifically assessed, as most of the data on sound effects relates to marine mammals (see Endangered and Protected Species section). For fishes, what are the physiological effects from air guns, for example and are there other impacts that might affect fisheries?

Particular attention needs to be given to species that may be most affected by oil and gas development, such as demersal fishes (excludes highly migratory pelagics), shellfish populations (crab, shrimp, scallops, etc.), highly localized species, and sharks. All of these groups include both commercially or recreationally important species.

Knowledge Gaps for Fish and Fisheries

Currently there is little to no data on existing body burdens for oil and gas development related pollutants. This information is needed for key indicator species and should be monitored for both population and individual loads. Indicator species would include localized noncommercial species and commercial species (such as, tilefishes, mussels, lobsters, and red crabs).

Some habitats within the Virginia lease sale area with limited information will require baseline studies, such as Norfolk and Washington Canyons. The ecosystems of canyons tends to be spatially diverse and complex and difficult to study, thus there is little know about the Middle Atlantic canyons. Similar focused studies would be needed for upper-slope (depth > 200 m) habitats.

When and where fisheries occur will be a key factor to determine relative to the timing of seismic surveys and considerations for fishery windows similar to those used to minimize environmental disruption from other activities. Little is known about the acoustic ecology of fishes and what the impacts of sound production from seismic surveys are. Dock surveys for various aspects of recreational and commercial fisheries would be needed to establish baseline data on total value of the Virginia region and as a point for assessing change in fisheries shifts (cross linked with Socioeconomics section).

Larval stages will have the most sensitivity to drilling muds and fluids. An assessment of data from the Gulf of Mexico region is needed to determine transferability of knowledge. Is Gulf of

Mexico, Pacific, and Alaska Regions information on fish attraction to oil and gas structures applicable in Mid-Atlantic Area? Do oil and gas structures result in more fishes or simply attract existing fishes and do these structures act as vectors for invasive species?

Larval stages are also subject to oceanographic processes and interactions with major topographic features. How all these processes and factors influence larval transport needs to be determined. In particular, how the Gulf Steam interacts with other coastal circulations to affect larval transport of both regionally spawning fishes and invertebrates, as well as extra-regional larvae transported into the Virginia area.

Benthic and Biological Issues

Facilitator: Linda Schaffner

Little nonfisheries benthic and biological data are available for the Virginia OCS lease sale area. This area likely represents a "Transition Zone" between the influences of a colder temperature regime to the north (cold pool) and warmer Gulf Stream dominated North Carolina and Cape Hatteras shelf region to the south. It is well known that bathymetric and latitudinal gradients are important sources of variation over the OCS. The position of the Virginia OCS lease sale area within the broader region means it is subject to significant temperature variations at the shelf break and slope. Canyons intruding into the shelf area and other topographic features along the shelf-edge further increase the variation among shelf habitats. The deep-sea regions in the east of the Virginia OCS lease sale area are likely more constant and typical of other deep-sea regions.

Summary of Discussion Points

The proposed lease area is small with the width of the western edge about 50-75 miles and tapers to a point to the east at a depth of 3000 m. The area also contains two canyons beyond the shelf break. The canyons represent unique habitat within the region and should be carefully evaluated and monitored for impacts from oil and gas activities. As with the other disciplines, the further offshore one goes the less information there is. In general, there have been a limited number of benthic and biological studies in the Virginia OCS lease sale area. Benthic information from the area is limited. There are a number of studies that have been conducted near or in part of the Virginia OCS lease sale area such as the BLM-OCS mid-Atlantic studies from the 1970-80s with data on the shallower shelf (Boesch et al., 1977 and Appendix D), MMS Manteo-Cape Hatteras study to the south (Blake and Diaz, 1994), general faunal surveys on the shelf and slope (Wigley and Theroux, 1981, Maciolek et al., 1987), and various NOAA reports.

Fauna changes occur at Cape Hatteras and further south for the continental shelf. Changes in the fauna at slope depths also occur between Virginia and Hatteras. There is a large change in topography of the shelf and slope between Virginia and North Carolina. The Virginia OCS is not comparable with shelf fauna further to the north either. The Virginia OCS is more influenced by the warm Gulf Stream water and northern OCS by cold water pools. The outer shelf and shelf break are not well studied and poorly characterized. The Nature Conservancy has attempted to identify benthic habitat by developing a GIS mapping database, which includes USGS grab samples from the 1960s used to classify bottom habitats.

Key habitat or bottom types that need to be identified and inventoried include dispersed hard bottom such as clay, rocky shale or shelly outcrops; low and high topographic areas on the outer shelf and slope; and hard bottoms overlain with soft sediments. Habitat types with particularly low or high productivity need to be identified including what is below soft sediment veneers. An important component of locating and determining the aerial extent of various habitat types is detailed bathymetry. Currently NOAA's National Geophysical Data Center (NGDC) has much of shelf area mapped at very coarse scales (see Figure 6 and http://ngdc.noaa.gov/mgg/coastal/grddas02/grdden02.htm for examples). The data that supports the NGDC maps needs to be assessed to determine the actual resolution and accuracy of the published maps.

Any effort directed to new studies needs to be focused in areas of expected oil and gas activity and concentrate on the most important habitats. Inshore of the proposed sale area is a broader region that will need to be assessed for benthic resources. This broader region can be divided into five segments for the purposes of benthic biology:

- Outer continental shelf from 3 to 50 miles offshore is about 40% of the total region.
- Shelf break about 20%.
- Slope about 10%.
- Canyon area is <2%.
- Deep-sea at eastern tip is about 30%

Synthesis of existing data from other deep-sea areas should show the deep-sea is broadly homogeneous along the Atlantic coast and that the deep-sea portion of the proposed sale area should be given low priority for new sampling. Canyons will require special attention as they tend to support high diversity of large epifaunal species related to the spatial and vertical extent of hard bottom. Sampling design would need to consider the limited area that canyons occupy and adjust effort to insure the canyons are adequately sampled. There is a need to describe canyon ecosystems in order to determine their uniqueness and sensitivity to oil and gas activities, as they may be high priority areas for protection.

Synthesis of existing data in the peer-reviewed and gray literature should be a primary task undertaken. This needs to include the large number of environmental studies and report supported by MMS (Appendix D). Before any synthesis takes place, MMS should develop scenarios as to how the existing data synthesis will be used. This will help to focus the effort on identification of data needs for future assessments. A workshop format with ecologists to discuss what is known, and how to prioritize and synthesize data is recommended. The flow of tasks would be for MMS to first develop scenarios for data needs and to identify who needs to be part of a synthesis team to attend a workshop. At a minimum, at least one experienced benthic ecologist for each major area segment would be needed (OCS, slope, and deep-sea). In addition, ecologists for benthic-pelagic coupling and physical oceanographers for physical-biological coupling would be needed. Second, the references and data should be compiled and synthesized by scientists who would present the findings at the workshop. The product from this workshop would be written as a peer-reviewed manuscript(s), which would be used to develop management tools for the area relative to oil and gas development.

There is a possibility that at the shelf break, rock outcrops and scarps may be present with unique community types. For example from New Jersey to North Carolina there are some deep reef-building organisms, and *Lophelia* spp. (deep water coral) may be present. Tile fish are present on hard substrate and clay bottoms. Geologically, ridge and swale topography is a prominent feature of the shelf in this area with sand waves as high as 10 m and wavelength of 10's of meters. These features are known to shape benthic community structure and can be seen at 50 m resolution.

Knowledge Gaps for Benthos and Biology

One of the larger unknown questions is what are the latitudinal gradients along bathymetric contours and how does the Virginia OCS lease sale area compare to the rest of the OCS along the Atlantic coast? A first step to address this question would be mapping of benthic habitats to identify the extent and diversity of habitats that are present. This would include the use of broad scale multibeam and swath mapping for classifying sediment type and determining general patterns and distributions of habitat types. This effort would be combined with intermediate scale side scan sonar and Autonomous Underwater Vehicle (AUV) mapping to provide higher resolution of selected areas. Remote ground-truthing would be needed to identify high-priority areas and sentinel sites, e.g. for hard-bottom, high productivity swales. The focus of the ground-truthing effort would be on the outer shelf/shelf break area and use a diversity of approaches. Included would be AUV and sled video (long distances; collect data at regular intervals) methods. Point sampling with cameras and box-cores would be required for collection of sediments and fauna. At a minimum, the baseline sampling would be used to determine details of biotic communities including diversity, abundance and biomass. The sampling would also need to determine if the Virginia OCS is similar to the OCS to the north and south. Interpretation of benthic data would also rely on physical factors that regulate communities and species distributions such as differences in temperature or sediment supply (cross-linked with Physical and Geological section).

Physical and Geological Oceanography

Facilitator: Larry Atkinson

Summary of Discussion Points

There is a need to balance long- and short-term studies to accommodate the data required prior to the lease sale date. Prior to any lease sale, there needs to be an evaluation of data gaps. For geological issues, factors that need to be assessed included the extent of methane hydrates and bottom resuspension within the Virginia OCS region. Of particular relevance to the shelf topography are the extensive ridge and swale sand wave features. From a physical oceanographic perspective, how physical parameters associated with the Gulf Stream, and other broad regional circulation patterns, will influence and effect exploration needs to be understood. Other factors to assess would be the extent of offshore disposal of military waste (since World War I) as these sites would have to be located and identified as hazardous. Of particular importance would be to understand how the two canyons (Washington and Norfolk Canyons) and deep currents interact with other shelf processes. In addition, proposals for any pipeline route running from offshore to onshore need to be considered in light of the above physical and geological factors. Research and databases developed for alternative energy studies may be of benefit to oil and gas development and vice-versa.

Existing Mid-Atlantic MMS studies and data, plus those other agencies and peer-reviewed literature, should be synthesized in such a way that they inform and facilitate the design of additional studies. We recommend the literature review and analyses of existing data be organized around priority topics (for example, deep water boundary currents, permanent moorings; Rossby waves associated with Gulf Stream meanders and eddies). Consideration needs to be given for interests of other agencies who may wish to partner with MMS. For example, would the Commonwealth of Virginia or the Navy have any interest or resources? Also, are there deep current studies of the Gulf Stream or other Navy data that can be "unclassified?"

For oil spill risk analysis, current and wind information are needed, is there sufficient data now or do we need more to properly map spills? Modeling is underway, and sea surface height anomaly, drifters, and circulation information are needed. This could be a high priority data gap.

Synopsis of physical oceanography projects supported by other agencies and MMS (ESPIS website: https://www.gomr.mms.gov/homepg/espis/espismaster.asp?appid=1 and example peer-reviewed citations):

- SYNOP project off Cape Hatteras, Office of Naval Research (ONR) program - echo sounder study, look at variability of Gulf Stream and modeling, deeper water (Savidge and Bane, 1999).
- High Energy Benthic Boundary Layer Experiment (HEBBLE) – BBL study under Gulf Stream. (Nowell and Hollister, 1985).
- Physical Oceanography Program - Manteo Project of North Carolina in 1992, drifters, current, wind, water level data collection (Appendix D).
- Study of physical processes in Mid-Atlantic Slope and Rise (MASAR) (Appendix D).
- Frontal eddy dynamics (FREDY) study off NC, current meters, drifters, cross-shelf transport. Was prior to Manteo project (Glenn and Ebbesmeyer, 1994; Appendix D).
- Data Assimilation and Model Evaluation Experiment (DAME´E), ONR program for ocean modeling Gulf Stream and then entire North Atlantic (Chassignet et al., 2000).
- Shelf Edge Exchange Processes (SEEP), DOE program (Biscaye, 1994).
- Dumpsite 106 studies for entire Atlantic Margin (Fry and Butman, 1991).
- Ship "Oleander" – profiles from New York to Bermuda weekly time series (Rossby et al., 2005).
- NOAA Coast Watch – Satellite remote sensing data source (http://coastwatch.noaa.gov/).
- MARCOOS (NOAA), coastal ocean, data sets and time series, gliders and codar data (http://www.marcoos.us/).

From the 1970s to today the questions addressed by these studies haven't changed but the technology has. Satellite data is clearly an advancement and should be key to understanding physical and biological processes on the OCS.

Knowledge Gaps for Physical and Geological Oceanography

The presence of Norfolk and Washington Canyons within the Virginia OCS complicate the physical and geological setting. How these canyons interact with local currents, general regional flows, and storms will be key to understanding sediment transport dynamics and resuspension. For example there is limited understanding of the effect of internal tides/waves and their

propagation/evolution on mixing and currents at the shelf break and canyon heads. Issues that need to be resolved with regard to deep near-bottom currents included their strength and variability and how turbidity is affected (background levels vs. what operations create). Seasonal variability in cross-shelf transport processes is also an important issue. In particular, how is the Benthic Boundary Layer (BBL) affected by hurricanes vs. Nor'easters, and "normal" events vs. larger-scale anomalies? The magnitude and frequency of events within the four defined environments (outer continental shelf, shelf break/slope, abyssal plain, and canyons) relative to bottom considerations, geological characterizations, and geohazards need to be viewed in a holistic way. This includes long-term cycles such as North Atlantic Oscillation (NAO) and other inter-annual variability effects. For many of these issues, satellite data will be a key asset. Nearshore processes, such as coastal currents, fronts and freshwater plums from Chesapeake and Delaware Bays, will also need to be assessed as they will play a large role in spill trajectories and movement of surface water layers.

Models and studies relevant to transport of potential spills and what they might encounter and disturb, both environmental (microbes, blue crab larvae, fish spawning, etc.) and human impacts, needs to be cross-referenced to biological and fisheries concerns. Key areas for acquiring data for these models would include wind and other meteorological data in high resolution in time and space, and surface currents. All models need to be validated with recent observations.

Ridge and swale topography is a prominent feature of Virginia OCS and how these topographic features interact with and influence transport and biological processes needs to be considered. For example, can ridge and swale topography change pollution transport, and what are the seasonal and storm induced movement implications and concerns for burying pipelines? This will be key to determining the appropriate depth of burial for pipelines to keep them below what could be exposed by movement of these features. Factors relative to the infringement of pipelines on the coastal environment and upland also need to be considered.

Geographic Information System (GIS) linked databases need to be developed to improve visualization and data dissemination. GIS could also be the primary means of interfacing the science with management decisions. Geological and geophysical data models are needed for a few locations (2-6 sites/scenarios informed by observations – at least one model for the shelf, slope and abyssal plain) to cover the variability of the shelf/slope environments. These models would inform drilling locations and establish a range of possible scenarios. Datasets needed to combine into the GIS based models would include:

- Bathymetry – A good example would be CARUMBA (**C**entral **A**tlantic **R**egion **U**S **M**argin **B**asin **A**nalysis: Central & North Atlantic; USA and Canadian Margin basins) a project to collect existing bathymetry data and put them into GIS format.
- Grain size – spatial variability of sand vs. mud – scale of observations cross-shelf distribution.
- Chemical/toxins – sediments and pore water.
- Sediment/fauna interactions.
- Drilling technology.
- Thermal distribution related to above

Ideas were prioritized for three issues (oil spills, geohazards, and site specific impacts) and four environments of interest (shelf, slope, abyssal plain, and canyons), as summarized in Table 3. One study recommendation would be to set up a range of stations that exemplify two to six site types (including at least one per environment of interest) expected to occur within the lease area that explain the spectrum of sediment transport and bottom characterization. From these stations a range of scenarios can be tested. The variables to measure include, but not limited to, are: currents, sediment transport, and various other geological and physical oceanographic considerations relevant to drilling locations.

Social and Economic Issues

Facilitators: Diane Austin and Doug Lipton

There are a few socioeconomic studies along the Atlantic coast that pertain to oil and gas activities (Appendix D). Most socioeconomic studies that have been conducted are concentrated in the Gulf of Mexico and Alaska OCS regions.

Summary of Discussion Points

The lack of information on the socioeconomic issues resulted in the breakout session focusing on key questions that would need to be addressed. The format of the discussion was therefore based on these questions rather than identification of existing information and future information needs.

Will data gaps in social and economic issues have a bearing on permit process?
Three-year permit process will provide opportunity to fill data gaps of concern to MMS.

Without a pipeline terminating in Virginia, what is the potential economic positive for Virginia? Currently there is no lease-sharing revenue agreement with Virginia. What are the implications for not having a lease-sharing agreement to oil and gas development in the region? Leasing has almost always been an issue in Virginia from the first lease sales in the 1970s (Table 1). Virginia Beach wanted to restrict development to natural gas (not oil) due to tourist industry issues. What will be the regional impacts on Virginia employment and the net effect on Virginia due to oil and gas related infrastructure?

Experience from the Gulf of Mexico region with increased traffic to bring in supplies to support oil and gas industries may be useful for decision-making in Virginia.

What are the interactions of oil and gas, alternative energy development, and other activities? For example, would it be possible to develope a multiuse framework with other industries, such as offshore aquaculture. What are reasonable development scenarios comparing and contrasting the different energy sources? Incorporation of offshore wind studies and other energy development project might be a way of accommodating multiple users. There is a need to consider the cumulative impacts of all offshore activities.

What are the economies of scope and most efficient use of resources on the OCS? There is a need to examine various options from no development to combinations of technologies. Possible interactions with military activity in the Virginia Capes area must be considered. Past and

current research on this needs to be summarized for possible hazards from military use, both environmental and economic impacts.

What are the impacts of potential energy development on education, academic research, training, and development? Is there potential for new growth and centers of excellence? What are the effects of creating such centers that might draw people from beyond Virginia?

How will potential offshore energy development affect existing relationships among local jurisdictions (Dillon's Rule, Payne 2003)? How would tourism be affected by a new energy industry? Are there revenue-sharing models for localities and multi-state levels? Case studies should be developed for key areas. Decision support models that would aid local/state planners need to be identified. Consideration to impacts of growth and development from oil and gas activities on the land use and value need to be assessed along with watershed issues, and indirect effects on Chesapeake Bay and coastal waters.

The potential impacts on port traffic and expansion of the Hampton Roads facilities needs to be accessed. How much port capacity do we have in local ports and can the additional vessel tie-ups be accommodated? What is the existing relevant labor force and what demographic implications will immigration of new workers bring? What is the existing transportation infrastructure and what are the potential impacts on that infrastructure of offshore development at each phase of that development? What are the environmental consequences of transportation expansion?

Consequences to individuals and communities need to be considered. For example, what is the existing housing infrastructure and what are the potential impacts on that infrastructure of offshore development at each phase of that development? What are the potential impacts of decommissioning on the communities, workers, institutions, etc? What does the public think? Need independent surveys, risk perception study of coastal residents. A risk perception study prior to and following a revenue sharing model is needed. Need to define what questions are important for such surveys. What will be the impacts of offshore development on the price of natural gas regionally and nationally? What are the consumer benefits?

Environmental concerns that have economic impacts (cross linked with Biology and Fisheries sections) would include the monetary value of potential ecosystem services impacts. What is the potential for spatial interactions and conflict with commercial and recreational fishing? What are the potential impacts of the possible importation of invasive species?

Linking models of regional economy to appropriate environmental questions and watershed models is needed and would include spatial dimensions, coupled with land use. Hampton Roads Planning District has models that could be utilized in a case study. Fiscal effects should be addressed through a regional model. What are the state level fiscal benefits of the program? What are the benefits other than revenue? Differences in the spatial distribution of the program may affect State level fiscal benefits, the net impact on the State depends on where growth occurs. State level effects should be addressed first, then regional effects. What will the employment benefits be? Need for a baseline economic analysis with sufficient spatial granularity.

Knowledge Gaps for Social and Economic Issues

What are the onshore socio-economic effects of reasonable estimates of offshore energy development for scenarios of no development, offshore oil and gas, offshore wind or other alternative energy sources, and both offshore oil and gas and wind? Issues of highest priority include potential impacts on transportation infrastructure, ports, housing, and commercial and recreational fishing.

A risk perception study at two scales is needed with a case study of Hampton Roads and a broader regional study that would include residents from Cape May to Cape Hatters. Where oil and gas development will be based will be key to planning these studies. Will it be Hampton Roads, or will constraints and costs move it to other areas? Where onshore development is likely to occur in response to offshore development will need to be determined ahead of time to avoid expending effort in the wrong areas. The regional economic model should dovetail with what local planning districts are doing as much as possible. Costs and constraints of infrastructure development should be incorporated into the model. Information on land use changes is also a high priority.

What are the threats/benefits to local economies (tourism, recreation, way of life, and fisheries) from onshore development, oil spills, increased ship traffic, and social structure and occupational shifts? Regional models should assess threats/benefits to local economies as well as consideration of existing state policies and interstate relationships. We identified three overarching themes that should apply to any socio-economic study:

- Consider oil and gas in context of other offshore energy development.
- Consider onshore infrastructure impacts.
- Consider cumulative, long-term impacts.

We identified four study topics that included:

Fiscal effects of offshore development - Regional economic models should dovetail with what local planning districts are doing. Costs and constraints of infrastructure development should be incorporated into the models. Link models of regional economy to appropriate environmental questions and watershed models, couple with land use. Hampton Roads Planning District has models that could be utilized in a case study. Experience from development in Gulf of Mexico may provide data and examples that apply to Virginia decision-making.

Spatial distribution of onshore development in response to offshore activities - Where is onshore development likely to occur in response to offshore development? What are the impacts of growth and development on the land itself relative to watershed issues, and what are the indirect effects on Chesapeake Bay and coastal waters? How would the industry impact port traffic and expansion of the Hampton Roads port? What is the existing transportation infrastructure and what are the potential impacts on that infrastructure of offshore development at each phase of that development? What are the environmental consequences of transportation expansion? What is the existing housing infrastructure and what are the potential impacts on that infrastructure of offshore development at each phase of that development?

Public perceptions of risks and benefits of offshore development - Include residents from Cape May to Cape Hatters. There is a need for risk perception study prior to and following a revenue sharing model. Need to define what questions are important for such surveys.

Threats/Benefits to local communities - What are the impacts of potential energy development on education, academic research, training, and development? What is the existing relevant labor force and what demographic implications will immigration of new workers bring? What is the potential for spatial interactions with commercial and recreational fishing?

Other issues to consider would include the possible interactions with military activity in the Virginia Capes area, potential impacts of decommissioning on the communities, workers, and institutions. What will be the impacts of offshore development on the price of natural gas?

Workshop Recommendations

Physical and Geological Oceanography

Synthesis, mining, and reanalysis of existing data and databases are needed in order to understand the current state of knowledge regarding physical and geological processes within the Virginia OCS lease sale area. The synthesis and interpretation would be central to planning new environmental studies.

For the entire water column, transport processes, temperature, salinity, and density (with seasonal considerations) need to be characterized with specific consideration for:

- Coastal fronts and estuarine interactions.
- Cross and along shelf processes (cold pools, upwelling/downwelling, storm events, tides).
- Shelf break processes, including seasonal stratification issues, Ekman transport, eddies and Gulf Stream, internal tides, and wind waves.
- Up and down canyon flows and forcing factors.
- Upper and lower layer interactions over the slope for the Deep Western Boundary Current (DWBC), topographic Rossby Waves (TRW), and Gulf Stream meanders and eddies.
- Climate trends including North Atlantic Oscillations (NAO).

For geologic and bottom processes, physical properties and distributions of sediment types on the shelf, slope, rise, and canyon need to be characterized with specific consideration for:

- Cross and along shelf transport.
- Sediment resuspension and dynamics.
- Bottom Boundary Layer (BBL), effects of stratification and instability.
- Slope and canyon wall stability and failure history.
- Acoustic bottom mapping with multibeam and sidescan.
- Methane seeps, gas hydrates, shallow gas deposits, and other geohazards.
- Paleochannels, shallow flow zones, past transport pathways (high resolution shallow seismic).
- Basin floor fan evolution.

Multi-disciplinary synthesis of physical oceanography and biological data to identify areas of high productivity or essential habitat. Integration of data and concerns from other disciplines is necessary with specific consideration for:

- Coastal fronts and channels relative to marine mammal feeding, migration, and gathering areas.
- Ridge and swale topography influence on physical and biological processes.
- Shelf break winter and summer processes.
- Canyon head.
- Slope sea and eddy

Studies that will require new observations and modeling:

- Deep current energy – trapped waves and possible sites of energy intensification, current-Rossby/topographic wave interactions.
- Canyons – unusual currents, upslope/downslope flow, warm ring interaction affecting cross isobath transport.
- Sediment dynamics studies – specifically on the slope and fan.
- Detailed survey of geohazards - methane venting, shallow gas.
- Mapping of seeps with interdisciplinary considerations (chemo-synthetic organisms, etc).

Fish and Fisheries

Synthesis, mining, and reanalysis of existing data and databases are needed in order to understand the current state of knowledge regarding fish and fisheries within the Virginia OCS lease sale area. The synthesis and interpretation would be central to planning new environmental studies. For fish and fisheries, the key elements of this synthesis need to specifically consider seasonal distributions of historical and extant finfish and shellfish fisheries. Distributions and reproduction of fishes and shellfishes in the Mid-Atlantic Bight from Cape Lookout to Cape Cod and from the shoreline to abyssal plain needs to be considered. Extant databases include those managed by NMFS, Mid-Atlantic Fishery Management Council, state agencies, and The Nature Conservancy. In particular, Essential Fish Habitat (EFH) characterization including managed species, prey species, and their habitat need to be included.

Environmental studies and knowledge from the Gulf of Mexico, Pacific, Alaska, and other oil and gas producing areas, for example Nova Scotia or North Sea, needs to be evaluated for possible application to impacts of oil and gas exploration and drilling and transport of and on the Virginia coast.

There are broad areas of overlap between fish and fisheries and other disciplines data needs:

- Passive acoustics as sampling methods and cumulative impact of sound pollution on fishes (Endangered and Protected Species).
- Linking oceanography and biology with bottom and water column currents, and temperature (physical and geological).
- Habitat mapping (Benthic and Biological).
- Trophic interactions with birds, marine mammals, benthic and pelagic fishes, and invertebrates (Biological, Endangered Species).
- Space-use conflicts with port-space and fishing areas (Socioeconomic).
- Techniques for visualizing and managing information (all disciplines).

Studies are needed to address knowledge gaps in the finfish and shellfish fauna and fisheries especially for the upper slope and canyon habitats. In particular there is a need to characterization EFH within the Virginia OCS lease sale area for managed species and their prey species, and to determine baseline contaminant loading in key commercial species, such as scallops, tilefish, red crabs, and goosefish. The potential for drilling infrastructure (e.g., pipeline, platform) to facilitate invasive species and adjacent fauna to establish residency also needs to be evaluated.

Rationale for and focus of these studies would be to assess changing environmental conditions and management strategies, and their effects on fishing techniques and target populations. Fish and fisheries need to be viewed in an ecological framework that includes both ecological processes and climate change factors. This approach would best inform MMS for EFH and other consultations. Baseline data to evaluate potential impacts over time must be collected prior to any oil and gas activities.

Benthos and Biology

Synthesis, mining, and reanalysis of existing data and databases are needed in order to understand the current state of knowledge regarding biological conditions within the Virginia OCS lease sale area. The synthesis and interpretation would be central to planning new environmental studies. Before any synthesis takes place, MMS should develop scenarios as to how the synthesis will be used. Formation of a synthesis team of interdisciplinary scientists with information exchanged in a workshop format is recommended.

The synthesis team would review and synthesize existing reports and data. MMS would first provide scenarios to the team as guidance with team members working with existing data in advance of meeting. Areas of focus would include:

- Spatial and temporal distributions - effects of bottom type, temperature regimes (latitudinally, bathymetric regimes).
- Potential impacts and effects - lessons learned from other regions and stressors.
- Information could be used to develop management tools.
- Products would be directed to peer-reviewed literature

Rationale for this approach is to examine the diverse sources of information as early as possible to provide focus for future investigations and better understanding of environmental risks. This effort could lead to the development of a database management approach that is based on GIS tools which will be essential for visualizing and conveying information to agencies and the public.

Studies are needed to address knowledge gaps in the biological and benthic processes especially to identify the location and extent of key high priority or unique habitats, such as those associated with high productivity (swales) or high biodiversity (hard bottom). Sampling effort would be stratified based on biotic zonation and areas of likely exploration impacts and with consideration of any pipeline pathway. Broad scale bathymetric mapping would be necessary for stratifying the area (coarse maps may already be available). Detailed mapping of select high priority habitats using acoustic, video, and photographic techniques will be needed. Ground-truthing and baseline data for megafauna, macrofauna, and other biogenic features need to be

collected prior to the start of oil and gas activities. The products should be primarily directed at the peer-reviewed literature and development of management tools such as GIS databases.

Following guidelines used in the Gulf of Mexico Region, unique biological communities should be protected areas for drilling. Consideration of buffer zones is needed to lessen the influence of development activities. In addition, improvements in oil development technology have reduced the footprint of impacts, therefore data synthesis efforts as well as new studies need to be informed by more recent environmental studies and technologies.

There is little data available for the Virginia OCS lease sale area for benthic resources. This area likely represents a "transition zone" between major biogeographic provinces and thus may contain unique faunal associations. It is situated in an area of significant topographic complexity in the transition from shelf to deep slope, which likely influences the area's biology.

Outline for a Benthic Study

A benthic mapping effort would be key to planning any new environmental studies of the bottom. Approximate distribution of effort in each of three major habitat areas would be:

- Shelf break (~50%)
- Outer shelf (~25%)
- Slope (~25%)

Canyons would be included in the sampling for the shelf break as this is where canyon heads are located.

Study metrics would include indicator species such as sea scallops, which can be surveyed photographically, amphipods, and echinoderms. A metric would need to be developed for offshore and deep-sea habitats specific to oil and gas activities similar to other coastal indices used in assessing benthic habitat conditions (for example see Weisburg et al., 1997 or Diaz et al., 2004). Metrics reflect critical importance of macrobenthos in assessing conditions of biodiversity, structure and sensitivity at the community level, and would function as indicators of sensitivity to environmental change at individual species and major taxa group levels. Abundance and biomass reflect the productivity regime and level of disturbance and would be measured as biomass per individual and depth distribution of biomass.

An assessment would need to be made to determine if full community studies versus selected components would be required. As species diversity is high in deep water and slope areas, diversity metrics will be important in assessing benthic conditions including habitat stability and degree of disturbance. Various methods for measuring deep-sea diversity should be explored.

Meiofauna and microbes would have a lower priority as they are small and more difficult to work with. But genomics may provide methods to make studies practical as baseline measurements. These groups could provide evidence of significant disturbance.

Details of the study plan would include a stratified/random approach with directed sampling of key habitats. Acoustic mapping/backscatter analysis would be needed to identify hard bottom and other OCS features such as sand ridges. For specific habitats (topographic lows, canyons,

hard bottom) rapid assessment technique (sled, video) would be used to characterize, but sediment samples would still be needed to adequately characterize habitats.

The deep-sea region is a small fraction of the Virginia OCS lease sale area and would require only a few samples. Data from surrounding deep areas will likely be able to characterize the Virginia OCS lease sale area as the deep-sea has the least likelihood of spatial variability and is relatively a small area. Visual surveys (video/photographic) would be used to quantify megafauna (echinoderms, anemone, crustacean, fish), biogenic structures to characterize function of community, and physical characteristics of the bottom would provide crude estimates of fluxes (turbidity, suspended particles). Visual surveys would also be used as ground truthing for multibeam and would require good geo-position data.

Endangered and Protected Species

There may be a significant amount of un-synthesized extant and developing data that could provide a foundation from which to develop preliminary assessments and research work plans for the region. It is important that these data sources be synthesized, mined, and reanalyzed in order to understand the current state of knowledge regarding endangered and protected species within the Virginia OCS lease sale area. A data inventory and synthesis would be developed for marine mammals, sea turtles, and coastal and marine birds (pelagic and onshore). Included would be on-going studies that are yielding data of interest (not yet published). Metadata files associated with studies need to be analyzed to look at season, geographic extent, etc. All products should be in a GIS database management system for data visualization and integration of all data streams.

New scientific surveys would be needed that are a combination of methods including:

- Shipboard - separate protocols for marine mammals, seabirds, and sea turtles, adaptive sampling with line transect approach.
- Aerial - restricted to sea turtles and marine mammals, high definition photography as a possibility for birds.
- Passive acoustics - broad spectrum (in terms of frequency sensitivity) pop-ups or equivalent, capable of detecting whales, dolphins and specifically beaked whales.
- Platforms of opportunity - train and place professional observers on whale watches, shelf-edge fishing charters, seismic vessels, rig service vessels, and other opportunities.

Studies would have to be multi-year to examine temporal trends and seasonal differences. All seasons and at least three years within the lease triangle plus a buffer area that would extend to shore would be required. Data would need to be collected pre-, during-, and post-seismic and -drilling activity. Methods to assess residency in sperm whales, humpbacks, beaked whales, right whales, selected dolphin species, and sea turtles using photoidentification, tagging specifically for turtles, and genetics need to be implemented.

Rationale for initiation of new surveys is that most sightings and distribution data is 20-30 years old, and may not be relevant to contemporary patterns. In addition, there is little or no survey effort beyond 50 miles, i.e., most of the lease site. There is an urgent need to identify the seasonal distribution and abundance patterns of most endangered and protected species in the lease region before activities are started.

A passive acoustic buoy array should be setup and maintained for the life of the project. In the first year, a baseline would be established with continued monitoring after seismic begins for at least two years. Baseline data on frequency of occurrence of different species and communication signals would also be collected. Species-specific hearing ranges and seasonality of species of concern would be documented to evaluate mitigation options with regard to seasonality of presence and activities for right, humpback, sperm and beaked whales, and sea turtles. Part of the data synthesis would integrate results from the Joint Industry Program (JIP) and determine what activity produces 180-200Db noise. Behavioral responses to seismic noise needs to be documented for the species of interest mentioned above. For the entire Mid-Atlantic Planning Area, there is an opportunity to conduct a study comparing responses of naïve animals in this area with data from Gulf of Mexico Region mammal studies.

Rationale for these studies is that effects of noise from seismic and operational activities on marine mammals and seas turtle have only been studied in a few species. Because of the multi-species assemblage that occupies the lease sale area, careful monitoring and planning will be required to mitigate negative impacts on a broad array of endangered species. Species of particular concern include right whales, humpbacks, beaked whales, finback whales, and sperm whales. Data on sea turtle responses to these sounds is sparse as well. A multi-pronged approach is recommended as described above.

There is significant overlap between endangered species and physical oceanographic data needs. A study that integrates the oceanography of the region with the presence of endangered species and other key resource species should be considered. In other areas, researchers have been developing such methods to predict the likelihood of a particular species present based upon seasonal oceanographic conditions.

Finally, we wanted to acknowledge that in spite of our focus on the lease sale area and the waters between the area and the Virginia coast, there is the potential for larger scale impacts. Those broader impacts are certain to involve noise production related to seismic activity, and however small the potential for oil spills may be, should one occur, it's effects will probably extend outside of the Virginia region.

Socioeconomics

In regard to socioeconomics, it is important that realistic scenarios for what will happen within the Virginia OCS lease sale area be developed. Overall, there is little data to assess specific or broader impacts on the economy and communities of the region. States and local planners need to know what will happen to their communities relative to oil and gas activities. What is the distribution of impacts within region expected to be? Is there a need to consider a synergistic view with other activities like wind power, navy actives?

Studies are needed to develop socioeconomic models to assess public perceptions of risk and benefits, developing a baseline of opinions now which tracks into the future. Three overarching themes that should apply to any socioeconomic study include:

- Consider oil and gas in context of other offshore energy development.
- Consider onshore infrastructure impacts.

- Consider cumulative, long-term impacts.

Recommended socioeconomic studies include:

- Fiscal effects of offshore development.
- Spatial distribution of onshore development in response to offshore activities.
- Public perceptions of risks and benefits of offshore development.
- Threats and benefits to local communities.

General Recommendations:

The principle recommendation from all breakout groups was to assess existing data in a thorough and systematic manner. The exception was socioeconomic, where there is little in the way of existing data to synthesis. This data assessment needs to incorporate all disciplines. New studies that focus on monitoring could be started immediately, but directed studies need to be informed by the results of the existing data synthesis.

A cross-disciplinary effort between biology, fisheries, and physical studies is needed. It will be essential that synthesis efforts incorporate water column and bottom processes data. Evidence for slope failure, methane seeps and other geohazards also needs to be integrated with the living resources data. Special attention needs to be given to the possibility of chemosynthetic organisms within the Virginia OCS lease sale area.

Given the complexities of OCS ecosystem, MMS should develop a comprehensive and integrative plan to assess the cumulative impacts of multiple energy uses on the OCS and adjacent ocean areas. MMS should work with other relevant agencies, states and stakeholders to develop consistent standards to assess the geographic extent of potential impacts and the consequent range of requisite studies. In particular, MMS should work with NMFS to identify issues with non-energy uses of the OCS such as offshore aquaculture.

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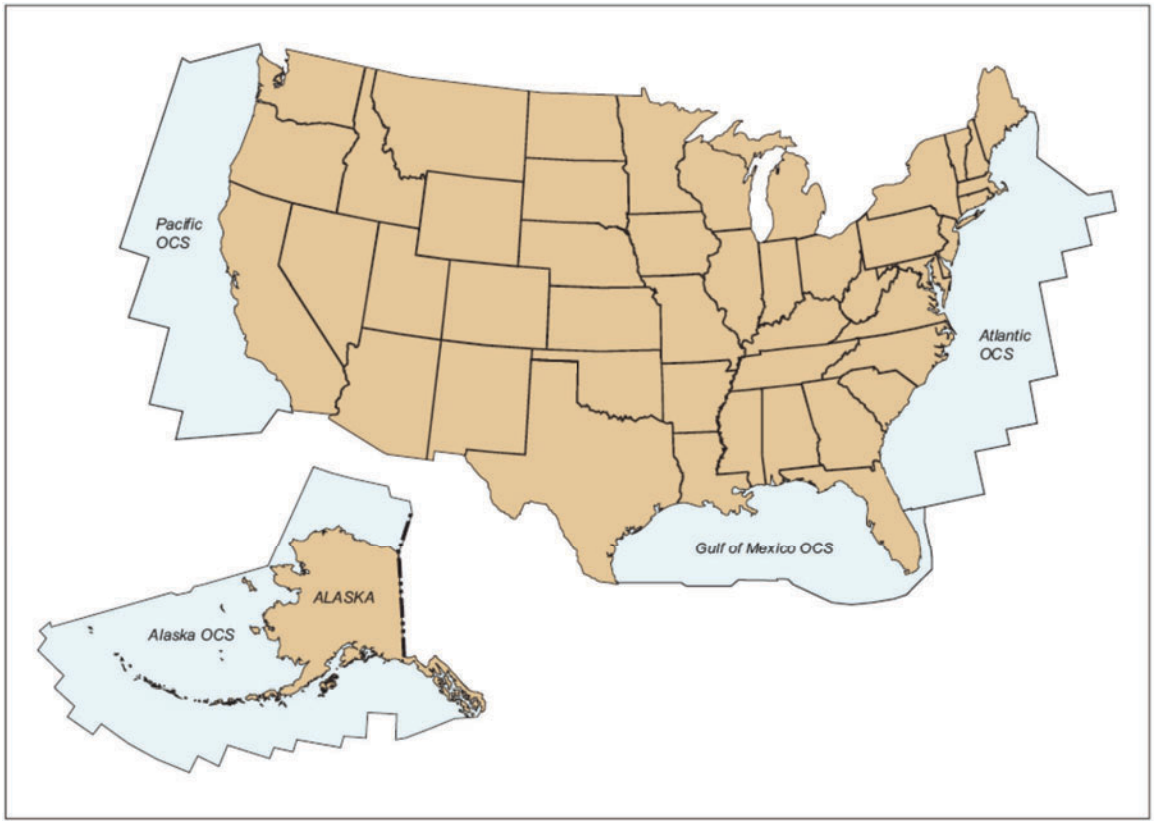

Figure 1. Federal outer continental shelf planning areas.

Figure 2. General location of proposed Mid-Atlantic Area Lease Sale 220 off the coast of Virginia. Status of leases and other lease sales for the 2007-2011 period are also shown.

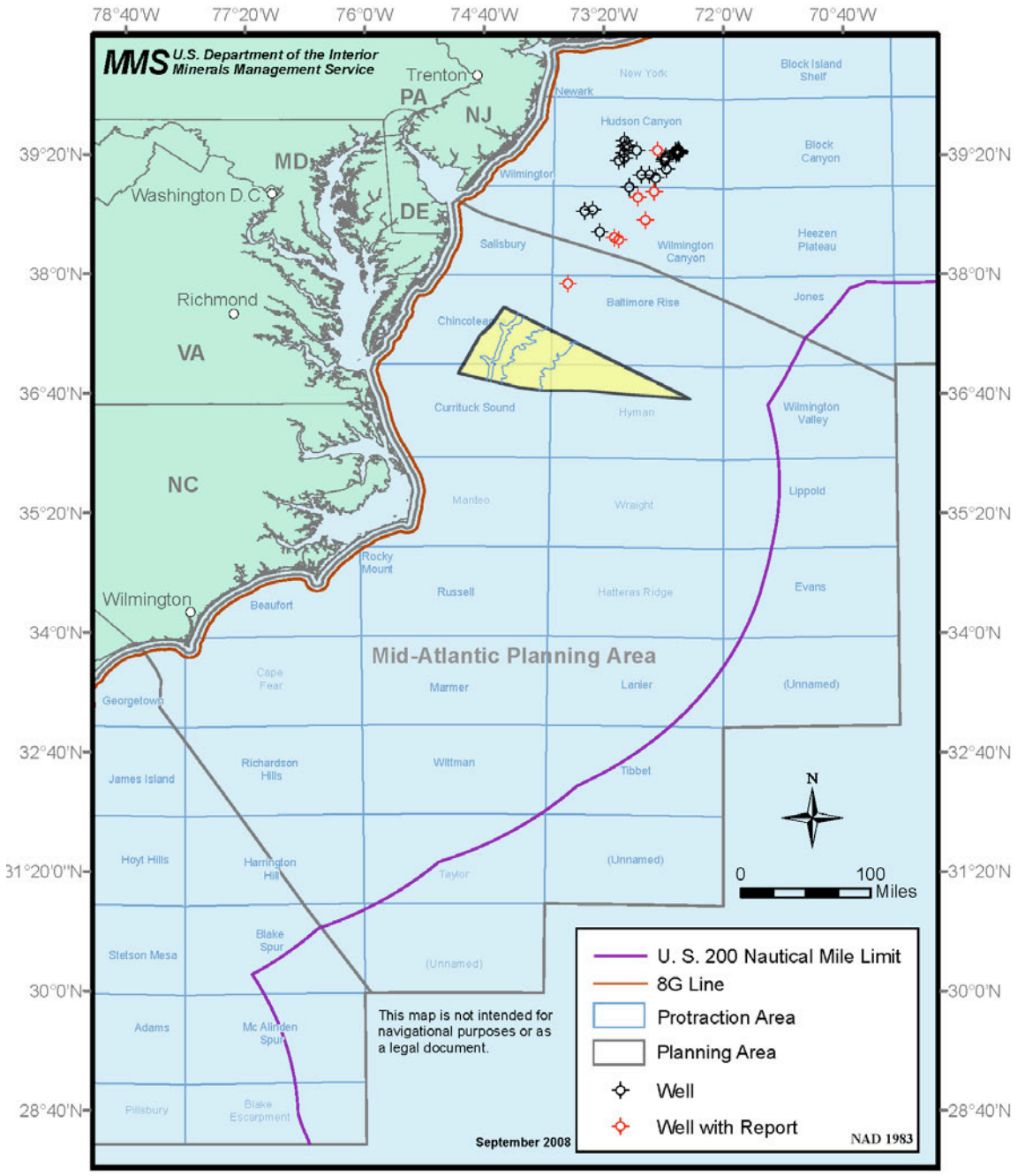

Figure 3. Mid-Atlantic OCS planning area showing protraction areas and wells drilled from previous lease sales.

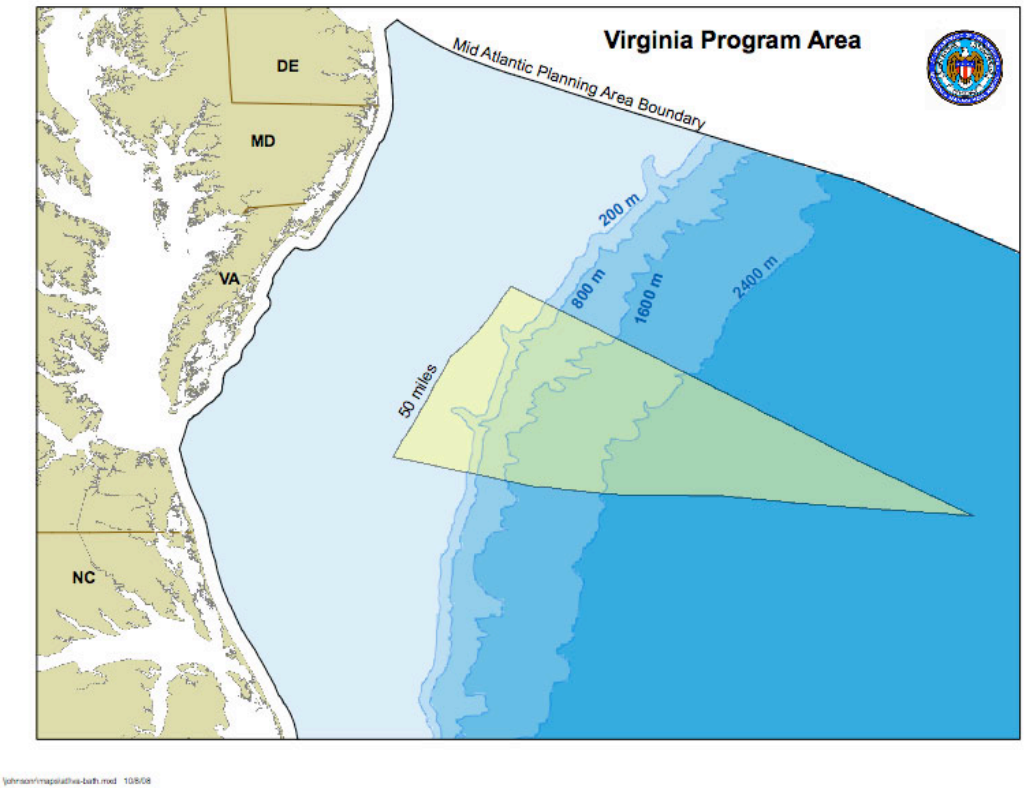

Figure 4. Detailed location of Virginia OCS lease sale area within the Mid-Atlantic OCS planning area.

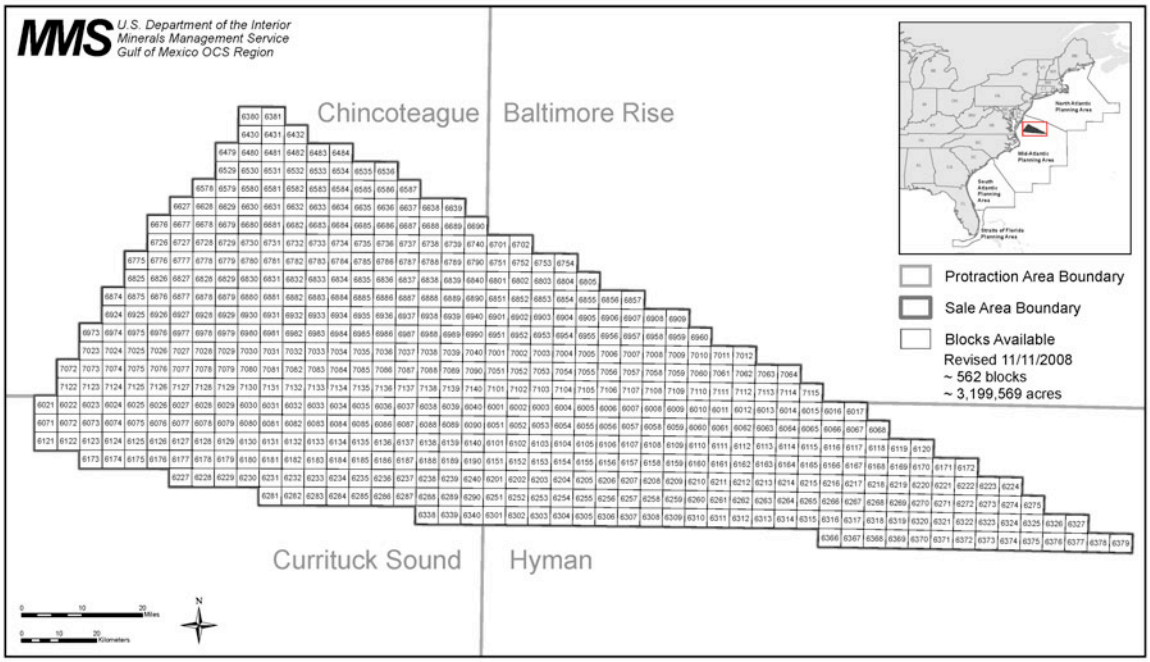

Figure 5. Details of Lease Sale 220 area off the coast of Virginia.

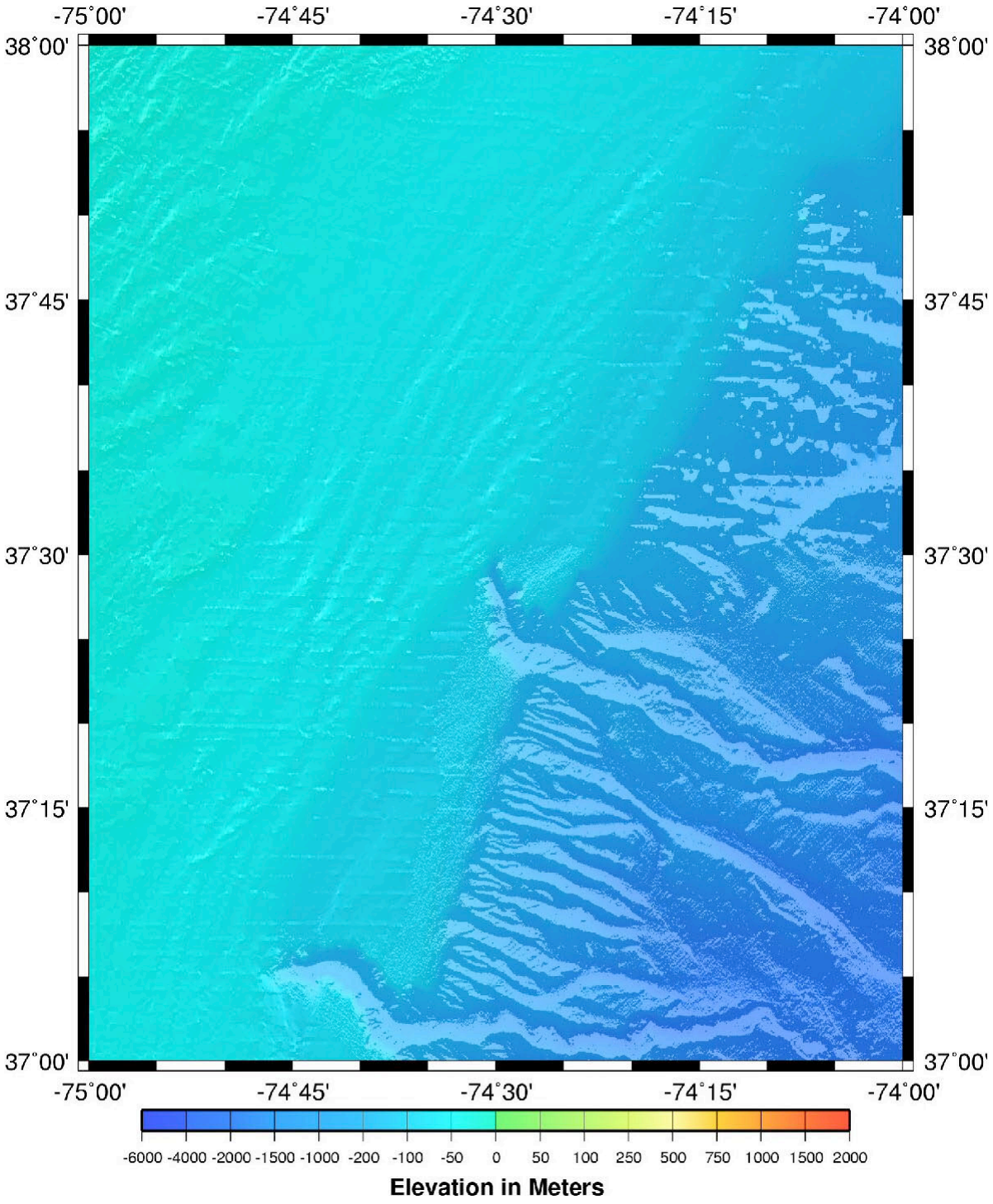

Figure 6. National Geophysical Data Center map encompassing much of the Virginia OCS lease sale area, Norfolk and Washington canyons are the prominent features, from: http://ngdc.noaa.gov/mgg/coastal/grddas02/grdden02.htm

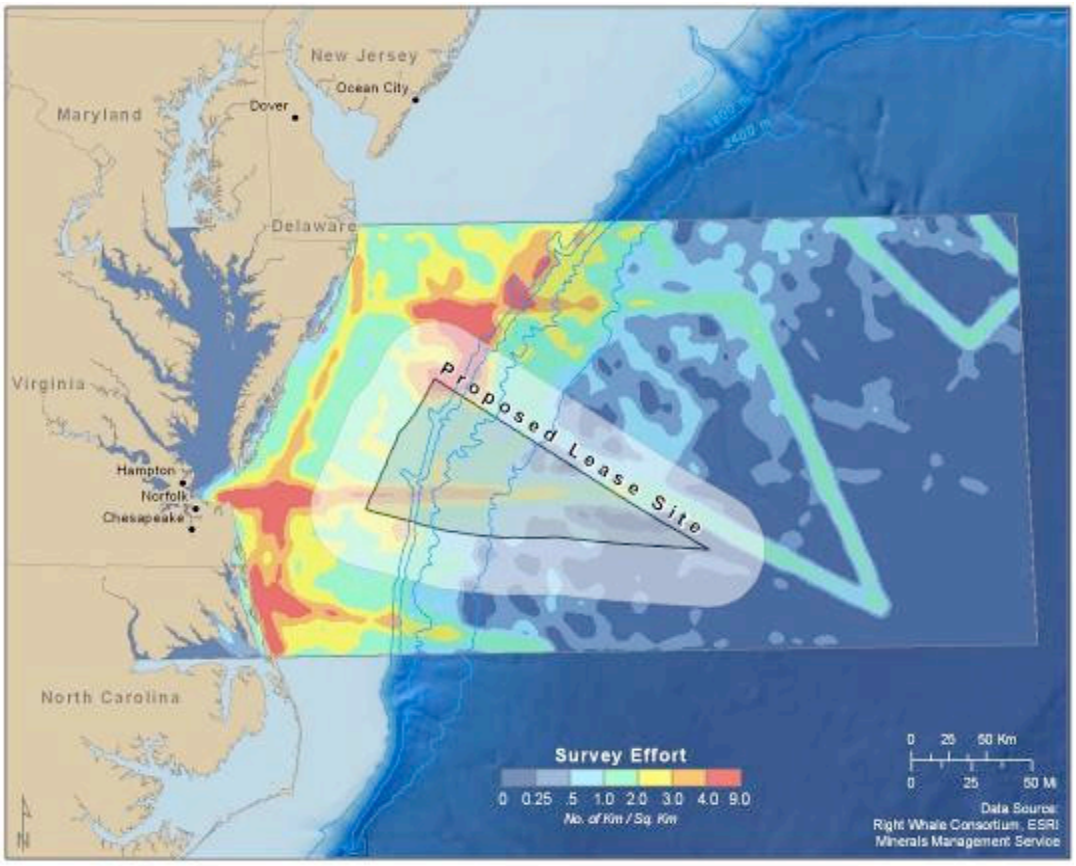

Figure 7. Survey effort for marine mammals and sea turtles in the Atlantic waters off of Virginia. Effort is given in kilometers of appropriately surveyed track line mile per square kilometer of ocean (color code at bottom of image). The light blue shading around the lease site is a 20 mile buffer zone (see text of workshop report).

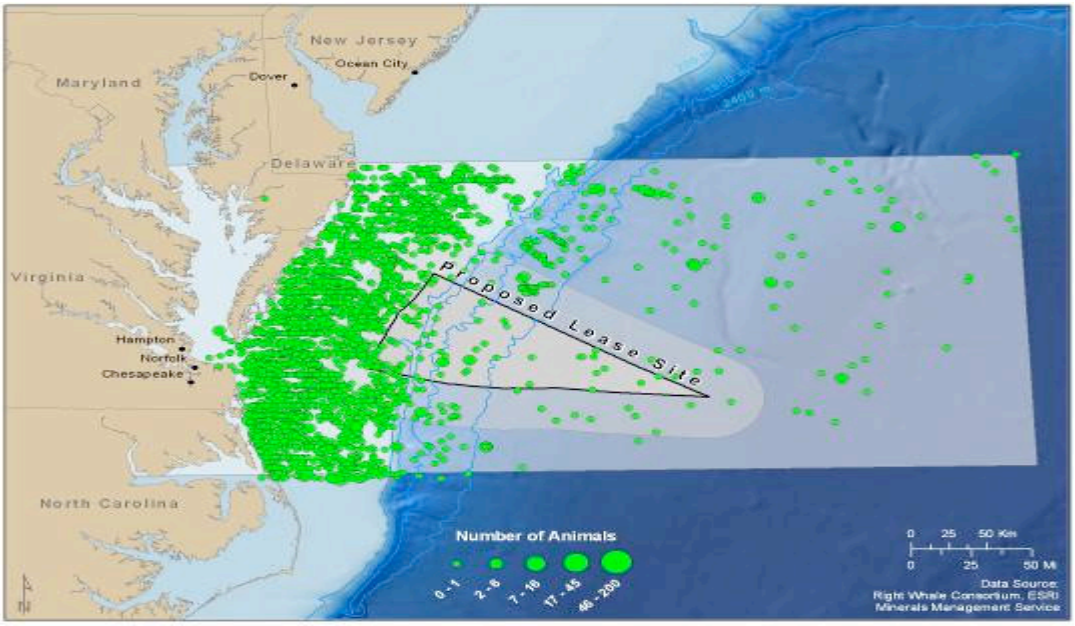

Figure 8. Sightings of Turtles (Green, Leatherback, Loggerhead, Kemp's Ridley, and Unidentified) in the Atlantic waters off of Virginia and around the proposed lease site.

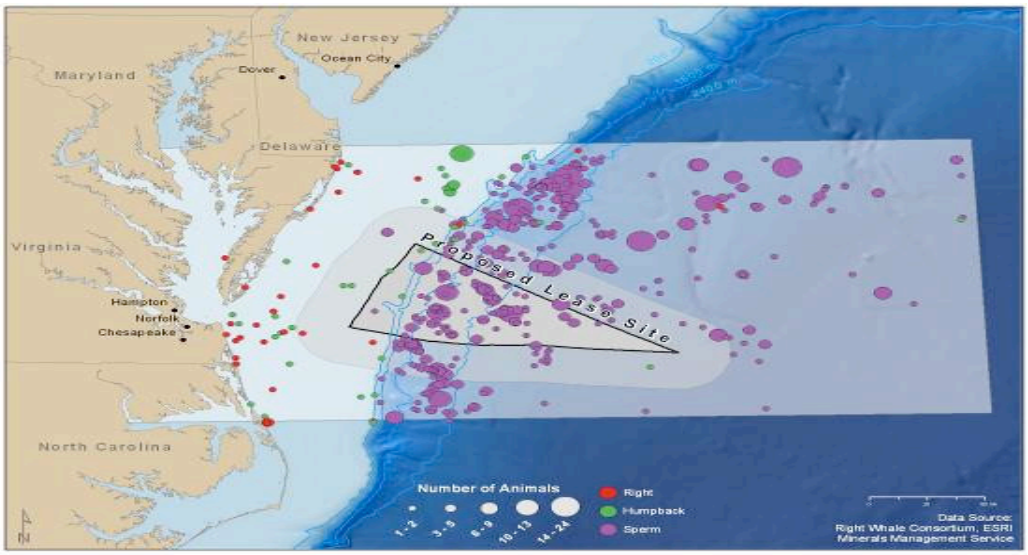

Figure 9. Sightings of North Atlantic Right, Humpback, and Sperm whales in the Atlantic waters off of Virginia and around the proposed lease site.

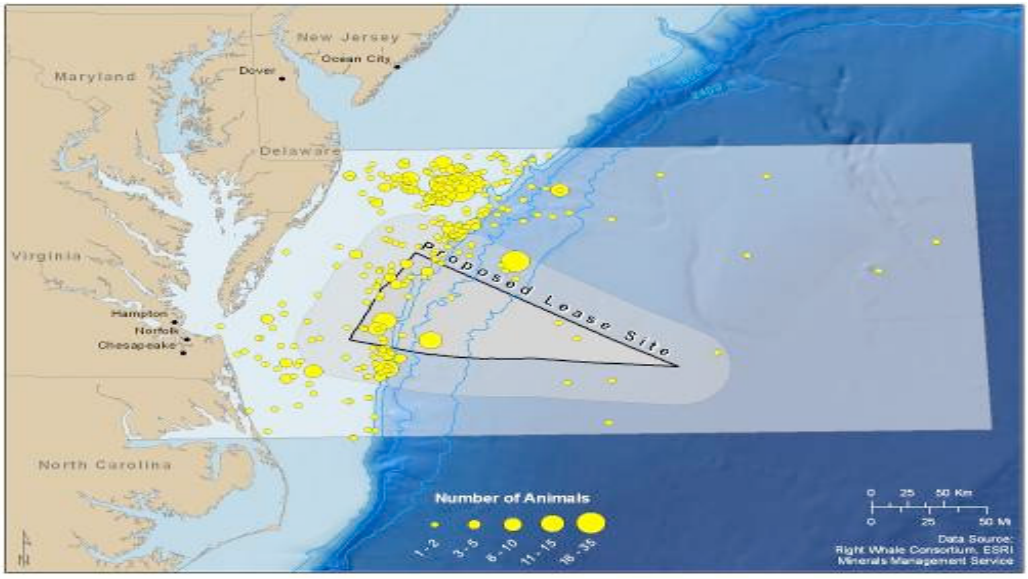

Figure 10. Sightings of Blue, Fin, Minke, Sei, and unidentified Balaenoptera and Rorqual whales in the Atlantic waters off of Virginia and around the proposed lease site.

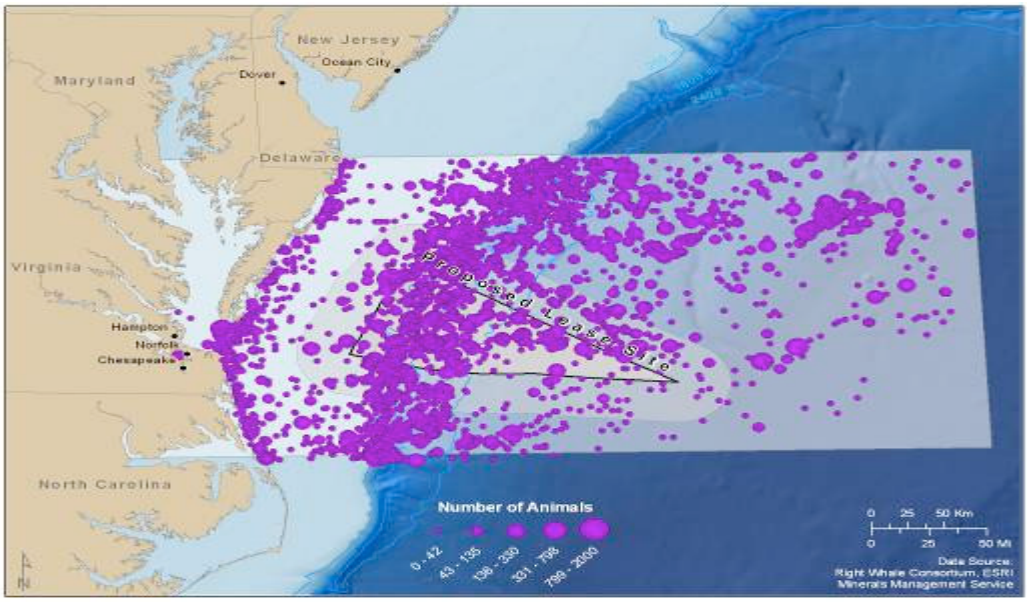

Figure 11. Sightings of dolphins and pilot whales in the Atlantic waters off of Virginia and around the proposed lease site.

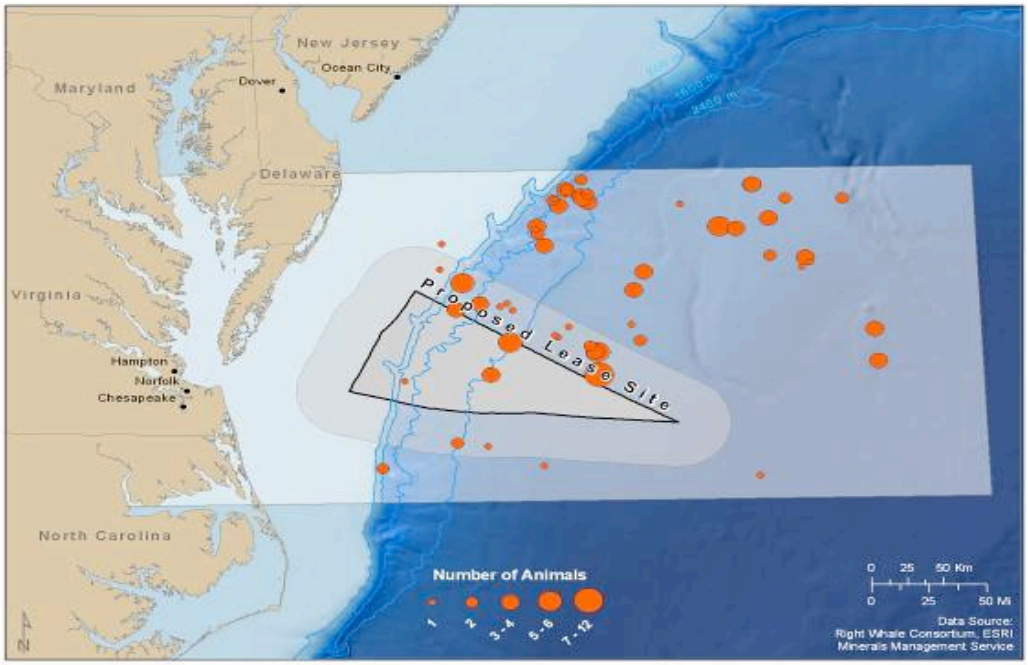

Figure 12. Sightings of beaked whales in the Atlantic waters off of Virginia and around the proposed lease site.

Figure 13. Oil spill cleanup after the Exxon Valdez (NOAA Photo)

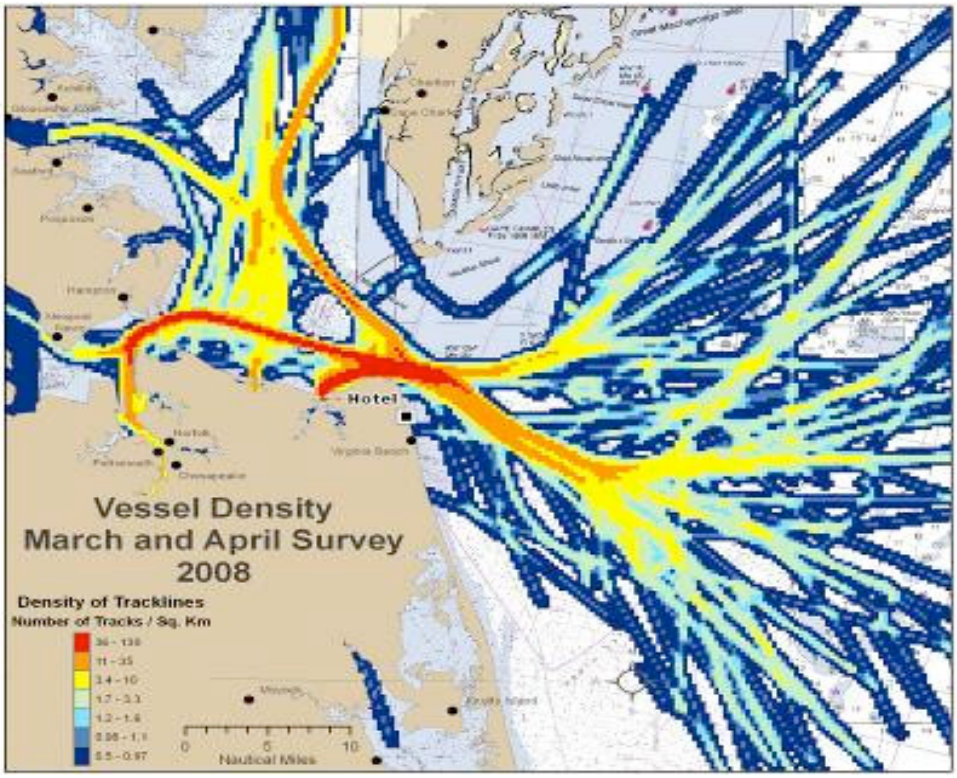

Figure 14. Shipping traffic density during two months in Hampton Roads, VA. Data courtesy Mark Swingle.

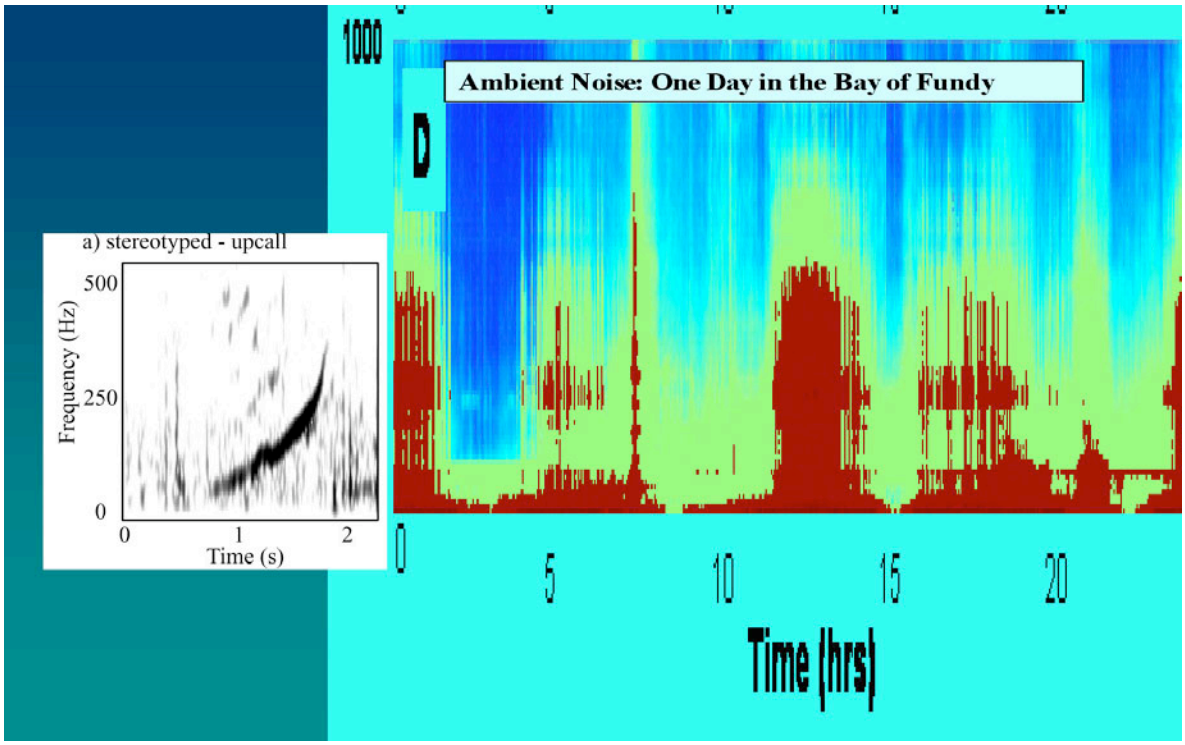

Figure 15. Ambient noise levels from 0 to 1000hz in the Bay of Fundy right whale habitat are shown on the right. The intensity of noise from ships passing through the region (7 times) during a single 24 hour period is shown in color (red is loud, blue is quiet). For reference, a right whale upcall is shown at left in black and white, with scale matched to the ambient noise spectrogram. Note the frequency overlap between the call and the shipping noise. Images and data courtesy Chris Clark and Susan Parks.

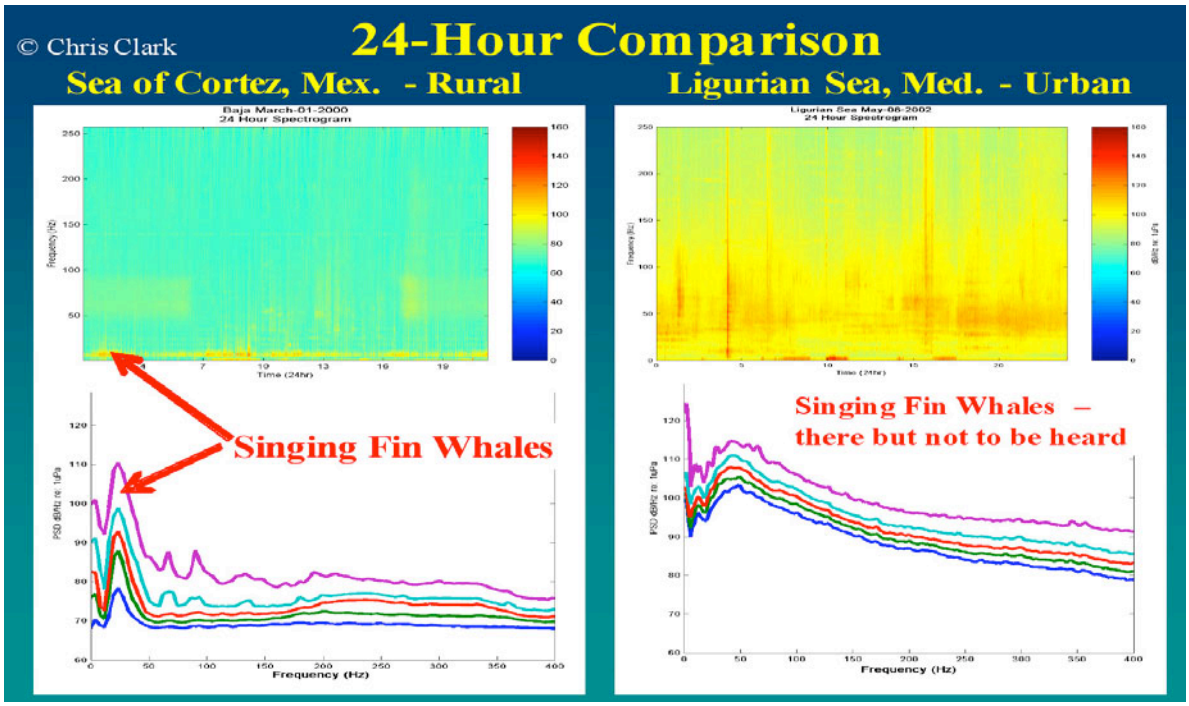

Figure 16. Ambient noise levels in a relatively pristine marine environment (left top) and in a highly urbanized one (right top). The lower graphs show that in the quiet ocean, finback whales provide the dominant low frequency noise, while in the urban one, finback sounds are completely masked by the ambient noise levels from human activities. Images and data courtesy Chris Clark.

Table 1. Lease sale history of the Atlantic OCS Planning Area, see Figure 2 for area boundaries. Data summarize and rounded from: http://www.gomr.mms.gov/homepg/offshore/atlocs/atlleas.html#ATLOCSSALE

Sale No.	Sale Date	Tracts Offered	Acres Offered	Bids	Tracts Leased	Acres Leased	Total Value	Exploratory Wells
North Atlantic								
42	12/79	116	660,000	189	63	359,000	816,000,000	8
Mid-Atlantic								
40	08/76	154	877,000	410	93	529,000	1,128,000,000	27
49	02/79	109	620,000	74	39	222,000	40,000,000	1
59	12/81	253	1,440,000	240	51	290,000	324,000,000	4
RS-2	08/82	155	882,000	19	18	102,000	4,000,000	0
76	04/83	4,050	22,665,000	53	37	211,000	68,000,000	0
Subtotal		4,721	26,485,000	796	238	1,355,000	1,564,000,000	32
South Atlantic								
43	03/78	224	1,275,000	99	43	245,000	101,000,000	6
RS-2	08/82	232	1,321,000	9	8	46,000	3,000,000	0
78	07/83	3,582	20,156,000	12	11	63,000	13,000,000	0
Subtotal		4,323	24,374,000	240	109	621,000	460,000,000	6
Straits of Florida								
5	05/59	80	458,000	23	23	132,000	2,000,000	3
Total All Sales		9,240	52,000,000	1,248	433	2,467,000	2,842,000,000	49

Table 2. Summary of the number Mid-Atlantic reports by major category. See Appendix C for details.

Number	Category
43	Information and Data Summaries
13	Socioeconomics
10	Onshore Impacts and Industry Information
14	Oil Spill Fates and Effects
31	Marine Mammals and Turtles
5	Marine and Coastal Birds
19	Benthic Biology
22	Fishing and Fisheries
34	Physical Oceanography
16	Geology and Geological Hazards

Table 3. Summary of physical and geological data needs for the Virginia OCS lease sale area.

Data Gaps	Water Column Processes: Currents and Transport	Bottom Processes: Sediments and Pollutants	Geohazards
Shelf	Water column information (X- and L-margin, current velocities, surface dynamics, currents) Characterize transport processes to and away from coast (with seasonal considerations), fronts. Spill trajectories Deep current characterization MAB	Ridge and swale BBL Sediment transport, accumulation rates Sediment properties	Mass movement (creep) Earthquakes/seismic activity, faulting Methane venting Shallow gas pockets Unexploded ordnance and archeological sites Disposal areas Cables Mapping Paleo channels/delta
Slope	Water column information (X- and L-margin, current velocities) Characterize transport processes to and away from coast (seasonal; fronts, turbidity currents) Spill trajectories Gulf Stream and eddy processes/interactions and scales Deep current characterization	Sediment transport, accumulation rates Sediment properties	Mass movement (slope failures) Earthquakes/seismic activity, faulting Methane venting Hydrates Unexploded ordnance and archeological sites Cables Mapping Paleo channels/delta
Rise (Deep)	Water column information (X- and L-margin, current velocities) Characterize transport processes to and away from coast (seasonal) Spill trajectories Gulf Stream and Eddy processes/interactions and scales Deep current characterization DWBC location?	Sediment transport Turbidity currents, accumulation rates Sediment properties	Mass movement Slope failures Earthquakes/seismic activity, faulting Unexploded ordnance and archeological sites Cables Methane venting Hydrates Unexploded ordnance
Canyon	Flow anomalies relative to regional currents Disturbances Flux of material Characterize transport processes (turbidity currents) Trapped/focused current energy?		Mass movement (slope failures)

Table 4. Summary of endangered and protected species concerns for the Virginia OCS lease sale area.

Data Gaps	Noise	Vessels	Discharges	Infrastructure
Marine Mammals	Behavioral Effects Co-occurrence Industry noise	Risk analysis Speed Distribution and abundance	Distribution and abundance	Coastal distribution and abundance
Sea Turtles	Potential co-occurrence Characteristics of hearing in turtles Behavioral effects	Distribution and abundance Not a recognized effect (acute)	Distribution and abundance	Coastal distribution and abundance
Birds	Distribution and abundance	Distribution and abundance	Light Distribution and abundance	Coastal distribution and abundance

Appendix A.

List of Atlantic BLM and MMS studies

Contract #	MMS #	Title
		Information and Data Summaries
08850-CT5-47	1976-1	Summary of Environmental Information on the Continental Slope Canadian/United States Border to Cape Hatteras, N.C. - Volume I, Book I
08850-CT5-47	1976-14	Summary of Environmental Information on the Continental Slope Canadian/United States Border to Cape Hatteras, N.C. - Bibliography and Index, Volume II, Book 2
08850-CT5-47	1976-2	Summary of Environmental Information on the Continental Slope Canadian/United States Border to Cape Hatteras, N.C. - Chapters 1-6
08850-CT5-47	1976-12	Summary of Environmental Information on the Continental Slope Canadian/United States Border to Cape Hatteras, N.C. - Chapter 7
08850-CT5-47	1976-3	Summary of Environmental Information on the Continental Slope Canadian/United States Border to Cape Hatteras, N.C. - Chapters 8-12
08850-CT5-47	1976-4	Summary of Environmental Information on the Continental Slope Canadian/United States Border to Cape Hatteras, N.C. - Appendices A, B and C
AA550-CT6-45	1977-2	A Summary and Analysis of Environmental Information on the Continental Shelf from the Bay of Fundy to Cape Hatteras - Volume I, Book II
AA550-CT6-45	1977-3	A Summary and Analysis of Environmental Information on the Continental Shelf from the Bay of Fundy to Cape Hatteras - Volume I, Book III
AA550-CT6-45	1977-4	A Summary and Analysis of Environmental Information on the Continental Shelf from the Bay of Fundy to Cape Hatteras - Volume II
AA550-CT6-45	1977-5	A Summary and Analysis of Environmental Information on the Continental Shelf from the Bay of Fundy to Cape Hatteras - Volume III
08550-CT-5-42	1977-6	Middle Atlantic Outer Continental Shelf Environmental Studies, Volume IIA: Chemical and Biological Benchmark Studies
AA550-CT6-62, MU7-31, 29129	1977-7	Middle Atlantic Outer Continental Shelf Environmental Studies, Volume IIB: Chemical and Biological Benchmark Studies
08550-MU5-33 & CT5-42	1977-9	Middle Atlantic Outer Continental Shelf Environmental Studies - Volume III - Geologic Studies
AA550-CT6-62, MU7-31, 29129	1979-37	Middle Atlantic Outer Continental Shelf Environmental Studies, Volume I: Executive Summary; Chemical & Biological Benchmark Studies
AA550-CT6-62, MU7-31, 29129	1979-38	Middle Atlantic Outer Continental Shelf Environmental Studies, Volume IIA: Chemical and Biological Benchmark Studies
AA550-CT6-62, MU7-31, 29129	1979-39	Middle Atlantic Outer Continental Shelf Environmental Studies, Volume IIB: Chemical and Biological Benchmark Studies
AA550-CT6-62, MU7-31, 29129	1979-40	Middle Atlantic Outer Continental Shelf Environmental Studies, Volume IIC: Chemical and Biological Benchmark Studies
AA550-CT6-62, MU7-31, 29129	1979-32	Middle Atlantic Outer Continental Shelf Environmental Studies, Volume IID: Chemical and Biological Benchmark Studies
AA550-CT6-62, MU7-31, 29129	1979-41	Middle Atlantic Outer Continental Shelf Environmental Studies, Volume III: Geologic Studies
Open-File Report 82-136	1982-27	A Regional Assessement of Potential Environmental Hazards to and Limitations on Petroleum Development of the Southeastern United States Atlantic Continental Shelf, Slope, and Rise, Offshore North Carolina
N/A	1981-22	Synopsis of Environmental Reprots from the Environmental Studies Progam and the New York OCS Office
N/A	1981-23	A Summary of Environmental Reports form the Environment Studies Program and the New York OCS Office
14-12-0001-29178	1983-20	Canyon and Slope Processes Study, Final Report, Volume I: Executive Summary
14-12-0001-29178	1983-21	Canyon and Slope Processes Study, Final Report, Volume II: Physical Processes
14-12-0001-29178	1983-22	Canyon and Slope Processes Study, Final Report, Volume III: Biological Processes
14-12-0001-29200	1984-11	Environmental Summary of the U.S. Atlantic Continental Slope and Rise, 28-42 N, Volume I: Introduction, Meteorology, Physical Oceanography, Geology, Chemistry
14-12-0001-29200	1984-12	Environmental Summary of the U.S. Atlantic Continental Slope and Rise, 28-42 N, Volume II: Biology, Human Activities Future Studies, Bibliography
N/A	1985-13	Contributions of the Atlantic OCS Region Environmental Studies Program to the Knowledge of Ocean Environments
14-35-0001-30503	90-0080	Impacts of Oil and Gas Exploration, Development, and Production on the Atlantic Continental Shelf, Final Report
14-12-0001-30337	85-0106	Proceedings of First Atlantic Outer Continental Shelf Region Information Transfer Meeting (ITM), September 4-6, 1985
N/A	1987-5	Agenda and Abstracts, Second Atlantic OCS Region, Information Transfer Meeting (ITM), January 28-29, 1987
14-12-0001-30337	87-0033	Proceedings of Second Atlantic Outer Continental Shelf Region Information Transfer Meeting (ITM) January 28-29, 1987
14-35-0001-30480	89-0099	Proceedings of Third Atlantic Outer Continental Shelf Region Information Transfer Meeting
14-12-0001-30583	92-0001	Proceedings of Fourth Atlantic OCS Region Information Transferr Meeting, September 1991
N/A	85-0112	Offshore Environmental Studies Program: Final Reports, Publications, and Presentations
N/A	86-0020	Environmental Studies Index: Atlantic Outer Continental Shelf, 1986
N/A	86-0071	Atlantic Summary/Index: January 1985-June 1986, Outer Continental Shelf Oil & Gas Activities
N/A	86-0080	Atlantic Outer Continental Shelf Studies Results: 1973-1985, Narrative Summary
N/A	88-0005	Oil and Gas Program: Cumulative Effects
17662	89-0087	Environmental Studies Program Bibliography, 1973-1987
14-12-0001-30014 & 14-12-0001-30321	90-0036	Technical Summaries of Selected Atlantic Region Final Reports, Volume I
N/A	90-0060	Atlantic Update: July 1986-June 1990, Outer Continental Shelf Oil and Gas Activties
N/A	92-0057	Environmental Studies Results: 1973-1992
		Socioeconomics
08550-CT3-11	1974-2	A Study of the Socio-Economic Factors Relating to the Outer Continental Shelf of the Mid-Atlantic Coast, Book I, Volumes I, II, and III
08550-CT3-11	1974-3	A Study of the Socio-Economic Factors Relating to the Outer Continental Shelf of the Mid-Atlantic Coast, Book II, Volumes IV and V
08550-CT3-11	1974-4	A Study of the Socio-Economic Factors Relating to the Outer Continental Shelf of the Mid-Atlantic Coast, Book III, Volumes VI, VII, VIII and IX
	1975-1	Economic Study of the Possible Impacts of a Potential Baltimore Canyon Sale - Technical Paper Number I
08550-CT5-51	1975-4	Travel Economic Impact Model, Volume I: Final Economic Analysis Methodology
08550-CT5-51	1975-5	Travel Economic Impact Model, Volume II: Final Demonstration Report
14-12-0001-30051	1984-3	Federal Outer Continental Shelf Oil and Gas Activities, A Socioeconomic Review, Final Report
14-12-0001-30051	1984-4	Federal Outer Continental Shelf Oil and Gas Activities, A Socioeconomic Review, Annotated Bibliography
14-35-001-30671	93-0052	Coastal North Carolina Socioeconomic Study, Volume I: Executive Summary
14-35-001-30671	93-0053	Coastal North Carolina Socioeconomic Study, Volume II: Base Case Characterization: County Studies

Contract #	MMS #	Title
14-35-001-30671	93-0054	Coastal North Carolina Socioeconomic Study, Volume III: Base Case Characterization: Community Studies
14-35-001-30671	93-0055	Coastal North Carolina Socioeconomic Study, Volume IV: Pile Sort and Data Analysis
14-35-001-30671	93-0056	Coastal North Carolina Socioeconomic Study, Volume V: Socioeconomic Monitoring Design and Methodology
		Onshore Impacts and Industry Information
ENV76-22611	1978-10	Methodology for Assessing Onshore Impacts for Outer Continental Shelf Oil and Gas Development, Volume II: Methodology
ENV76-22611	1978-11	Methodology for Assessing Onshore Impacts for Outer Continental Shelf Oil and Gas Development, Volume III: Baltimore Canyon Test Case
ENV76-22611	1980-5	Methodology for Assessing Onshore Impacts for Outer Continental Shelf Oil and Gas Development, Volume I: Executive Summary
N/A	1982-35	Deepwater Technology: Exploration, Production, and Blowout Prevention - Technical Paper 82-01
AA851-CT2-41/29199	1983-13	Study of Alternative Modes for Transporting OCS-Produced Oil and Natural Gas
14-12-0001-29063	1983-15	Drilling Discharges in the Marine Environment
14-12-0001-29195	1983-30	Identification and Assessment of Impacts Associated with the Construction and Operation of Submarine Pipelines on the Mid-Atlantic Outer Continental Shelf - Final Report
14-12-0001-29195	1983-5	Indentification and Assessment of Impacts Associated with the Construction and Operation of Submarine Pipelines on the Mid-Atlantic Outer Continental Shelf
14-35-0001-30588	93-0005	Synthesis and Analysis of Existing Information Regarding Environmental Effects of Marine Mining, Executive Summary
14-35-0001-30588	93-0006	Synthesis and Analysis of Existing Information Regarding Environmental Effects of Marine Mining, Final Report
		Oil Spill Fates and Effects
08550-CT-4-B	1976-11	A Gas Chromatographic-Mass Spectrometric-Computer Analysis of Hydrocarbons Associated with Sediment, Benthic Fauna and Zooplankton (Mid-Atlantic)
Open File 76-451	1976-5	An Oil Spill Risk Analysis for the Mid-Atlantic Outer Contiental Shelf Lease Area
AA550-CT6-33	1976-8	Sources, Effects and Sinks of Hydrocarbons in the Aquatic Environment
AA550-CT6-45	1977-1	A Summary and Analysis of Environmental Information on the Continental Shelf from the Bay of Fundy to Cape Hatteras - Volume I, Book I
AA550-CT8-1	1978-6	Design for a Simplified Regional Impact Methodology Using Rims and Seas
14-01-0001-2193	1978-8	An Analysis of U.S. Tanker and Offshore Petroleum Production Oil Spillage Through 1975
Water-Resources Investigations 78-56	1978-9	An Oil Spill Risk Analysis for the Mid-Atlantic (Proposed Sale 49) Outer Contiental Shelf Lease Area
N/A	1981-29	Papers on Oil Spreading Dynamics - On A Classical Treatment of a Static Contact Angle Problem
14-12-0001-30222	1986-16	Offshore Hydrocarbon Resource Estimation: The Minerals Management Service's Methodology
N/A	1989-7	Oil Spill Risk Assessment Task Force Report
N/A	1989-8	Drilling and Production Discharges and Oil Spills in the Marine Environment
14-35-0001-30500	91-0043	Estimating the Environmental Costs of OCS Oil and Gas Development and Marine Oil Spills: A General Purpose Model: Overview and Summary
14-35-0001-30500	91-0043	Estimating the Environmental Costs of OCS Oil and Gas Development and Marine Oil Spills: A General Purpose Model, Economic Analysis of Environment Costs
14-35-0001-30500	91-0043	Estimating the Environmental Costs of OCS Oil and Gas Development and Marine Oil Spills: A General Purpose Model, Model Methodology, Documentation and Sample Outputs
		Marine Mammals and Turtles
N00014-74-C-0262; NR 083-004	1977-10	The Development and Testing of a Radio Whale Tag, Technical Report
AA551-CT8-48	1979-34	Summary of CETAP'S Data Collection Effort, Second and Third Quarter
AA551-CT8-48	1979-35	A Characterization of Marine Mammals and Turtles in the Mid- and North- Atlantic Areas of the U.S. Outer Continental Shelf, Executive Summary for 1979
AA551-CT8-48/29163	1979-36	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 for the Cetacean and Turtle Assessment Program
AA551-CT8-48	1979-42	Cetacean and Turtle Assessment Program Report for the Fourth Quarter
AA551-CT8-48/29163	1980-11	A Characterization of Marine Mammals and Turtles in the Mid- and North- Atlantic Areas of the U.S. Outer Continental Shelf, Annual Report 1980 for the Cetacean and Turtle Assessment Program
AA851-CT0-23 & N00014-79-C-0071 & NR 083-004	1981-2	Radio Tagging of Finback Whales - Iceland, June-July 1980, Technical Report (WH0I-81-2)
N/A	1982-16	Possible Effects of Noise From Offshore Oil and Gass Drilling Activities on Marine Mammals: A Survey of the Literature (Technical Report 776)
AA851-IA0-5	1982-17	Effects of Noise of Offshore Oil and Gas Operations on Marine Mammals - An Introductory Assessment, Volume 1: Technical Report 844
N/A	1982-18	Effects of Noise of Offshore Oil and Gas Operations on Marine Mammals - An Introductory Assessment, Volume 2: Technical Report 844
14-16-0009-80-946/FWS/OBS-82/37	1982-19	Effects of Petroleum on the Development and Survival of Marine Turtle Embryos
AA551-CT9-29	1982-25	Study of the Effects of Oil on Cetaceans, Final Report
14-12-0001-29169	1984-15	Study of the Effects of Oil on Marine Mammals, Sixth Interim Report
14-12-0001-29169/CT9-29	1985-19	Expanded Studies of the Effects of Oil on Cetaceans, Final Report, Part I
14-12-0001-29169/CT9-29	1985-20	Cutaneous Response to Plastic and Metallic Implants of Potential use for Marking Cetaceans, Final Report, Part II
PE-OGVT	1990-6	Underwater Blast Effects from Explosive Severance of Offshore Platform Legs and Well Conductors
14-12-0001-30673	1990-8	Marine Mammals and Noise, Final Manuscript
13269	1991-1	Southeast Atlantic Right Whale Behavior and Whale/Boat Interactions Using Coordinated Airship Overflights
N/A	1992-2	Right Whales in Coastal Waters of Northeast Florida, January 1992 -- 1. Fine-grain Biological Studies, 2. Survey Methodology, 3. Mitigation of Human Impacts
14-12-0001-30063	86-0070	Study of the Effects of Oil on Marine Turtles, Final Report, Volume I: Executive Summary

Contract #	MMS #	Title
14-12-0001-30063	86-0070	Study of the Effects of Oil on Marine Turtles, Final Report, Volume II: Technical Report
14-12-0001-30063	86-0070	Study of the Effects of Oil on Marine Turtles, Final Report, Volume III: Appendices
14-12-0001-30369	87-0029	Workshop to Assess Possible Systems for Tracking Large Cetaceans
AA-730-79-4120-0109	87-0038	Development of Satellite-Linked Methods of Large Cetacean Tagging and Tracking In OCS Lease Areas, Final Report
14-12-0001-30293	88-0049	Synthesis of Effects of Oil on Marine Mammals
14-35-0001-30486	90-0079	Endangered Right Whales of the Southern North Atlantic, Volume I
14-12-0001-30362	90-0093	Effects of Noise on Marine Mammals
14-12-0001-30362	90-0093A	Effects of Noise on Marine Mammals, Executive Summary
14-12-0001-30411	91-0069	Application of Remote Sensing Methods for Tracking Large Cetaceans: North Atlantic Right Whales: Final Report
14-35-0001-30486	93-0024	Endangered Right Whales of the Southwestern North Atlantic
14-12-0001-30411	93-0049	Satellite-Monitored Movements and Dive Behavior of the Right Whale, Eubalaena Glacialis, in the Western North Atlantic
		Marine and Coastal Birds
14969	93-0001	Synthesis of Information on Marine and Coastal Birds of the Atlantic Coast: Abundance, Distribution, and Potential Risks from Oil and Gas Activities, Volume I: Executive Summary
14969	93-0002	Synthesis of Information on Marine and Coastal Birds of the Atlantic Coast: Abundance, Distribution, and Potential Risks from Oil and Gas Activities, Volume II: Species Accounts, Abundance, Distribution and Status
14969	93-0003	Synthesis of Information on Marine and Coastal Birds of the Atlantic Coast: Abundance, Distribution, and Potential Risks from Oil and Gas Activities, Volume III: Potential Effects and Risks from Oil and Gas Activities
14969	93-0004	Synthesis of Information on Marine and Coastal Birds of the Atlantic Coast: Abundance, Distribution, and Potential Risks from Oil and Gas Activities, Volume IV: Bibliography Part 1 of 2
14969	93-0004	Synthesis of Information on Marine and Coastal Birds of the Atlantic Coast: Abundance, Distribution, and Potential Risks from Oil and Gas Activities, Volume V: Bibliography Part 2 of 2
		Benthic Biology
AA550-IA7-35	1978-7	Benthic Survey of the Baltimore Canyon Through May 1974, Final Report (Report No. SHL 78-8)
AA551-CT8-49	1979-48	Historical Coral Report for the Canyon Assessment Study in the Mid- and North-Atlantic Areas of the U.S. OCS
AA551-CT8-49	1980-13	Epifaunal Zonation and Community Structure in Three Mid- and North Atlantic Canyons, Final Report for the Canyon Assesment
AA551-CT8-32	1981-36	Experimental Colonization of Cruide Oil Contaminated Sediments by Benthos on the Middle Atlantic Continental Shelf
AA551-CT9-5	1981-4	Crude Oil Effects to Developmental Stages of the American Lobster, Technical Report
AA551-CT9-5	1982-30	Crude Oil Effects to Developmental Stages of the American Lobster, Final Report
14-12-0001-30197	1985-11	Analysis of Trace Metals in Bottom Sediments in Support of Deepwater Biological Processes Studies on the U.S. Mid-Atlantic Continental Slope and Rise
AA550-IA7-35	1985-25	Distribution and Abundance Trends of 22 Selected Species in the Middle Atlantic Bight from Bottom Trawl Surveys During 1967-1979
AA551-CT1-18/PO # 10244	85-0055	Effects of a Natural Disturbance on a Continental Shelf Live Bottom Community off North Carolina
14-12-0001-30064	85-0095	Study of Biological Processes on the U.S. Mid-Atlantic Slope and Rise, First Interim Report
14-12-0001-30064	86-0004	Study of Biological Processes on the U.S. Mid-Atlantic Slope and Rise, Second Interim Report
14-12-0001-30197	85-0100	Analysis of Trace Metals in Bottom Sediments in Support of Deepwater Biological Processes Studies on the U.S. Mid-Atlantic Continental Slope and Rise
14-12-0001-30197	86-0102	Analysis of Trace Metals in Bottom Sediments in Support of Deepwater Biological Processes Studies on the U.S. Mid-Atlantic Continental Slope and Rise, Final Report
14-12-0001-30064	87-0050	Study of Biological Processes on the U.S. Mid-Atlantic Slope and Rise, Volume I: Executive Summary
14-12-0001-30064	87-0050	Study of Biological Processes on the U.S. Mid-Atlantic Slope and Rise, Volume II: Final Report
14-35-0001-30672	93-0014	Benthic Study of the Continental Slope Off Cape Hatteras, North Carolina, Volume I: Executive Summary
14-35-0001-30672	93-0015	Benthic Study of the Continental Slope Off Cape Hatteras, North Carolina, Volume II: Final Report
14-35-0001-30672	93-0016	Benthic Study of the Continental Slope Off Cape Hatteras, North Carolina, Volume III: Appendices
14-35-0001-30487	90-0070	A Comparison of Marine Productivity Among Outer Continental Shelf Planning Areas
		Fishing and Fisheries
AA550-IA7-35	1979-45	The Distribution and Abundance of Ichthyoplankton in the Middle Atlantic Bight as Determined from Coastal Surveys and Site-Specific Studies, 1965-1976
E(11-1)4047	1980-6	An Oil Spill - Fishery Interaction Model Development & Applications
04-8-M01-149 & 79AA-D-00102	1981-3	Small-Scale Commercial Fishing in Southern New England (WH0I-81-72)
CT9-26 & 29167	1981-31	Assessment of Space and Use Conflicts Between the Fishing and Oil Industries, Volume I: Interactions Between Fishing Gear and Oil Structures
CT9-26 & 29167	1981-32	Assessment of Space and Use Conflicts Between the Fishing and Oil Industries, Volume II: Engineering Assessment
CT9-26 & 29167	1981-33	Assessment of Space and Use Conflicts Between the Fishing and Oil Industries, Volume III: Historical Interactions Between the Fishing and Offshore Oil and Gas Industries
CT9-26 & 29167	1981-34	Assessment of Space and Use Conflicts Between the Fishing and Oil Industries, Volume IV: Catch Loss Model
CT9-26 & 29167	1981-35	Assessment of Space and Use Conflicts Between the Fishing and Oil Industries, Volume V: Potential Port Impacts on Space, Labor, Marine Facilities, and Other Inputs
CT9-26-29167	1981-28	Assessment of Space and Use Conflicts Between the Fishing and Oil Industries, User's Guide to Computer Models

Contract #	MMS #	Title
AA851-CT0-75 & 29181	1981-37	Assessing the Impact of Oil Spills on a Commercial Fishery, Final Interim Report
AA550-1A7-35	1981-38	Diseases of North American Marinee Fishes, Crustaceans and Mollusks
AA851-CT0-75 & 29181	1982-31	Assessing the Impact of Oil Spills on a Commerical Fishery. Final Report
AA550-CT6-62	1979-47	Middle Atlantic Bight Zooplankton: Second Year Results and a Discussion of the Two-Year BLM-VIMS Survey, Chapter 4
14-12-0001-29189/AA851-CT1-68	1983-24	North Carolina Fisheries and Environmental Data Search and Synthesis Study, Executive Summary
14-12-0001-29189/AA851-CT1-68	1983-25	North Carolina Fisheries and Environmental Data Search and Synthesis Study, Final Report
14-12-0001-30336	89-0029	Potential Impacts of OCS Oil and Gas Activities on Fisheries, Final Report, Executive Summary
14-12-0001-30336	89-0029	Potential Impacts of OCS Oil and Gas Activities on Fisheries, Final Report, Volume II: Annotated Bibliography for OCS Oil and Gas Impact Studies, Section 1, Part 1
14-12-0001-30336	89-0029	Synthesis of Knowledge of the Potential Impacts of OCS Oil and Gas Activities on Fisheries, Final Report, Volume I: Distribution and Relative Abunance of Selected Target Species
14-12-0001-30336	89-0029	Potential Impacts of OCS Oil and Gas Activities on Fisheries, Final Report, Volume I: Annotated Biblography and Database Descriptions for Target Species Distribution and Abunance Studies, Section 1, Part 2
14-12-0001-30336	89-0029	Potential Impacts of OCS Oil and Gas Activities on Fisheries, Final Report, Volume I: Annotated Biblography and Database Descriptions for Target Species Distribution and Abunance Studies, Section 1, Part 1
14-12-0001-30336	89-0029	Potential Impacts of OCS Oil and Gas Activities on Fisheries, Final Report, Volume I: Annotated Biblography and Database Descriptions for Target Species Distribution and Abundance Studies, Section 2
14-12-0001-30336	89-0044	Review of Selected Fisheries Issues
		Physical Oceanography
AA550-IA6-12	1977-13	Summarization and Interpretation of Historical Physical Oceanographic and Meteorological Information for the Mid-Atlantic Region, Final Report
E(40-1)-5163	1977-8	Measurement of Gulf Stream and Wind Induced Shelf Circulation in the South Atlantic Bight
AA551-CT8-34	1979-26	Proceedings of the Continental Shelf Physical Oceanographic Model Evaluation Workshop, April 25-26, 1979
AA551-CT9-32	1982-23	A Numerical Model of the Shelf Circulation in the Middle Atlantic Bight Driven by Tides, Transient Storms and the Offshore, Large-Scale Circulation: Formulation of Proper Open Boundary Conditions (Report Number 73)
29113	1983-27	A Description of a Three-Dimensional Coastal Ocean Circulation Model
14-12-0001-30152	1984-2	Effects of Wind and Gulf Stream Events on the Currents off the Coast of North Carolina as it Relates to Oil Spill Risk Potential
14-12-0001-30066	1985-15	MASAR Special Cruise Report for the Deployment of Two Mooring in Lease Block 510 off Cape Hatteras (Nov 1-5, 1985)
14-12-0001-30066	1985-16	Mid-Atlantic Slope and Rise Physical Oceanography Study (MASAR/POS) Semi-Annual Report No. 2
14-35-0001-30599	1993-2	A Physical Oceanographic Field Program Offshore North Carolina -- Imagery Data Products, 1992
14-35-0001-30599	1993-3	A Physical Oceanographic Field Program Offshore North Carolina -- Current Meter, Surface Wind and Water Level Data Products
14-35-0001-30599	1993-4	A Physical Oceanographic Field Program Offshore North Carolina -- Special Event-Near Shore Experiment
14-35-0001-30599	1993-5	A Physical Oceanographic Field Program Offshore North Carolina -- Hydrographic Data Products and ARGOS Drifter Tracks
14-35-0001-30599	1993-6	A Physical Oceanographic Field Program Offshore North Carolina -- ARGOS Drifter Tracks
14-35-0001-30599	1993-7	A Physical Oceanographic Field Program Offshore North Carolina -- Special Event-Near Shore Experiment, Second Experiment
14-35-0001-30599	1994-1	A Physical Oceanographic Field Program Offshore North Carolina -- Current Meter, Surface Wind and Water Level Data Products, February-August 1993
14-35-0001-30599	1994-2	A Physical Oceanographic Field Program Offshore North Carolina -- Imagery Data Products, January - August, 1993
14-35-0001-30599	1994-3	A Physical Oceanographic Field Program Offshore North Carolina -- Hydrographic Data Products
14-35-0001-30599	1994-4	A Physical Oceanographic Field Program Offshore North Carolina -- Hydrographic Data Products (November 1993) and ARGOS Drifter Tracks (August/November 1993)
N/A	85-0108	Offshore Environmental Studies Program: North Carolina Physical Oceanography Programs
14-12-0001-30066	87-0024	Study of Physical Processes on the U.S. Mid-Atlantic Continental Slope and Rise, Final Report, Volume I: Executive Summary
14-12-0001-30066	87-0024	Study of Physical Processes on the U.S. Mid-Atlantic Continental Slope and Rise, Final Report, Volume II: Technical
14-12-0001-30066	87-0024	Study of Physical Processes on the U.S. Mid-Atlantic Continental Slope and Rise, Final Report, Volume III: Appendix
14-12-0001-30340	87-0071	Evaluation of Satellite-Tracked Surface Drifting Buoys for Simulating the Movement of Spilled Oil in the Marine Environment, Volume I: Executive Summary
14-12-0001-30340	87-0071	Evaluation of Satellite-Tracked Surface Drifting Buoys for Simulating the Movement of Spilled Oil in the Marine Environment, Volume II: Final Report
14-12-0001-30349	89-0028	Frontal Eddy Dynamics Experiment off North Carolina, Volume I: Executive Summary
14-12-0001-30349	89-0028	Frontal Eddy Dynamics Experiment off North Carolina, Volume II: Technical Report
14-35-0001-30485	90-0050	Field Evaluation of Satellite-Tracked Surface Drifting Buoys in Simulating the Movement of Spilled Oil in the Marine Environment, Technical Report
14-35-0001-03485	90-0050	Field Evaluation of Satellite-Tracked Surface Drifting Buoys in Simulating the Movement of Spilled Oil in the Marine Environment, Final Report Appendices
14-35-0001-30485	90-0050	Field Evaluation of Satellite-Tracked Surface Drifting Buoys in Simulating the Movement of Spilled Oil in the Marine Environment, Executive Summary
N/A	91-0011	North Carolina Physical Oceanography Panel Report
14-12-0001-30350	92-0003	The Physical Oceanography of the U.S. Atlantic and Eastern Gulf of Mexico, Final Report
14-35-0001-30594	93-0031	A Review of Physical Oceanography of the Cape Hatteras, North Carolina Region, Volume I: Literature Synthesis, Appendix A: Annotated Bibliography

Contract #	MMS #	Title
14-35-0001-30594	93-0031	A Review of Physical Oceanography of the Cape Hatteras, North Carolina Region, Volume II: Catalog of Existing Studies
14-35-0001-30594	93-0031	A Review of Physical Oceanography of the Cape Hatteras, North Carolina Region, Volume I: Literature Synthesis
		Geology and Geological Hazards
	1979-44	Probabilistic Estimates of Maximum Seismic Acceleration in Rock on the East Coast and the Adjacent Outer Continental Shelf
AA551-MU8-21 & AA551-MU9-4 Open-File Report 81-600	1981-6	Geology and Potential Hazards of the Continental Slope Between Lindenkohl and South Toms Canyons, Offshore Mid-Atlantic United States (Open File Reprot 81-600)
AA551-MU9-4 Open-File Report 81-733	1981-7	Geotechnical Properties and Slope Stability Analysis of Surficial Sediments on the Baltimore Canyon Continental Slope (Open File Report 81-733)
AA551-MU8-21 & AA551-MU9-4	1982-13	Summary of Environmental Geologic Studies in the Mid-Atlantic Outer Continental Shelf Area - Results of 1978-1979 Field Seasons
AA551-MU8-21 & AA551-MU9-4	1982-14	Environmental Geologic Studies in the Mid-Atlantic Outer Continental Shelf Area, Results of 1978-1979 Field Seasons, Final Report
AA851-MU0-18/AA851-IA1-17/AA851-IA2-26	1983-32	Environmental Geologic Studies on the United States Mid and North Atlantic Outer Continential Shelf Area, 1980-1982 - Volume II: Mid-Atlantic Region
AA851-MU0-18/AA851-IA1-17/AA851-IA2-26	1983-33	Environmental Geologic Studies on the United States Mid and North Atlantic Outer Continential Shelf Area, 1980-1982 - Volume I: Executive Summary
AA851-MU0-18/AA851-IA1-17/AA851-IA2-26	1983-34	Environmental Geologic Studies on the United States Mid and North Atlantic Outer Continential Shelf Area, 1980-1982 - Volume III: North Atlantic Region
14-12-0001-30296	1988-6	Geologic Framework and Hydrocarbon Potential Offshore Delaware, Final Technical Report
N/A	1989-5	Summaries of Atlantic Reports Completed by State Geological Surveys Under the American Association of State Geologists - University of Texas COOP Program for the Minerals Management Service
N/A	1990-7	Summaries of Atlantic Continental Margin Reports: January 1985 - April 1990
14-12-0001-30432	1991-3	Investigations of Isolated Sand Shoals on the Inner Shelf of Southern Virginia
14-35-0001-30497	1992-4	Stratigraphic Framework of Upper Cenozoic Sediments and Potential Nonenergy Mineral Resources of Delaware and Offshore Regions
14-35-0001-30534	1994-6	Preliminary Textural and Mineralogical Analyses of Cretaceous and Holocene Sediments from the Northern New Jersey Coastal Plain, Final Technical Report, Year 8
14-35-0001-30643	1996-2	Investigations of Isolated Sand Shoals and Associated Deposite, Virginia Inner Shelf
N/A	86-0118	Humic Substances Isolated from Surface Sediments: Analytical Characteristics, Mid-Atlantic Continental Shelf & Slope

Appendix B.

Workshop Agenda

Workshop on Environmental Research Needs in Support of Potential Virginia Offshore Oil and Gas Activities

December 3-4, 2008
Williamsburg Woodlands Conference Center
Woodlands Hotel and Suites
105 Visitors Center Drive
Williamsburg, Virginia

Wednesday, December 3

7:45-8:30 a.m.	Breakfast (Continental breakfast provided) and Registration
8:25-8:30 a.m.	Opening Remarks, Robert Diaz, VIMS
	Historical Perspective
8:30-8:40 a.m.	History of MMS activities along the Atlantic Coast, Jim Cimato, Branch Chief Environmental Studies Program, MMS
8:40-9:00 a.m.	Activities associated with oil and gas development, Kent Satterlee, Shell Exploration and Production Company
	Environmental Resources
9:00-9:20 a.m.	Physical oceanography of the Virginian Sea, Larry Atkinson, Old Dominion University
9:20-9:40 a.m.	Pelagic fishes, Rich Brill, NOAA
9:40-10:00 a.m.	Demersal fishes, Ken Able, Rutgers University
10:00-10:40 a.m.	**Break**
10:40-11:00 a.m.	Benthos, Linda Schaffner, VIMS
11:00-11:20 a.m.	Protected and endangered species, Scott Kraus, New England Aquarium
11:20-11:40 a.m.	Economic issues, Doug Lipton, University of Maryland
11:40-12:00	Social issues, Diane Austin, University of Arizona
12:00-1:00 p.m.	**Lunch (Box lunch provided, Maple Room)**

Workshop Breakout Sessions

1:00-1:05 p.m.	Workshop directions, Diaz
1:05-3:00 p.m.	Room A, Social/Economic Issues, Lipton/Austin Room B, Fish/Fisheries Issues, Able/Brill Room C, Benthic Issues, Schaffner Room D, Geological/Physical Oceanographic Issues, Atkinson Room E, Endangered Species Issues, Kraus
3:00-3:30 p.m.	**Break**
3:30-4:20 p.m.	Continuation of breakout groups.
4:20-4:30 p.m.	Breakout group facilitators meet.
5:00-7:00 p.m.	**Social with cash bar (Oak Room)**

Thursday, December 4

Continuation of Working Groups

7:45-8:30 a.m.	Breakfast (Continental breakfast provided) and Registration
8:30-10:00 a.m.	Room A, Social/Economic Issues, Lipton/Austin Room B, Fish/Fisheries Issues, Able/Brill Room C, Benthic Issues, Schaffner Room D, Geological/Physical Oceanographic Issues, Atkinson Room E, Endangered Species Issues, Kraus
10:00-10:30 a.m.	**Break**
10:30-12:00 p.m.	Continuation of breakout groups.
12:00-1:00 p.m.	**Lunch (Box lunch provided, Maple Room)**

Breakout Group Summaries

1:00-2:30 a.m.	Social/Economic Issues, Lipton/Austin Fish/Fisheries/Endangered Species Issues, Able/Brill Benthic Issues, Schaffner Geological/Physical Oceanographic Issues, Atkinson Endangered Species Issues, Kraus
2:30-3:00 p.m.	**Final Discussion and Closing Comments**
3:00-3:30 p.m.	**Stakeholder Concerns**

Appendix C.

Workshop Attendees

AFFILIATION	NAME		ADDRESS		PHONE	E-MAIL
Rutgers University	Ken	Able	241 W. Herschel St.	Egg Harbor, NJ 08215	(609) 296-5260 x230	able@marine.rutgers.edu
Minerals Management Service (MMS)	Jan	Arbegast	381 Elden St.	Herndon, VA 20170	(703) 787-1227	jan.arbegast@mms.gov
DGIF	Ernie	Aschenbach	4010 West Broad St.	Richmond, VA 23230	(804) 367-2733	Ernie.Aschebach@dgif.virginia.gov
Old Dominion University	Larry	Atkinson	CCPO	Norfolk, VA 23529	(757) 683-4926	latkinso@odu.edu
University of Arizona	Diane	Austin	P.O. Box 210030	Tucson, AZ 85721-0030	(520) 626-3879	daustin@u.arizona.edu
Murphy Exploration and Production	Charles	Bedell	69 Pinnacle Lane	Lexington, VA 24450	(504) 289-2130	chuck_bedell@murphyoilcorp.com
Minerals Management Service (MMS)	James	Bennett	381 Elden St., Mailstop 4042	Herndon, VA 20170	(703) 787-1660	jfbennett@mms.gov
Minerals Management Service (MMS)	Tom	Bjerstedt	1201 Elmwood Park Blvd.	New Orleans, LA 70123	(504) 736-2759	thomas.bjerstedt@mms.gov
AECOM Environment	James	Blake	89 Water Street	Woods Hole, MA 02543	(508) 457-7900	James.Blake@aecom.com
Old Dominon University	Jose	Blanco	4111 Monarch Way, 3rd Floor	Norfolk, VA 23508	(757) 683-5556	jblanco@odu.edu
Minerals Management Service (MMS)	Mary	Boatman	381 Elden St.	Herndon, VA 20170	(703) 956-6593	mary.boatman@mms.gov
Shell International Exploration & Prod.	Michael	Bourque	200 North Dairy Ashford	Houston, TX 77079	(281) 544-3220	michael.m.bourque@shell.com
NMFS, NEFSC/VIMS	Richard	Brill	P.O. Box 1346	Gloucester Point, VA 23062	(804) 684-7875	rbrill@vims.edu
Minerals Management Service (MMS)	Elizabeth	Burkhard	381 Elden St., Mailstop 4041	Herndon, VA 20170	(703) 787-1749	Elizabeth.Burkhard@mms.gov
TGS-NOPEC	Michaele	Cerf	2500 City West Blvd., Suite 2000	Houston, TX 77077	(713) 860-2124	
Minerals Management Service (MMS)	Joseph	Christopher	1201 Elmwood Park Blvd.	New Orleans, LA 70123	(504) 736-2759	joseph.christopher@mms.gov
Minerals Management Service (MMS)	James	Cimato	381 Elden St.	Herndon, VA 20170	(703) 787-1721	james.cimato@mms.gov
The Nature Conservancy	Gwynn	Crichton	490 Westfield Rd.	Charlottesville, VA 22901	(434) 951-0571	gcrichton@tnc.org
Virginia Institute of Marine Science	Robert	Diaz	P.O. Box 1346	Gloucester Point, VA 23062	(804) 684-7364	diaz@vims.edu
William & Mary Research Institute	Jay	Diedzic	424 Duke of Gloucester St., Rm. 203	Williamsburg, VA 23185	(757) 784-0447	brockmjd@aol.com
Old Dominion University Ocean, Earth & Atmospheric Sciences	Fred	Dobbs	4600 Elkhorn Ave.	Norfolk, VA 23529	(757) 683-5329	fdobbs@odu.edu
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Minerals Management Service (MMS)	Holli	Ensz	1201 Elmwood Park Blvd.	New Orleans, LA 70123	(504) 736-2356	holli.ensz@mms.gov
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Appendix D.

Workshop PowerPoint presentations

1 Cimato History

2 Kent Oil&Gas

3 Atkinson Physical

4 Brill Fisheries

5 Able Fish

6 Schaffner Benthos

7 Kraus Proteced Species

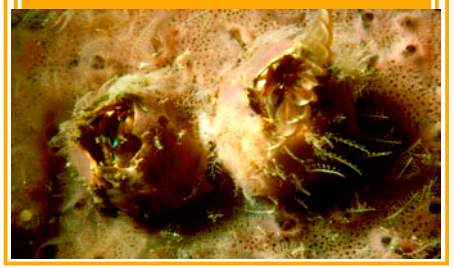
8 Lipton Economics

9 Austin Social

U.S. Department of the Interior
Minerals Management Service

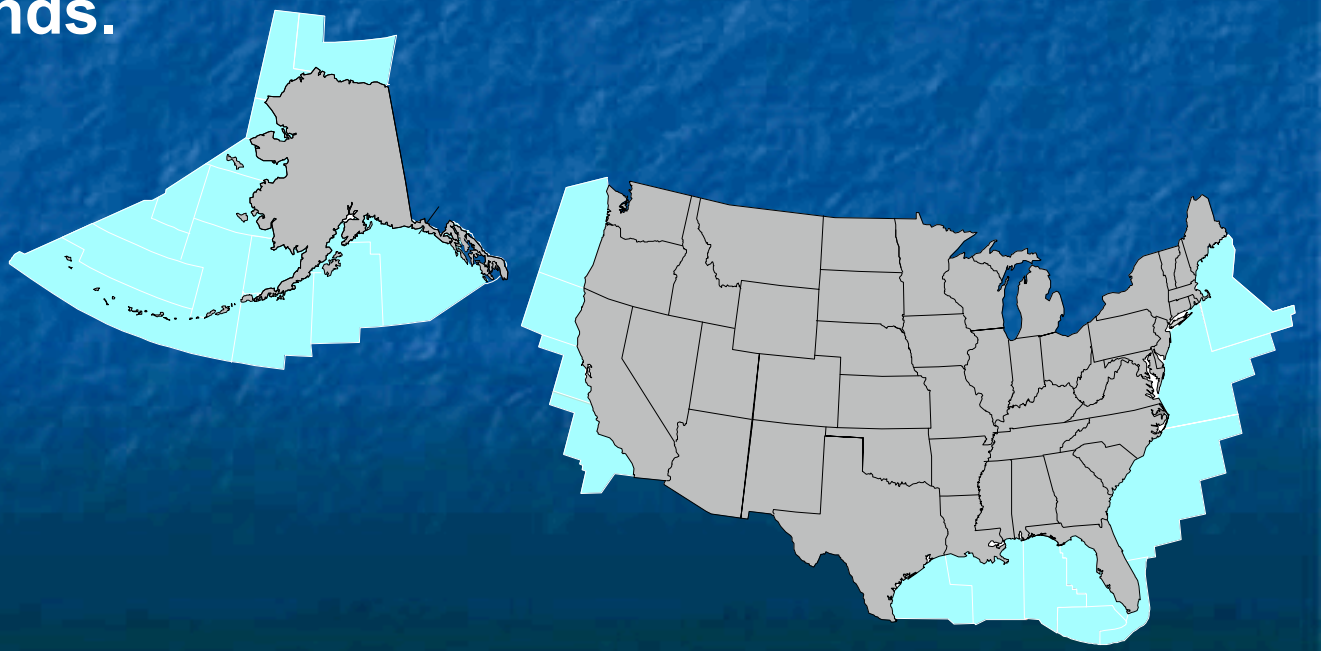
History of MMS Activities along the Atlantic Coast

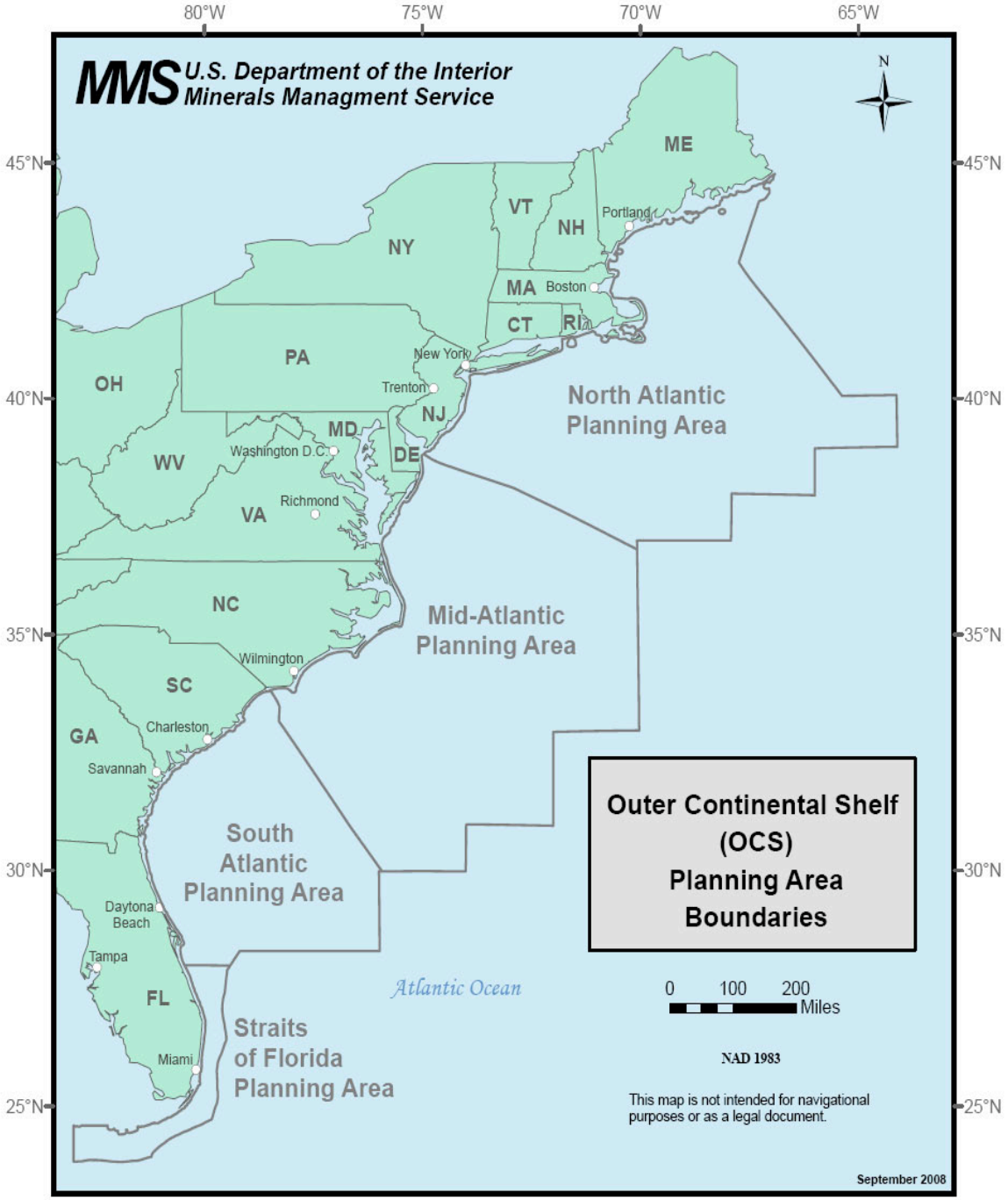
James M. Cimato
Chief, Environmental Sciences Branch
December 2008

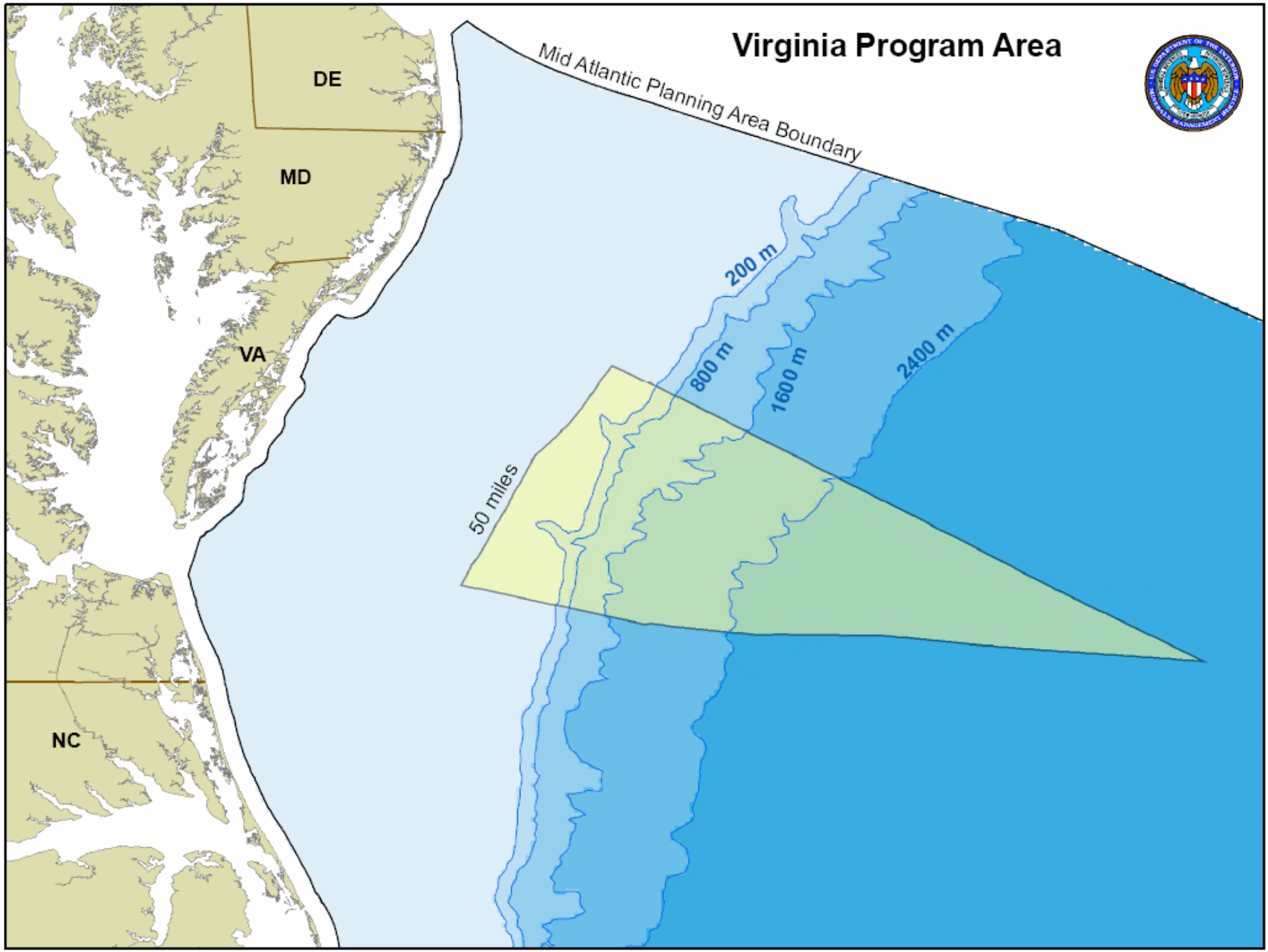


MMS Mission

To manage the energy and mineral resources on the OCS in an environmentally sound and safe manner and to timely collect, verify, and distribute mineral revenues from Federal and Indian lands.

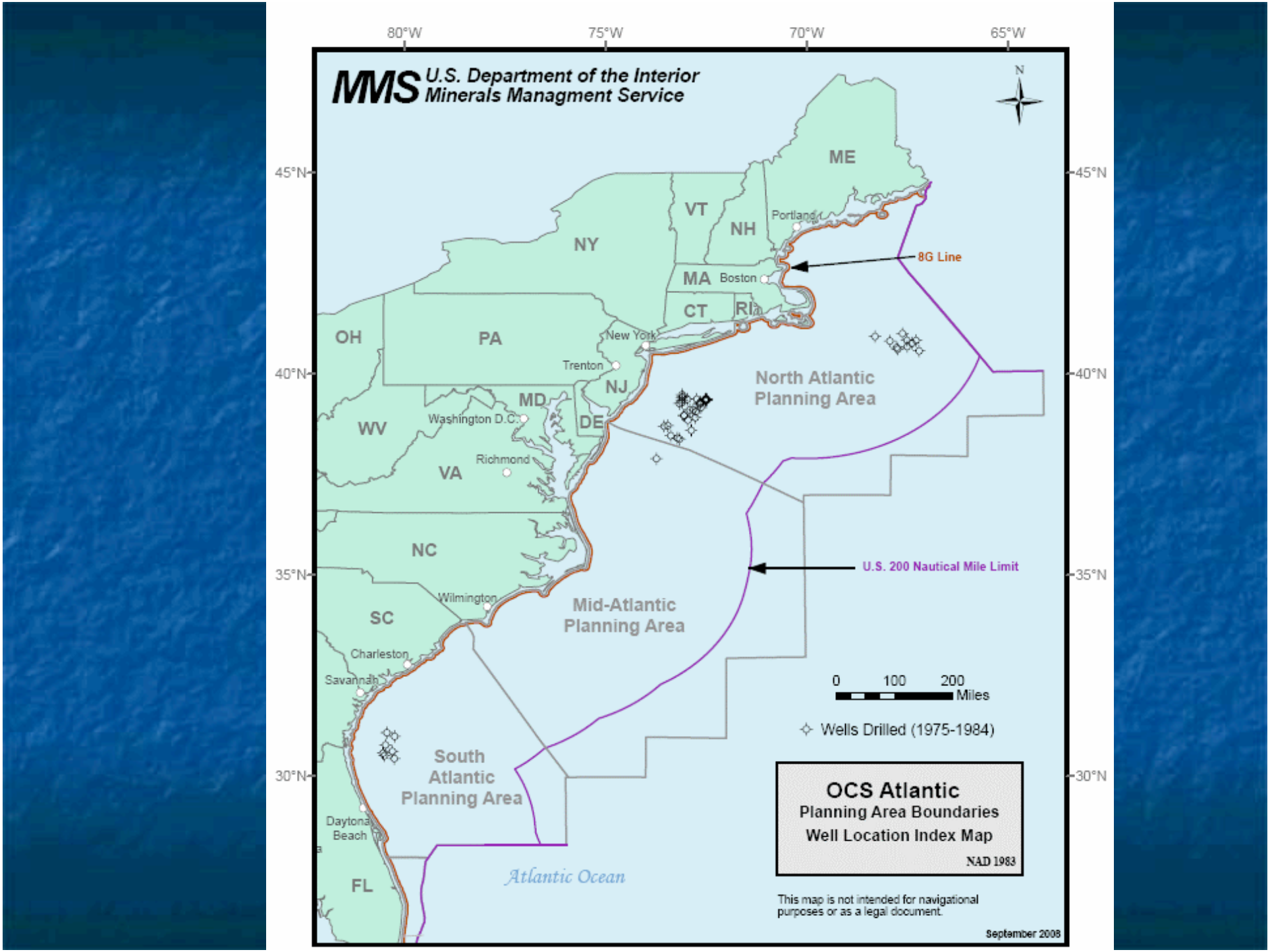



MMS U.S. Department of the Interior
Minerals Managment Service
N
80°W
75°W
70°W
65°W
45°N
40°N
35°N
30°N
25°N
ME
VT
NH
Portland
NY
MA
Boston
CT
RI
New York
PA
OH
Trenton
NJ
MD
DE
Washington D.C.
WV
VA
Richmond
NC
Wilmington
SC
GA
Charleston
Savannah
Daytona Beach
Tampa
FL
Miami
North Atlantic Planning Area
Mid-Atlantic Planning Area
South Atlantic Planning Area
Straits of Florida Planning Area
Atlantic Ocean
Outer Continental Shelf (OCS) Planning Area Boundaries
0 100 200
Miles
NAD 1983
This map is not intended for navigational purposes or as a legal document.
September 2008


Virginia Program Area
Mid Atlantic Planning Area Boundary
DE
MD
VA
NC
200 m
800 m
1600 m
2400 m
50 miles

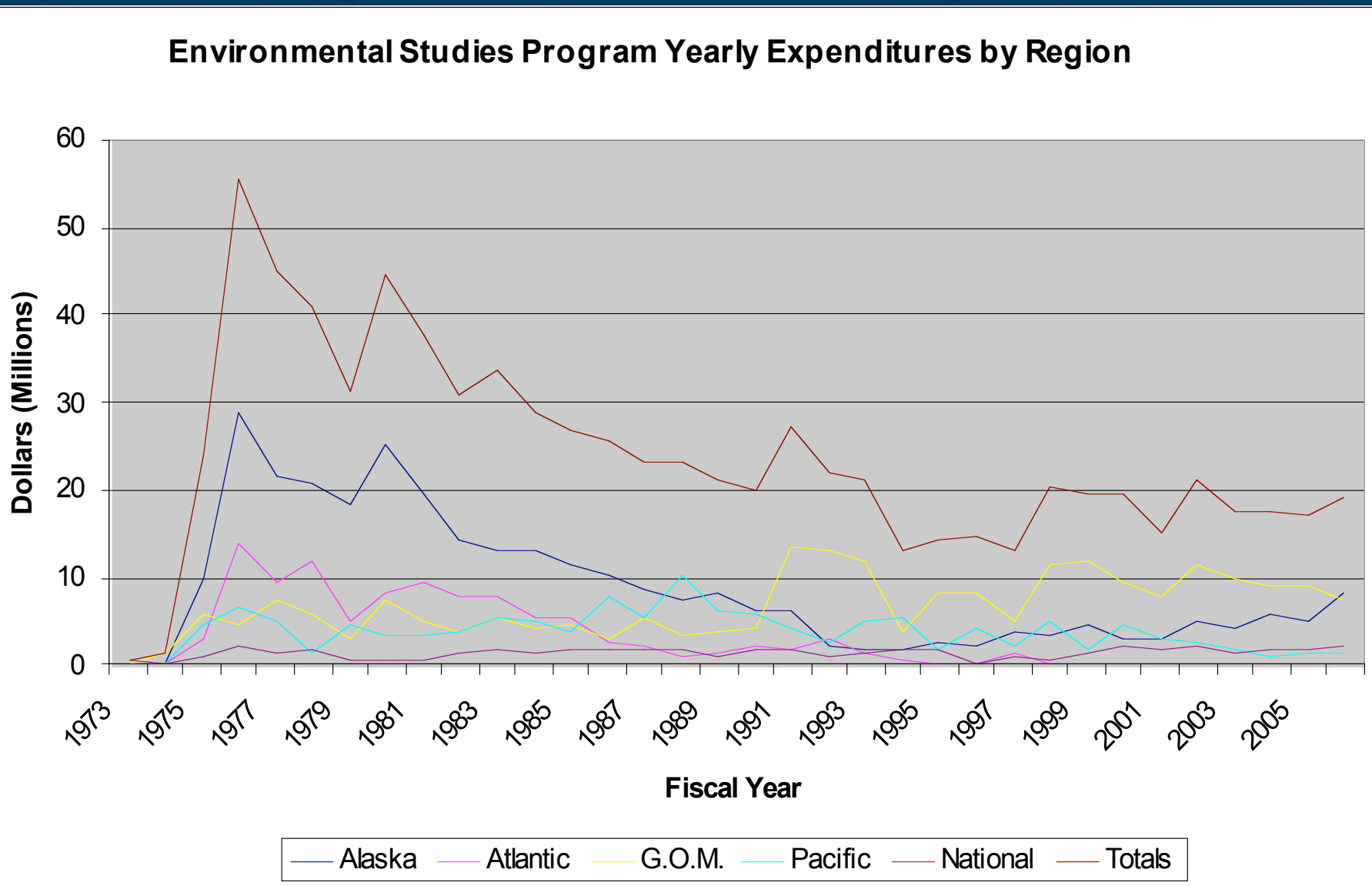
Lease Activity

- Ten oil and gas lease sales between 1976 and 1983
- 410 leases, last 8 leases relinquished in 2000
- Only one Virginia lease, no drilling


MMS U.S. Department of the Interior
Minerals Managment Service
80°W
75°W
70°W
65°W
45°N
40°N
35°N
30°N
N
ME
VT
NH
NY
MA
Boston
Portland
CT
RI
OH
PA
New York
Trenton
NJ
MD
DE
WV
Washington D.C.
Richmond
VA
NC
SC
Wilmington
Charleston
Savannah
FL
Daytona Beach
8G Line
U.S. 200 Nautical Mile Limit
North Atlantic Planning Area
Mid-Atlantic Planning Area
South Atlantic Planning Area
Atlantic Ocean
0 100 200
Miles
Wells Drilled (1975-1984)
OCS Atlantic
Planning Area Boundaries
Well Location Index Map
NAD 1983
This map is not intended for navigational purposes or as a legal document.
September 2008

Environmental Studies Program Mission

To provide the information needed to predict, assess, and manage impacts from offshore energy and marine mineral exploration, development, and production activities on human, marine, and coastal environments.


Environmental Studies Program Yearly Expenditures by Region
Dollars (Millions)
60
50
40
30
20
10
0
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
Fiscal Year
Alaska
Atlantic
G.O.M.
Pacific
National
Totals

Environmental Studies Program

- Over 120 separate studies funded in the Atlantic Region
- Spans the years from 1974 to 1998
- Over 70 summary documents and workshop proceedings

Environmental Studies Program

- Characterization of biological resources
- Observation and modeling of ocean currents
- Fates and effects of impact producing agents (oil, muds, noise, emissions)
- Social, economic and cultural impacts
- Oil spill risk assessment

Research Planning

- What is known -- gap analysis:
  - Gather & Synthesize existing literature
  - Workshops with scientists & stakeholders
- Identify the issues of concern
  - Discharges (oil, muds, emissions)
  - Noise
  - Habitat Disruption
  - Space-use conflicts
  - Effects on Social Systems

Determining Priorities

- Mission relevance
- Technically feasible
- Scientific merit
- Timing
- Applicability
- Affordable

Program Quality

- Information Needs Reviewed Internally/Externally
- NAS Reviews
- OCS Scientific Committee
- External Participation on Proposal Reviews
- Scientific/Quality Review Boards
- Peer Reviewed Literature

Partnering

- National Oceanographic Partnership Program (NOPP)
- National Oceanic and Atmospheric Administration (NOAA)
- United States Geological Survey (USGS)
- Coastal Marine Institutes –LSU and UAF

Research Web Pages:

MMS Environmental Studies:
http://www.mms.gov/eppd/sciences/esp/index.htm

Ongoing Studies:
http://www.mms.gov/eppd/sciences/esp/profiles/index.htm

Completed Reports:
https://www.gomr.mms.gov/homepg/espis/espisfront.asp

MMS Technology: www.mms.gov/tarphome

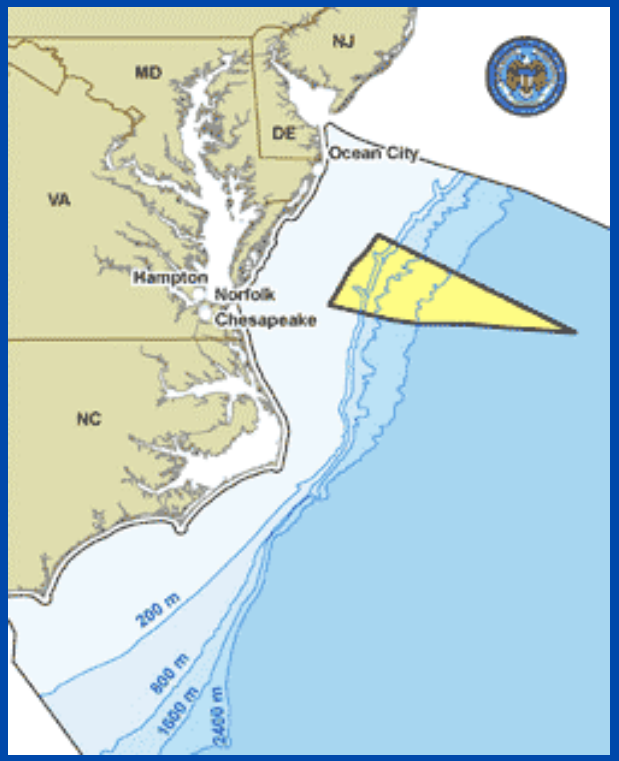
International Committee on Regulatory Research and Development: www.icrard.org

Environmental Studies Program Marine Minerals

- Sand: over 40 studies completed or in progress
- 30 million yd^3; 23 sites
- 5 states; 125 miles of coastline

Shell Exploration & Production

MMS Workshop - Environmental Research Needs in Support of Potential Virginia Offshore Oil and Gas Activities



Activities Associated with Offshore Oil & Gas Development

December 3-4, 2008

Disclaimer statement

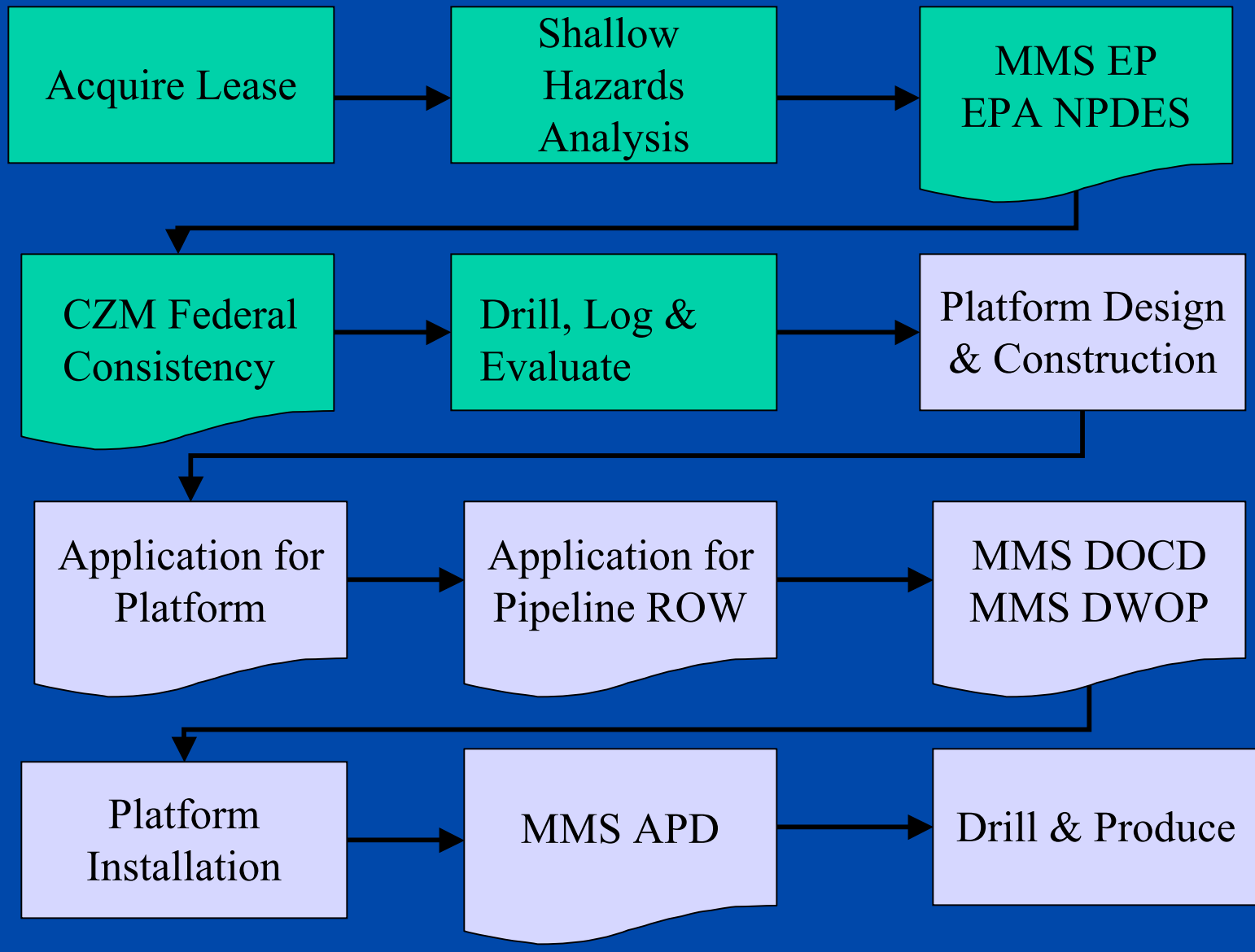
This presentation contains forward-looking statements concerning the financial condition, results of operations and businesses of Royal Dutch Shell. All statements other than statements of historical fact are, or may be deemed to be, forward-looking statements. Forward-looking statements are statements of future expectations that are based on management's current expectations and assumptions and involve known and unknown risks and uncertainties that could cause actual results, performance or events to differ materially from those expressed or implied in these statements. Forward-looking statements include, among other things, statements concerning the potential exposure of Royal Dutch Shell to market risks and statements expressing management's expectations, beliefs, estimates, forecasts, projections and assumptions. These forward-looking statements are identified by their use of terms and phrases such as ''anticipate'', ''believe'', ''could'', ''estimate'', ''expect'', ''intend'', ''may'', ''plan'', ''objectives'', ''outlook'', ''probably'', ''project'', ''will'', ''seek'', ''target'', ''risks'', ''goals'', ''should'' and similar terms and phrases. There are a number of factors that could affect the future operations of Royal Dutch Shell and could cause those results to differ materially from those expressed in the forward-looking statements included in this Report, including (without limitation): (a) price fluctuations in crude oil and natural gas; (b) changes in demand for the Group's products; (c) currency fluctuations; (d) drilling and production results; (e) reserve estimates; (f) loss of market and industry competition; (g) environmental and physical risks; (h) risks associated with the identification of suitable potential acquisition properties and targets, and successful negotiation and completion of such transactions; (i) the risk of doing business in developing countries and countries subject to international sanctions; (j) legislative, fiscal and regulatory developments including potential litigation and regulatory effects arising from recategorisation of reserves; (k) economic and financial market conditions in various countries and regions; (l) political risks, project delay or advancement, approvals and cost estimates; and (m) changes in trading conditions. All forward-looking statements contained in this presentation are expressly qualified in their entirety by the cautionary statements contained or referred to in this section. Readers should not place undue reliance on forward-looking statements. Each forward-looking statement speaks only as of the date of this presentation, May 4, 2006. Neither Royal Dutch Shell nor any of its subsidiaries undertake any obligation to publicly update or revise any forward-looking statement as a result of new information, future events or other information. In light of these risks, results could differ materially from those stated, implied or inferred from the forward-looking statements contained in this document.

The United States Securities and Exchange Commission (SEC) permits oil and gas companies, in their filings with the SEC, to disclose only proved reserves that a company has demonstrated by actual production or conclusive formation tests to be economically and legally producible under existing economic and operating conditions. We use certain terms in this presentation, such as "oil in place" that the SEC's guidelines strictly prohibit us from including in filings with the SEC. U.S. Investors are urged to consider closely the disclosure in our Form 20-F, File No 1-32575 and disclosure in our Forms 6-K file No, 1-32575, available on the SEC website www.sec.gov. You can also obtain these forms from the SEC by calling 1-800-SEC-0330.

Offshore Activities Summary

- Seismic acquisition
- Lease sale
- Exploratory drilling and seismic surveys
- Shallow hazard survey
- Environmental and engineering baseline surveys
- Delineation and development drilling
- Platform/Pipeline Installation
- Shore base facility construction
- Production operations
- Decommissioning

Flowchart of Offshore E&P Regulatory Process



OCS Regulatory Approval & *Environmental Review* Processes

1. Develop 5-Year Program

Pre Lease

Solicit Comments → (50-day Comment Period) → Draft Proposed Program Published → (60-day Comment Period) → Proposed Program / *Draft EIS Published* → (90-day Comment Period) → Proposed Final Program / *Final EIS* → (60-day Period with Congress) → 5-Year Program Announced

2 ½ -3 yrs.

2. Planning for Specific Sale

Call for Information Published → (30-day Comment Period) → Sale Area Identification → *Draft EIS Distributed* → (45-60 day Comment Period) → *Final EIS Published* / CZM review begins → (↔ 30-day Comment Period / ↔ 3-month Period*) → Proposed Notice of Sale → (60-day Period) → Lease Sale → Leases Issued

12-14 mos.

3. Exploration Plan (EP) Approval

EP/EIA Submitted → *Environmental Assessment* → (30-day Period) → CZM Review Starts → (3-month Period*) → Exploration Plan Approved → Well Permit Approved → Exploration Drilling Starts

3-6 mos.

Post Lease

4a. Development and Coordination Document (DOCD) Approval*

DOCD/EIA submitted → *Environmental Assessment* → (30-day Period) → CZM Review Starts → (3-month Period*) → DOCD approved → Facility Permits Approved → Development Drilling Starts

4-8 mos.

4b. Development and Production Plan (DPP) Approval **

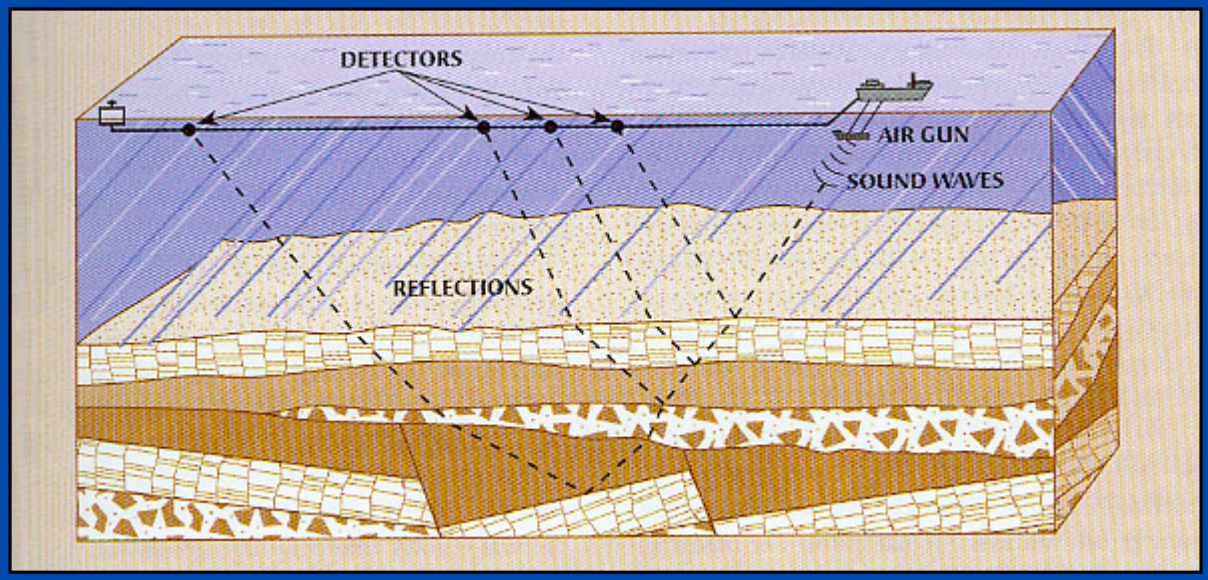
DPP submitted → CZM Review Starts → (3-month Period*) → *Draft EIS Published* → (90-day Comment Period) → *Final EIS Published* → DPP Approved → Production Well Application

12-18 mos.

* An additional 3-month period can be requested by the affected state. ** DPP used outside of Gulf of Mexico current planning areas.

EIA = Environmental Impact Analysis

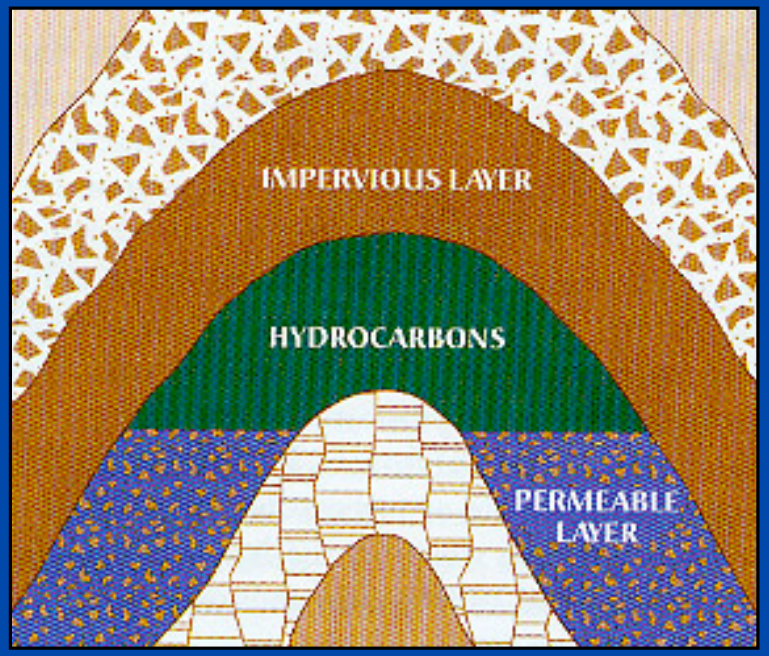
Seismic Surveying

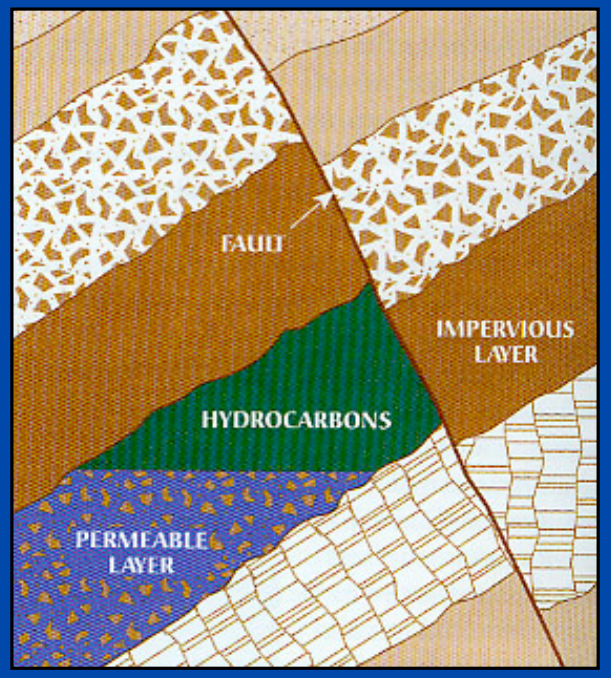


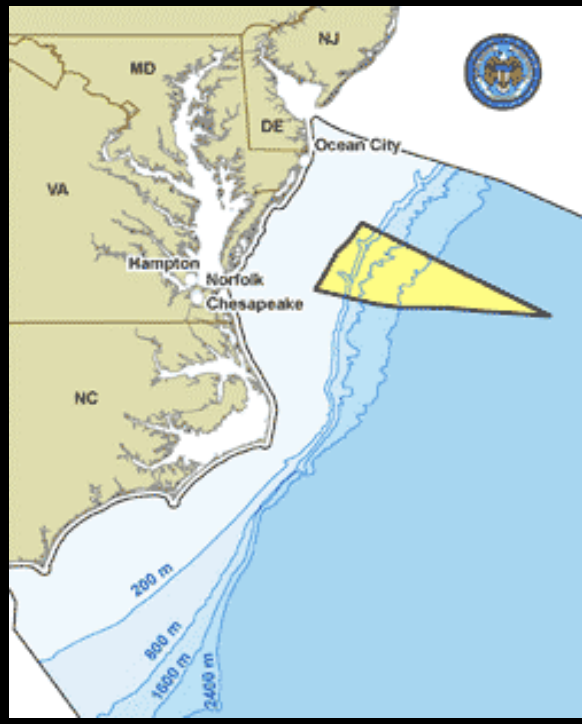
- Seismic surveys provide detailed information about subsurface formations.
- A special air gun is used to produce sound that is reflected from the rock layers.
- Detectors pick up the sound reflections.
- The arrival times of each reflection indicate the depth of the rock layers, which is used to produce a cross section view of the subsurface.

Hydrocarbon Traps

- Earth forces create *folding* that results in *anticlinal* traps.
- Hydrocarbons migrate into a porous and permeable layer where they are trapped by an impervious layer.
- A *fault* is a fracture or break in rock layers created by movements in the earth.
- A *fault trap* has an impervious layer that moves opposite a porous and permeable layer, which traps the hydrocarbons.

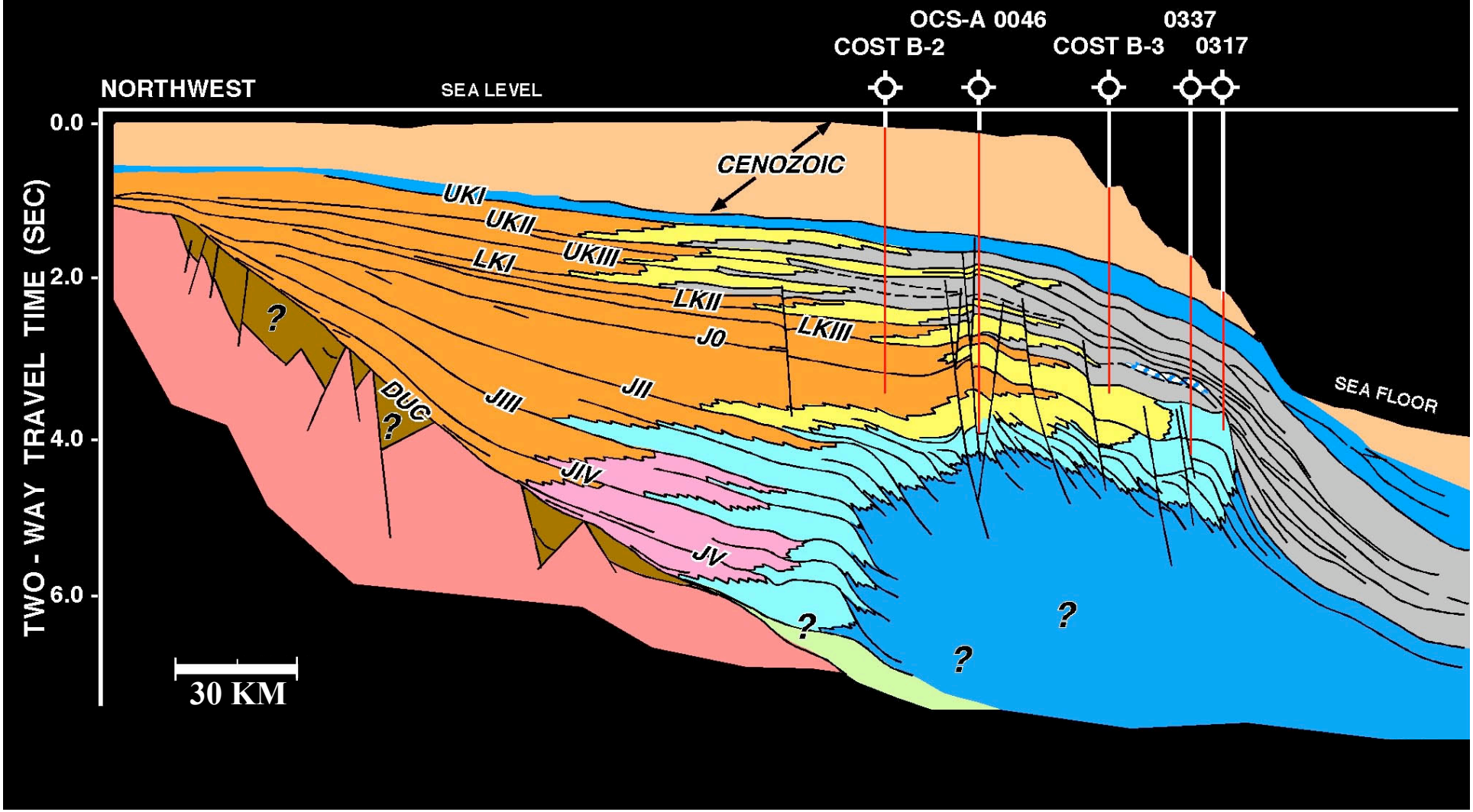




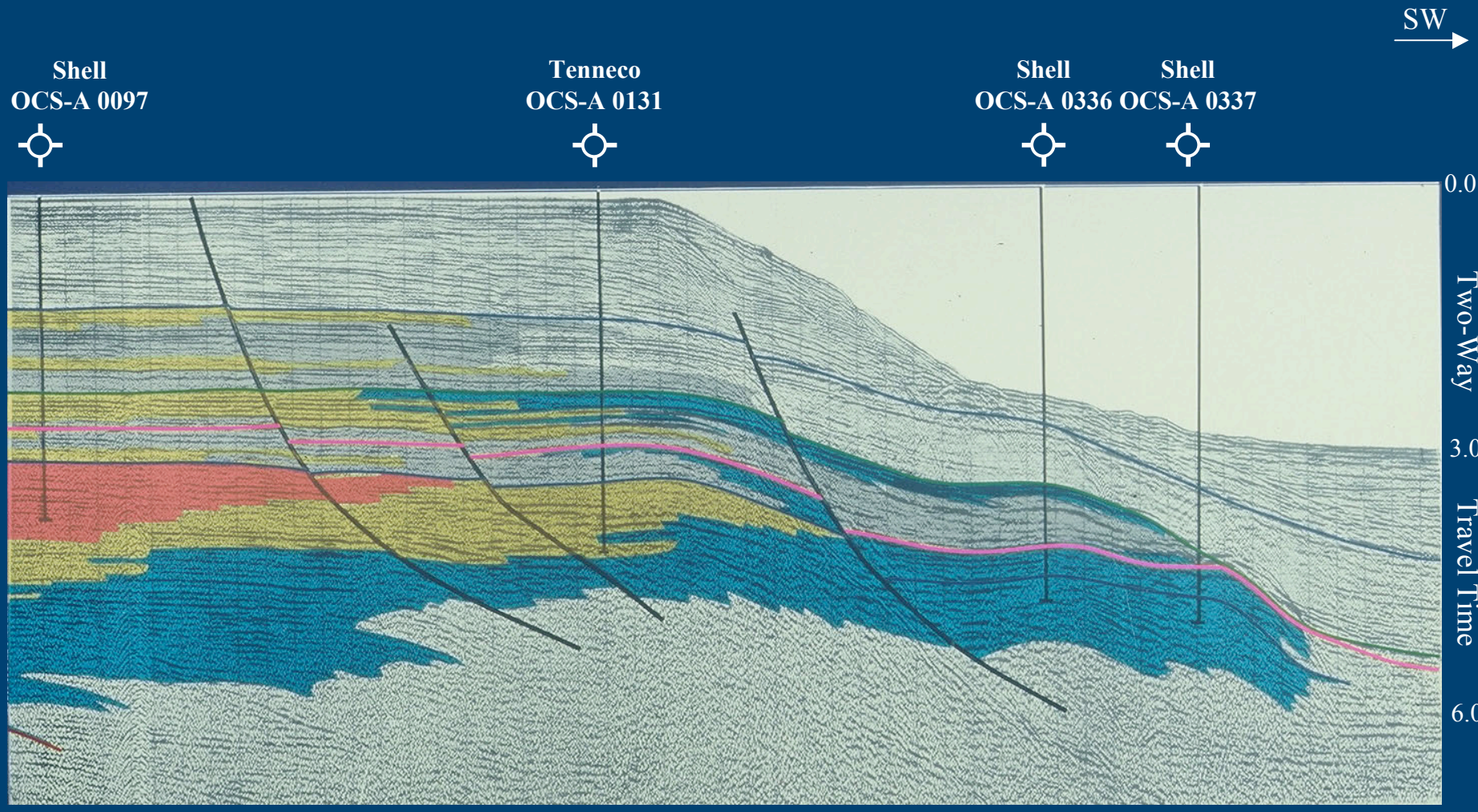


Atlantic Margin Basins

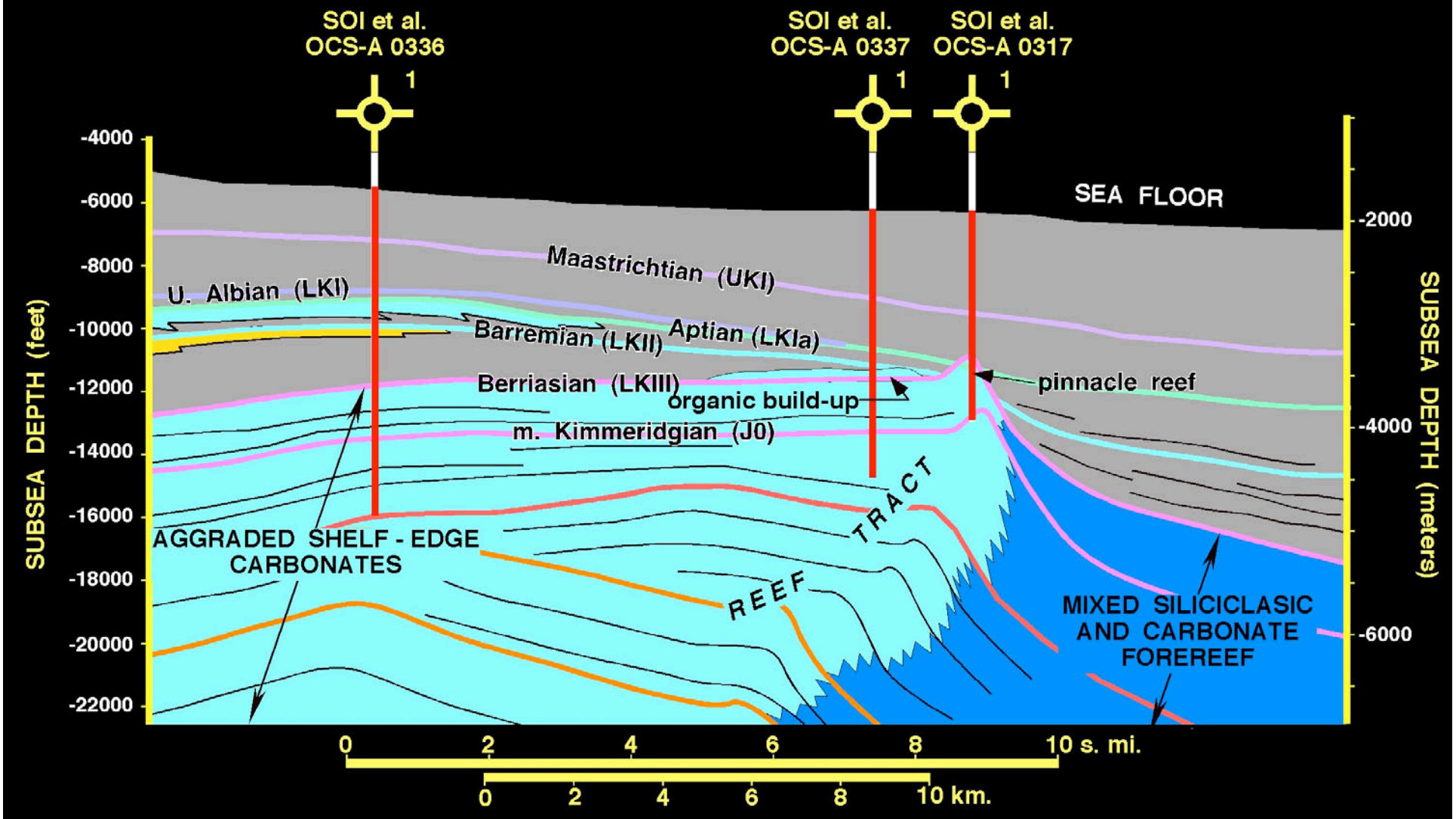
Baltimore Canyon Trough Seismic Stratigraphy



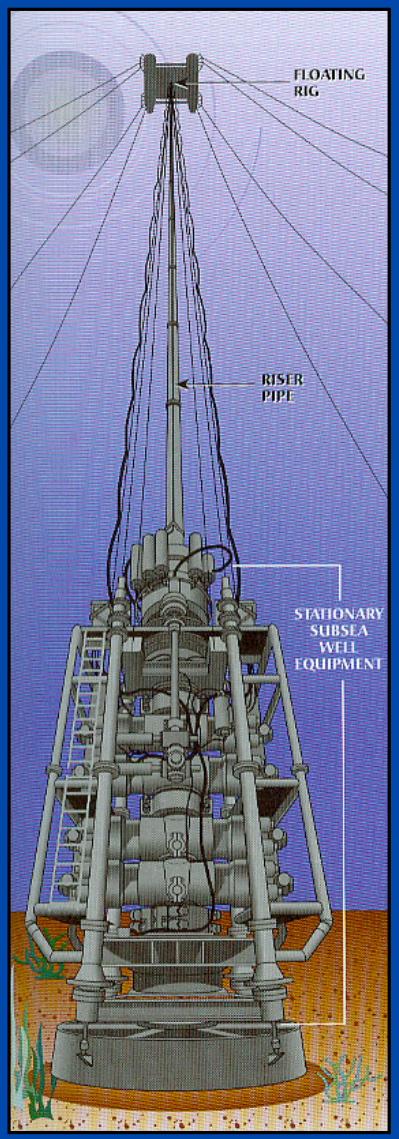
Baltimore Canyon Trough
Jurassic Platform



Baltimore Canyon Trough
Jurassic Carbonate Platform



Exploratory Drilling



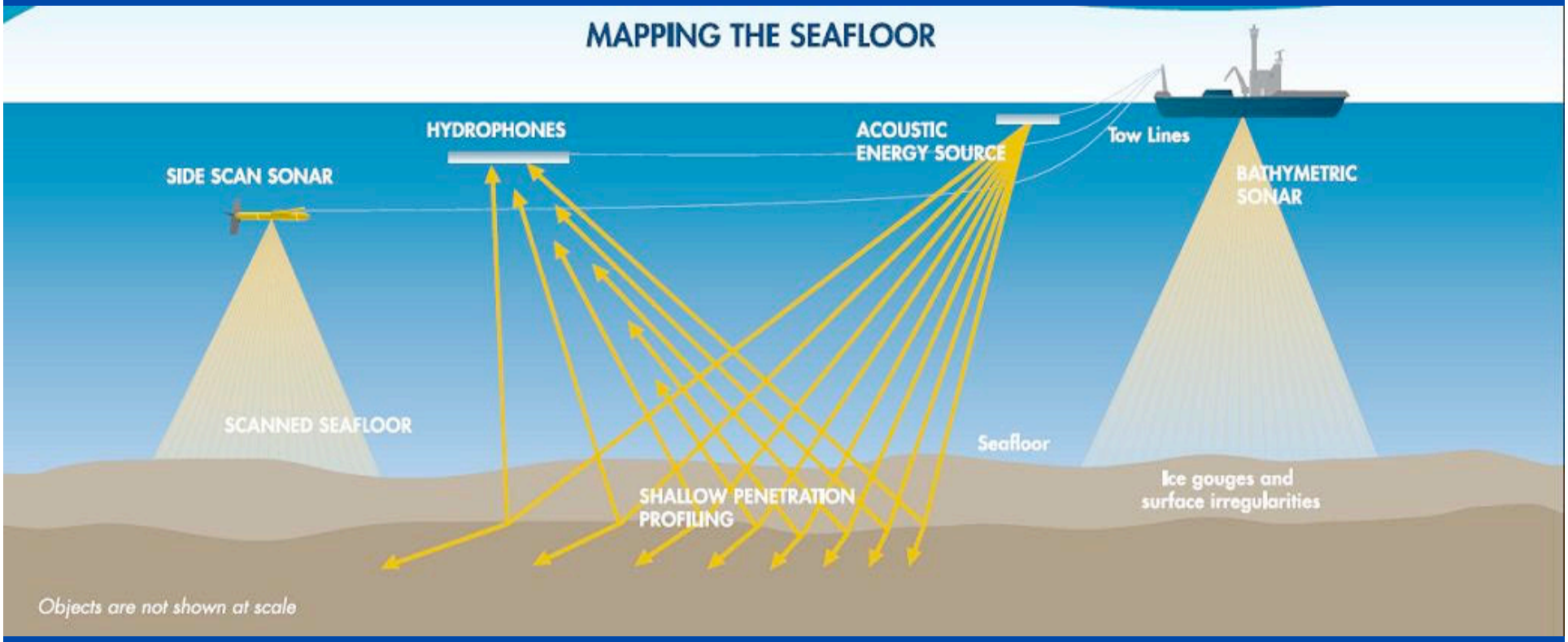
One DP Semi-sub Drilling Rig for Noble Drilling

(Scheduled Delivery in 2008)

Noble Clyde Boudreaux

Water Depth: 10,000 Feet
Variable Load: 7,000 ST
Drilling Depth: 35,000 Feet
Mud Capacity: 10,085 bbls
Mud System: 7,500 Psi
Delivered : June 2007

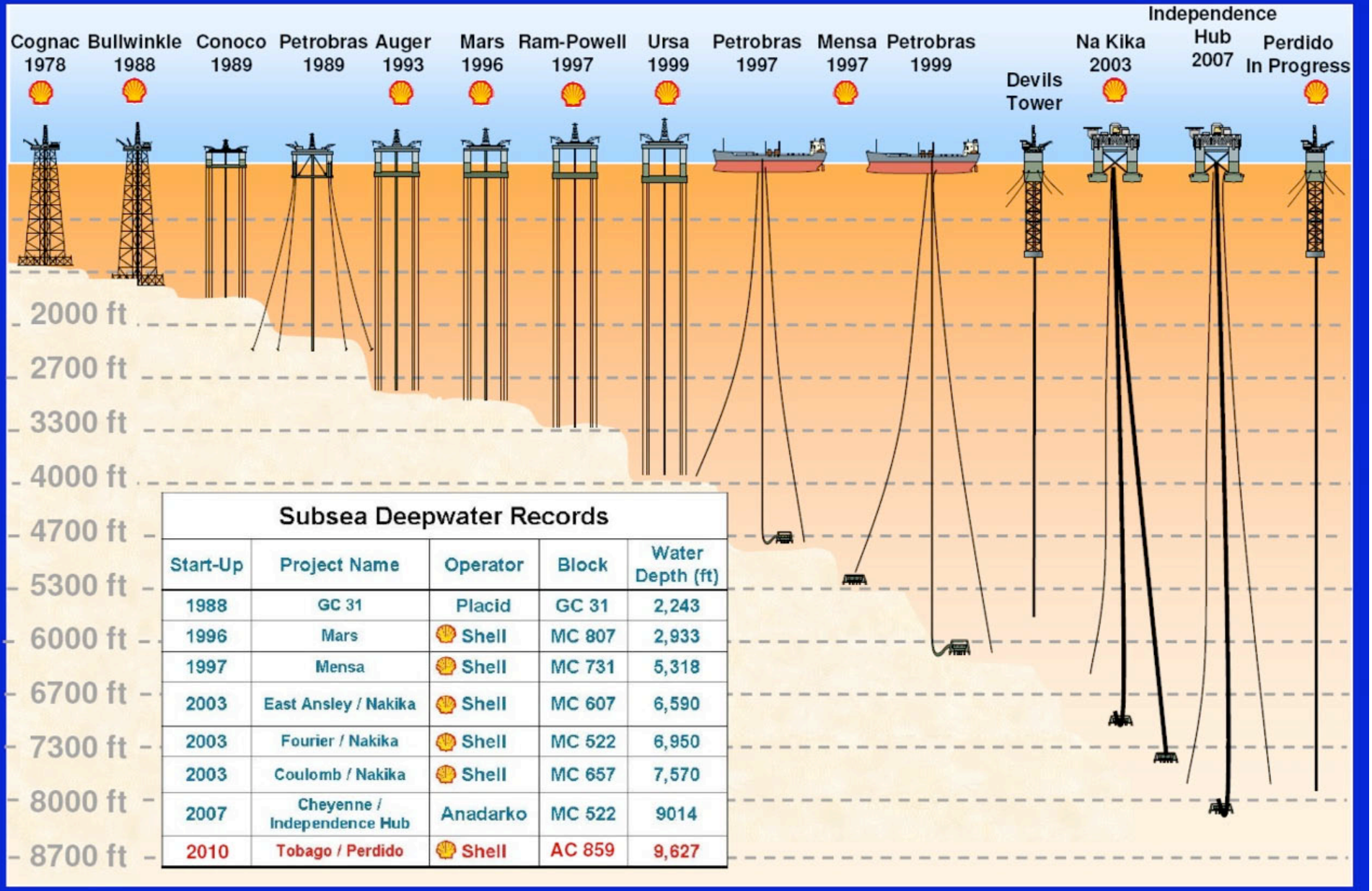
Shallow Hazards Surveys



State-of-the-art technology is used to determine the best surface locations to drill

Industry Deepwater Milestones

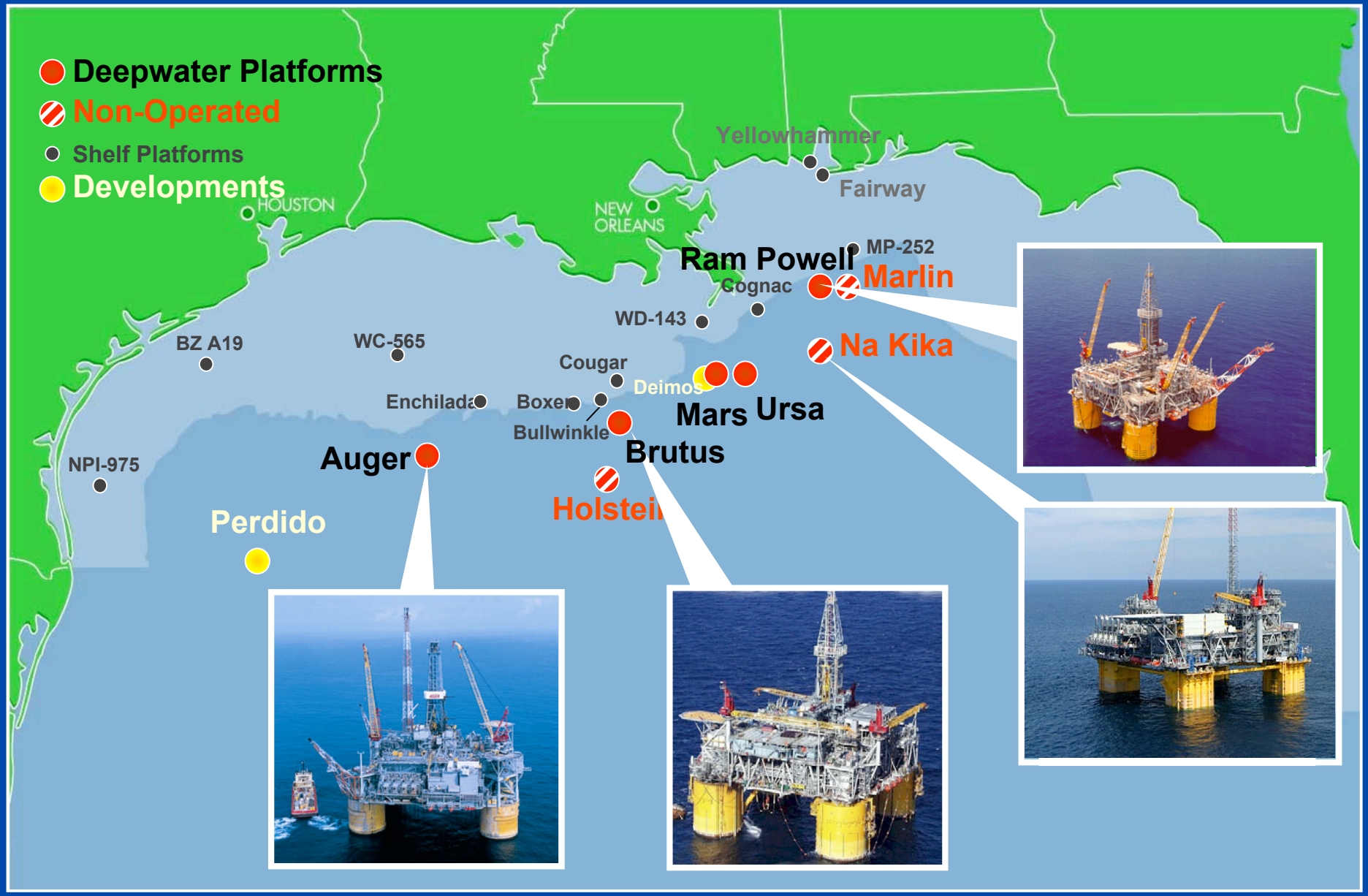
EPW Developments - a long history of pushing the boundaries in Deepwater



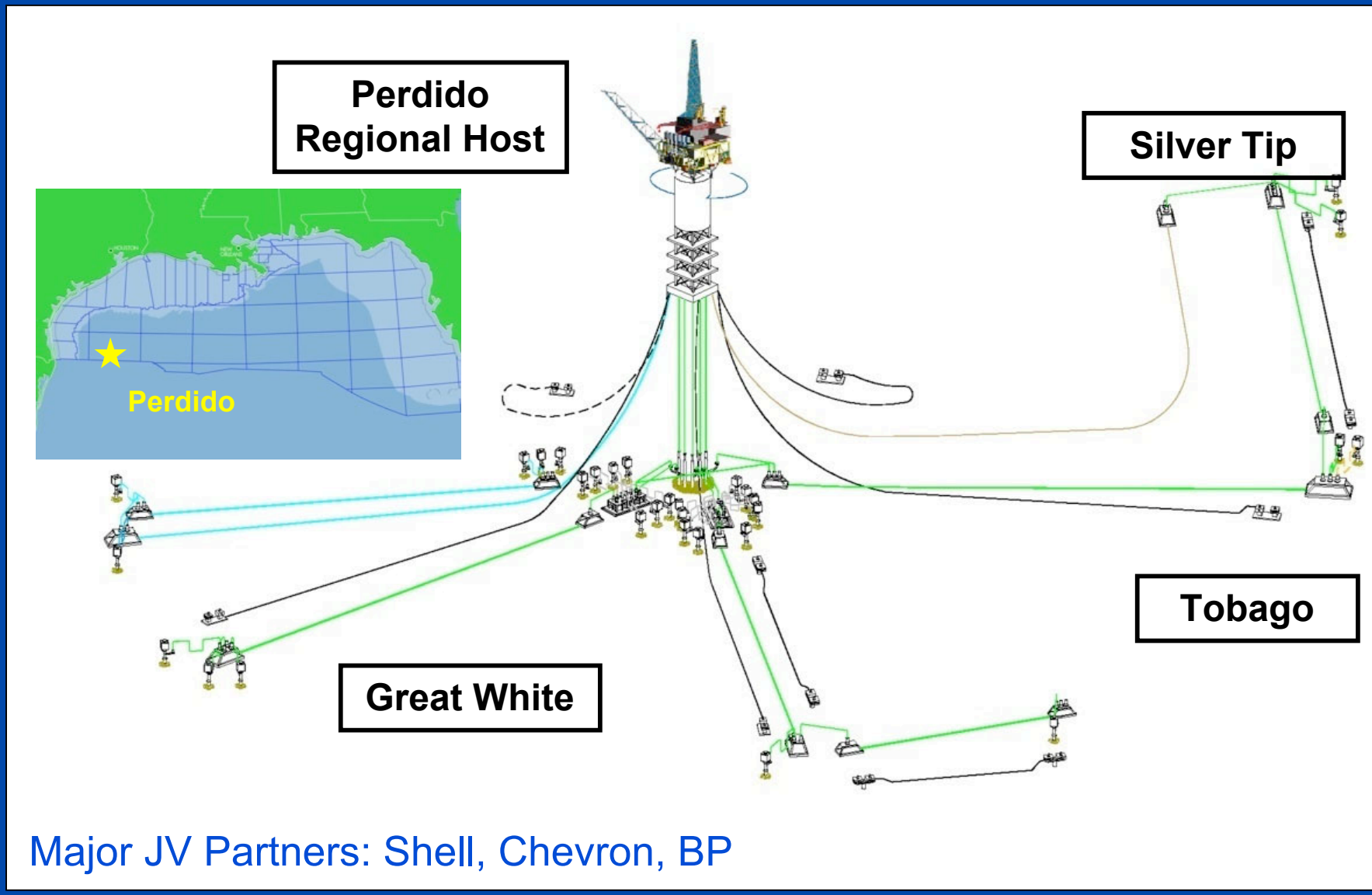
Subsea Deepwater Records

Start-Up	Project Name	Operator	Block	Water Depth (ft)
1988	GC 31	Placid	GC 31	2,243
1996	Mars	Shell	MC 807	2,933
1997	Mensa	Shell	MC 731	5,318
2003	East Ansley / Nakika	Shell	MC 607	6,590
2003	Fourier / Nakika	Shell	MC 522	6,950
2003	Coulomb / Nakika	Shell	MC 657	7,570
2007	Cheyenne / Independence Hub	Anadarko	MC 522	9014
2010	Tobago / Perdido	Shell	AC 859	9,627

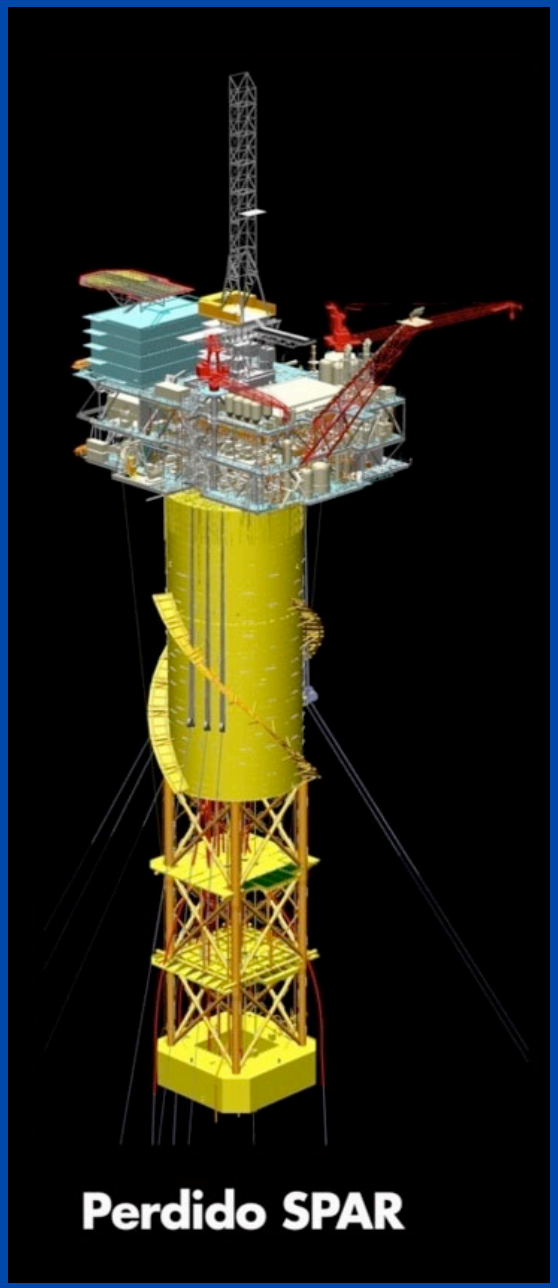
Shell in the Gulf of Mexico



Perdido Development



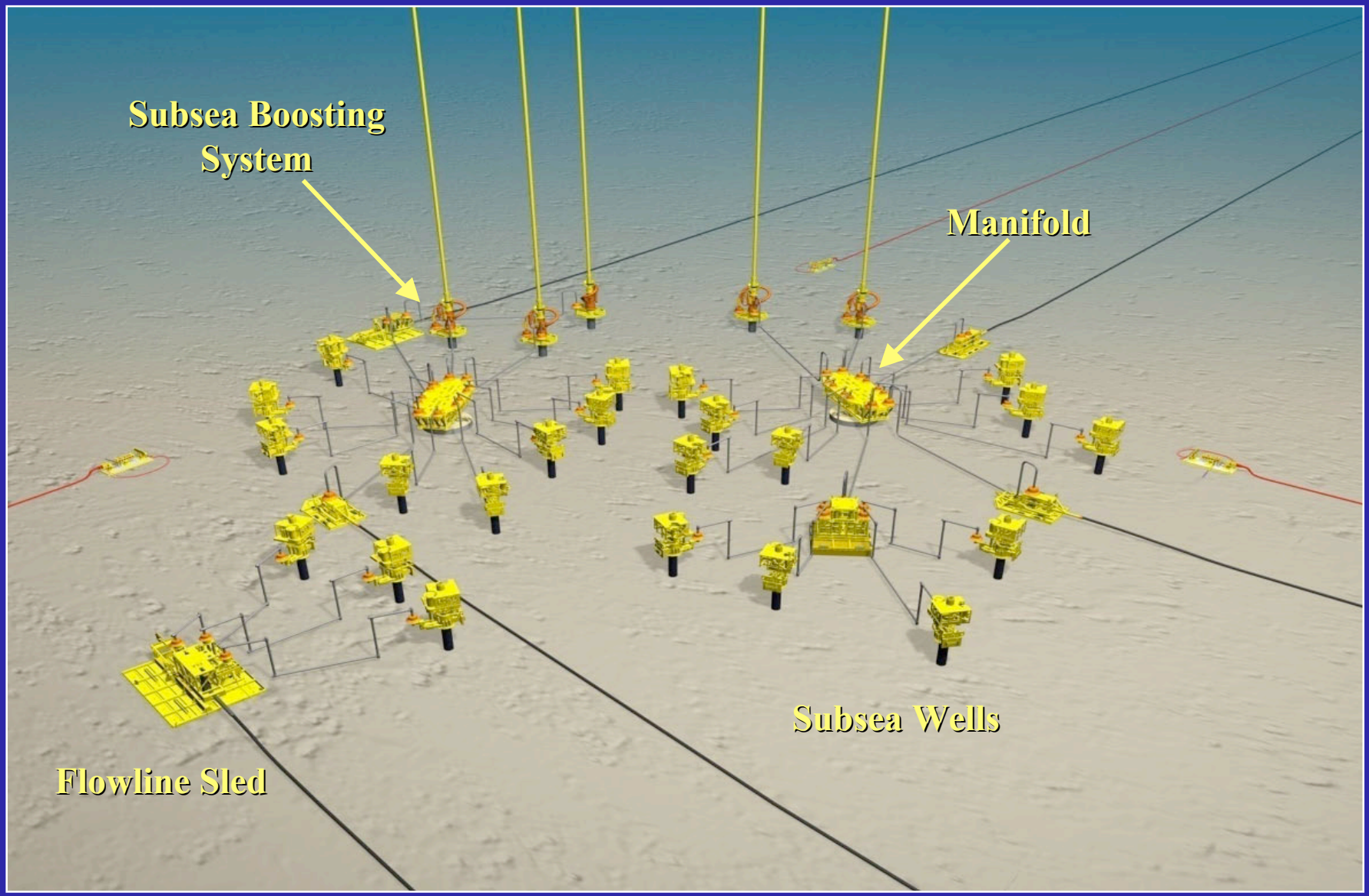
Major JV Partners: Shell, Chevron, BP



Key Features

- Deepest spar at 7817 ft (2382m); 6 slot well bay
- Deepest subsea production at Tobago 9627 ft (2934m)
- 34 wells (22 DVA subsea, 12 remote subsea)
- All production commingled, gas and liquid separated and pumped subsea
- 100k bopd, 200 mmscf/d and 80k bwipd topsides processing
- Light-weight, “single lift” topsides; enhanced safety systems; 150 man quarters
- Oil (77 miles) and gas (107 miles) export pipelines; deepest producing pipeline cut and tie-in (5000 ft)

Subsea Layout under the Spar



Offshore Pipelay Operations

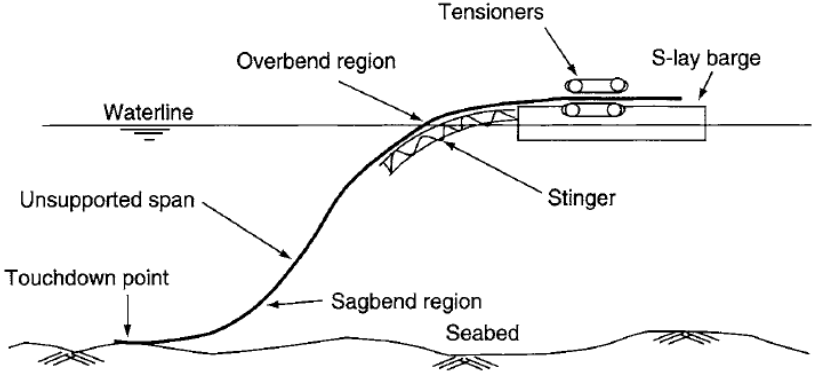


FIGURE 11.1 S-lay Configuration.

Semi-sub S-lay barge--LB 200

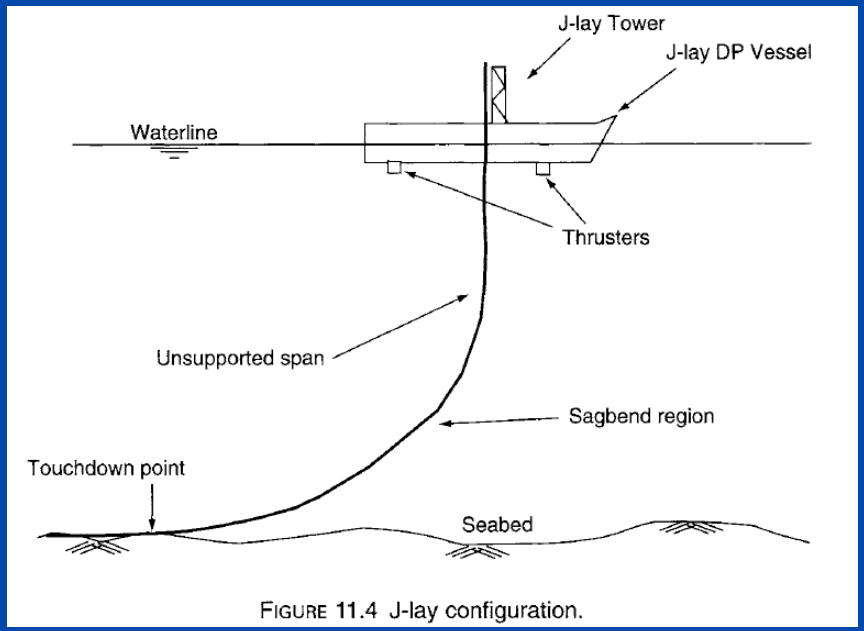
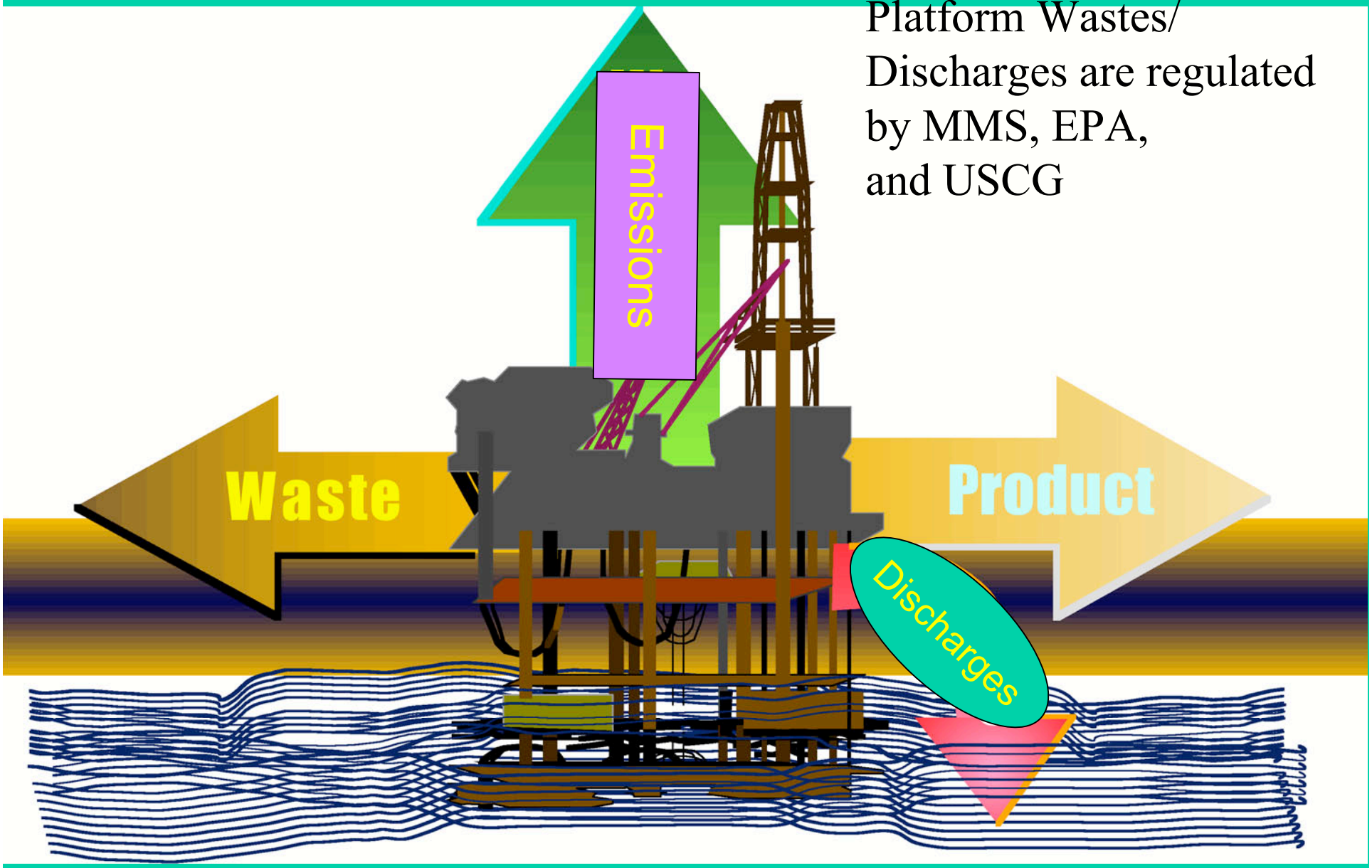


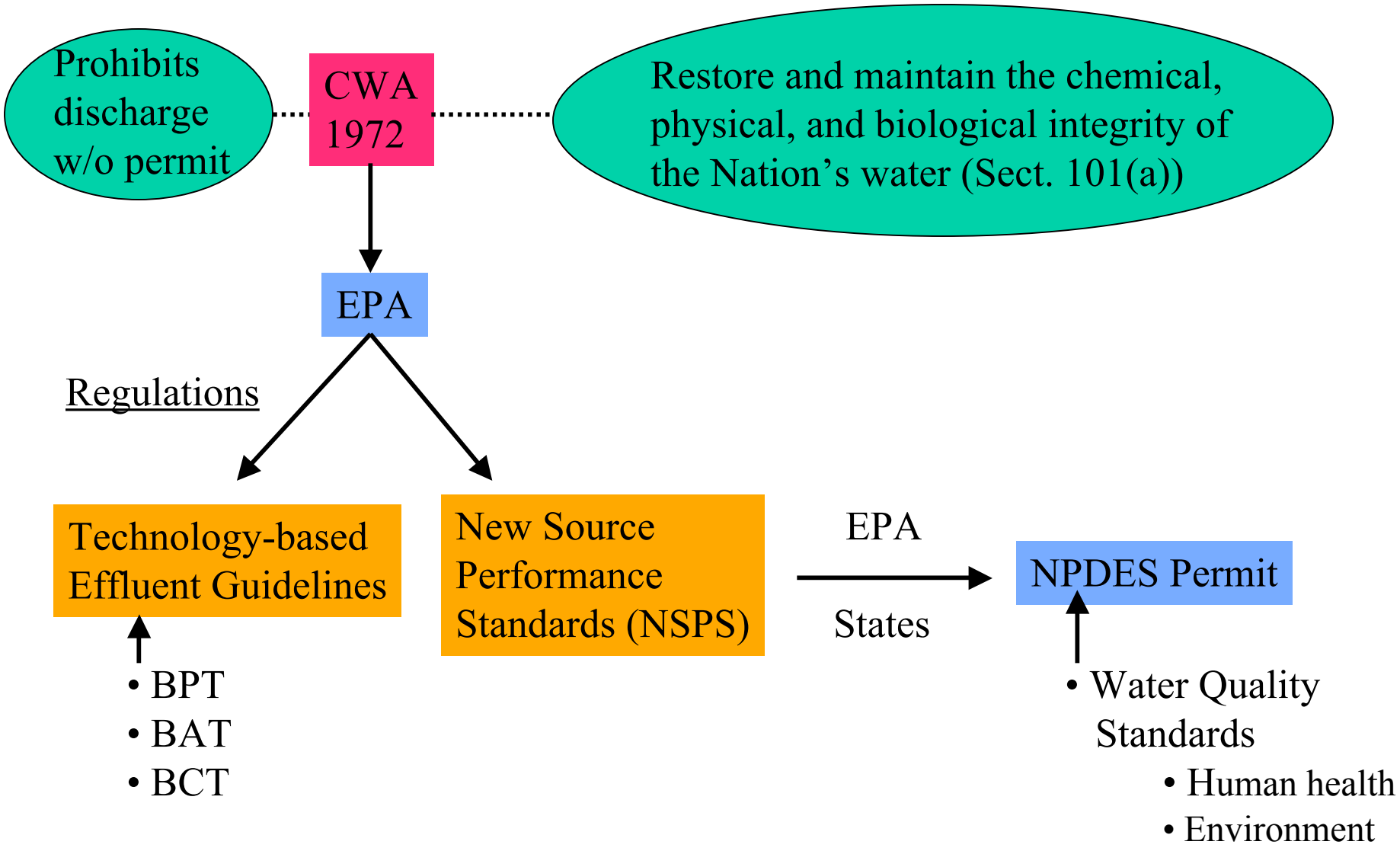
FIGURE 11.4 J-lay configuration.

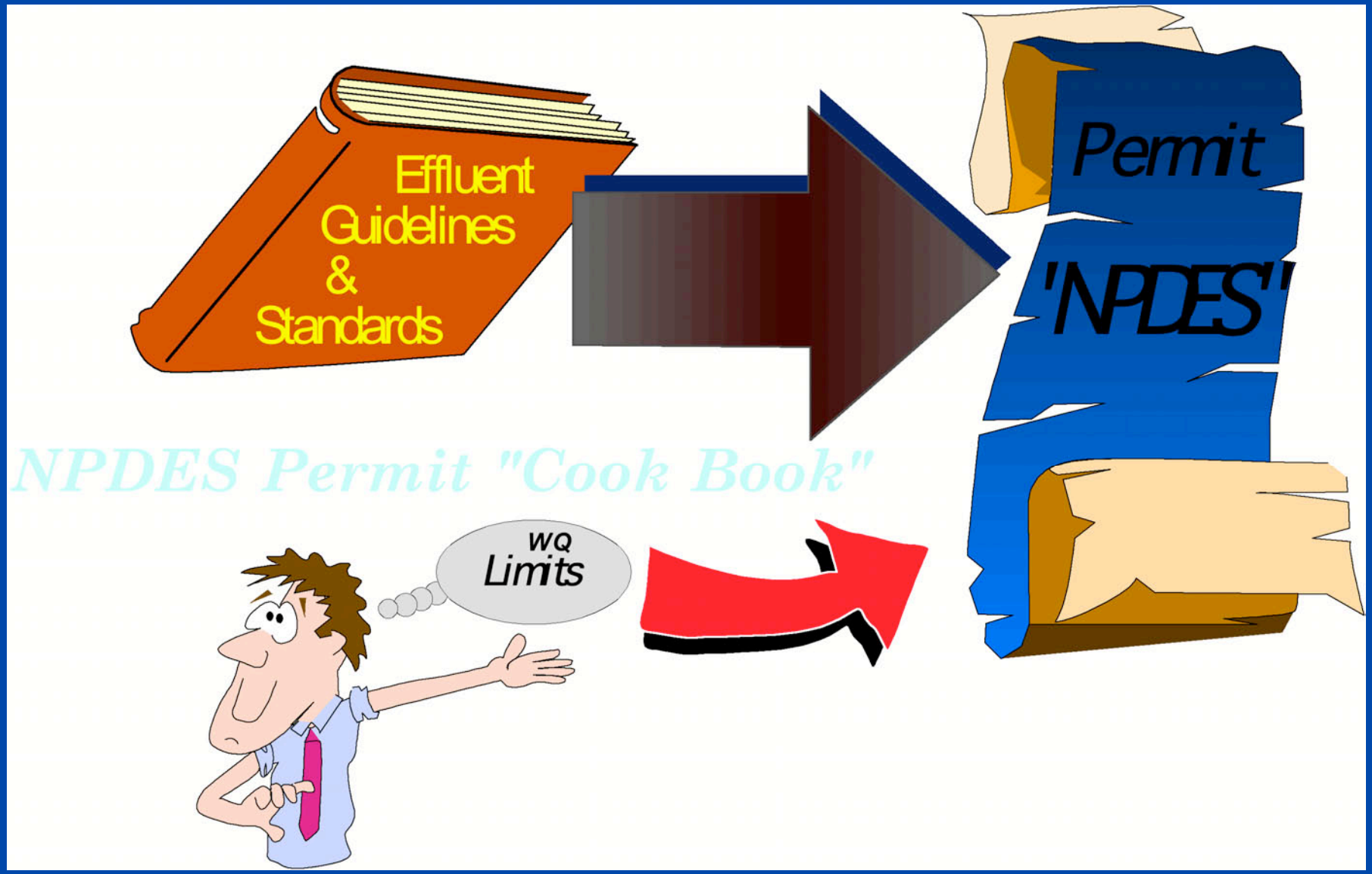
Technip's DP vertical reel vessel Deep Blue (J-lay)

Platform Wastes/
Discharges are regulated
by MMS, EPA,
and USCG



WATER DISCHARGE PERMITS




Effluent
Guidelines
&
Standards
Permit
'NPDES'
NPDES Permit "Cook Book"
WQ
Limits

Platform Discharges

- Produced Water
  - Oil & Grease…42 mg/l daily max / 29 mg/l mo. avg.
  - Toxicity…no effects at edge of mixing zone
- Drilling Fluids
  - No free oil…by static sheen test
  - Toxicity…LC50 $\geq$ 30,000 ppm
  - Mercury and Cadmium…1 mg/kg / 3 mg/kg in Barite
- Workover, Treatment, and Completion Fluids
  - Oil & Grease…42 mg/l daily max / 29 mg/l mo. avg.
  - No free oil…by static sheen

Platform Discharges

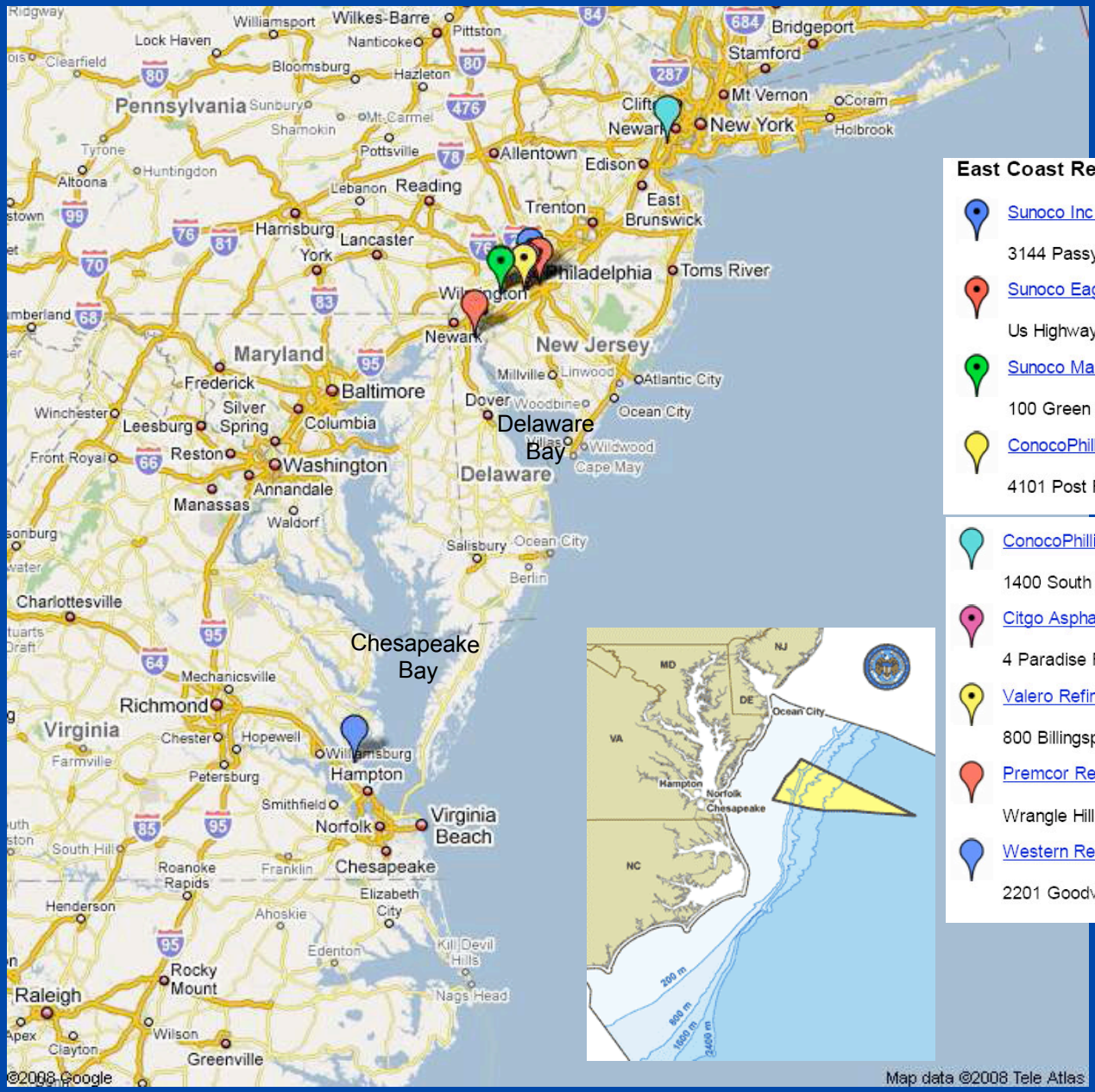
- Sanitary waste…residual chlorine 1 mg/l min.
- Domestic waste…no floating solids
- Misc. discharges…no free oil by visual observation
- Misc. discharges chemically treated
  - No free oil by visual observation
  - Toxicity…no effects at edge of mixing zone

Platform Discharges

- Synthetic based drilling fluid (olefin/ester)
  - No discharge of whole fluids
  - Stock base fluid limits
    - Poly-nuclear Aromatic Hydrocarbons (PAH)
    - Sediment toxicity
    - Biodegradation Rate
  - Discharge limits
    - Formation oil by RPE/GCMS
    - Sediment toxicity
    - Retained fluids on cuttings $\leq$ 6.9 % or implement BMP

East Coast Refineries

Total Refining Capacity = 1.5 MBPD



East Coast Refineries

Sunoco Inc R&M Refinery

3144 Passyunk Ave., Pennsylvania, PA (335,000 barrels per day)

Sunoco Eagle Point Refinery

Us Highway 130 South & Highway 295, Westville, NJ (145,000 barrels per day)

Sunoco Marcus Hook Refinery

100 Green St., Marcus Hook, PA (178,000 barrels per day)

ConocoPhillips Trainer Refinery

4101 Post Rd., Trainer, PA (185,000 barrels per day)

ConocoPhillips Bayway Refinery

1400 South Park Ave., Linden, NJ (238,000 barrels per day)

Citgo Asphalt Refining Co.

4 Paradise Rd., Paulsboro, NJ (32,000 barrels per day)

Valero Refining Co.

800 Billingsport Rd., Paulsboro, NJ (160,000 barrels per day)

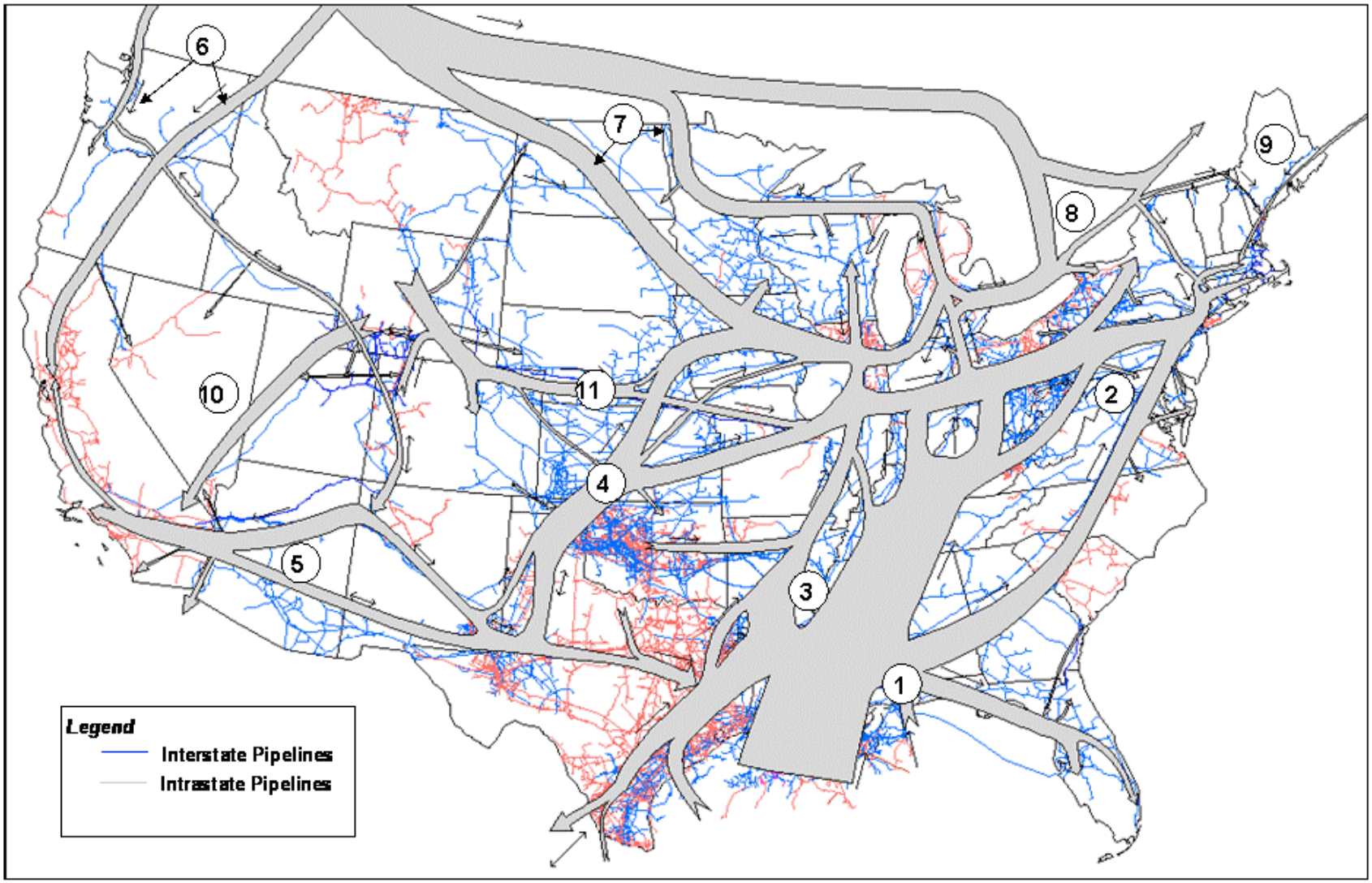
Premcor Refining Group, Inc.

Wrangle Hill Rd., Delaware City, DE (182,200 barrels per day)

Western Refining Yorktown Inc.

2201 Goodwin Neck Rd., Grafton, VA (63,650 barrels per day)

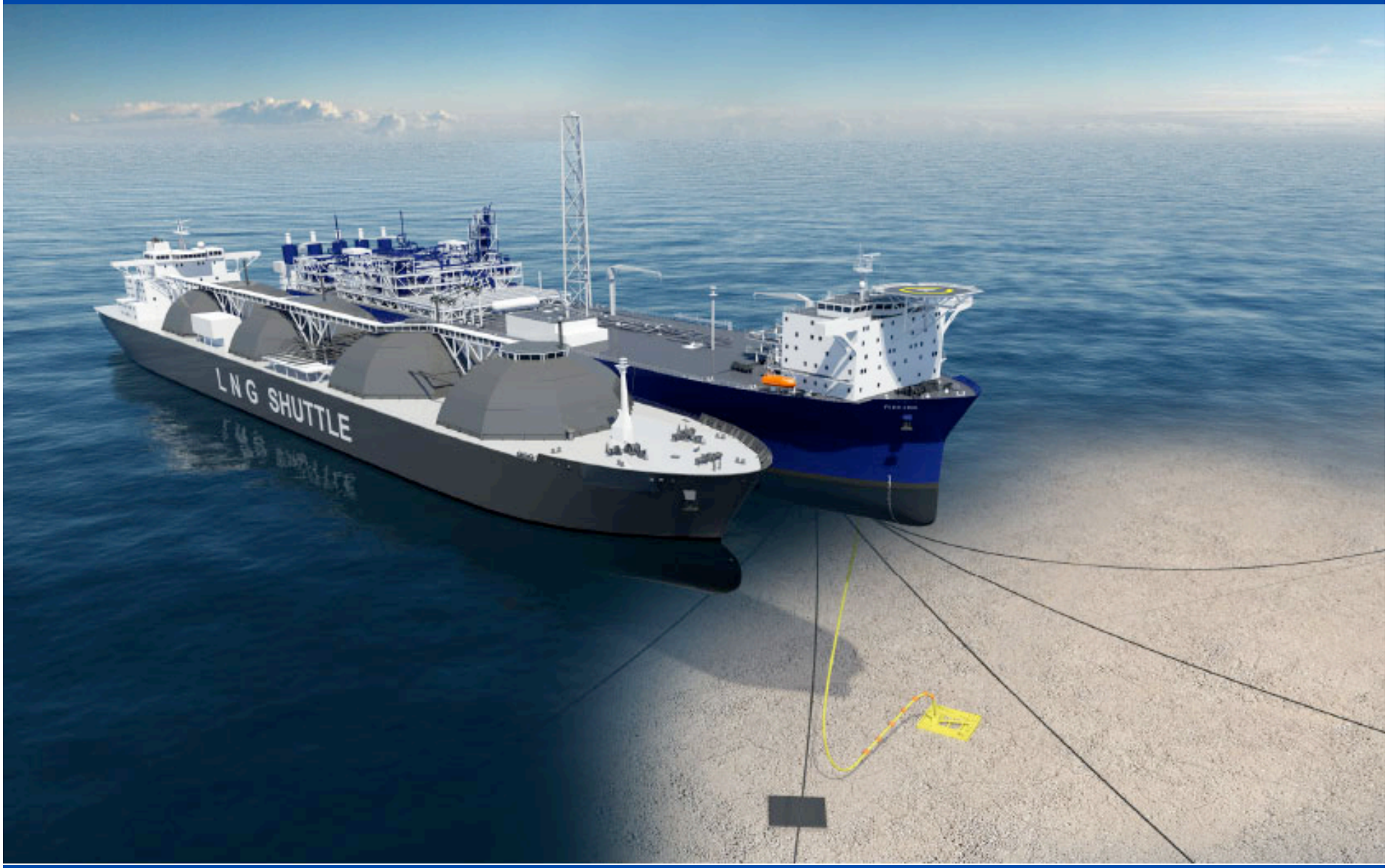
Major U.S. Natural Gas Transportation Corridors, 2008



Source: Energy Information Administration, Office of Oil and Gas, Natural Gas Division, GasTran Gas Transportation Information System.

The EIA has determined that the informational map displays here do not raise security concerns, based on the application of the Federal Geographic Data Committee's *Guidelines for Providing Appropriate Access to Geospatial Data in Response to Security Concerns*.

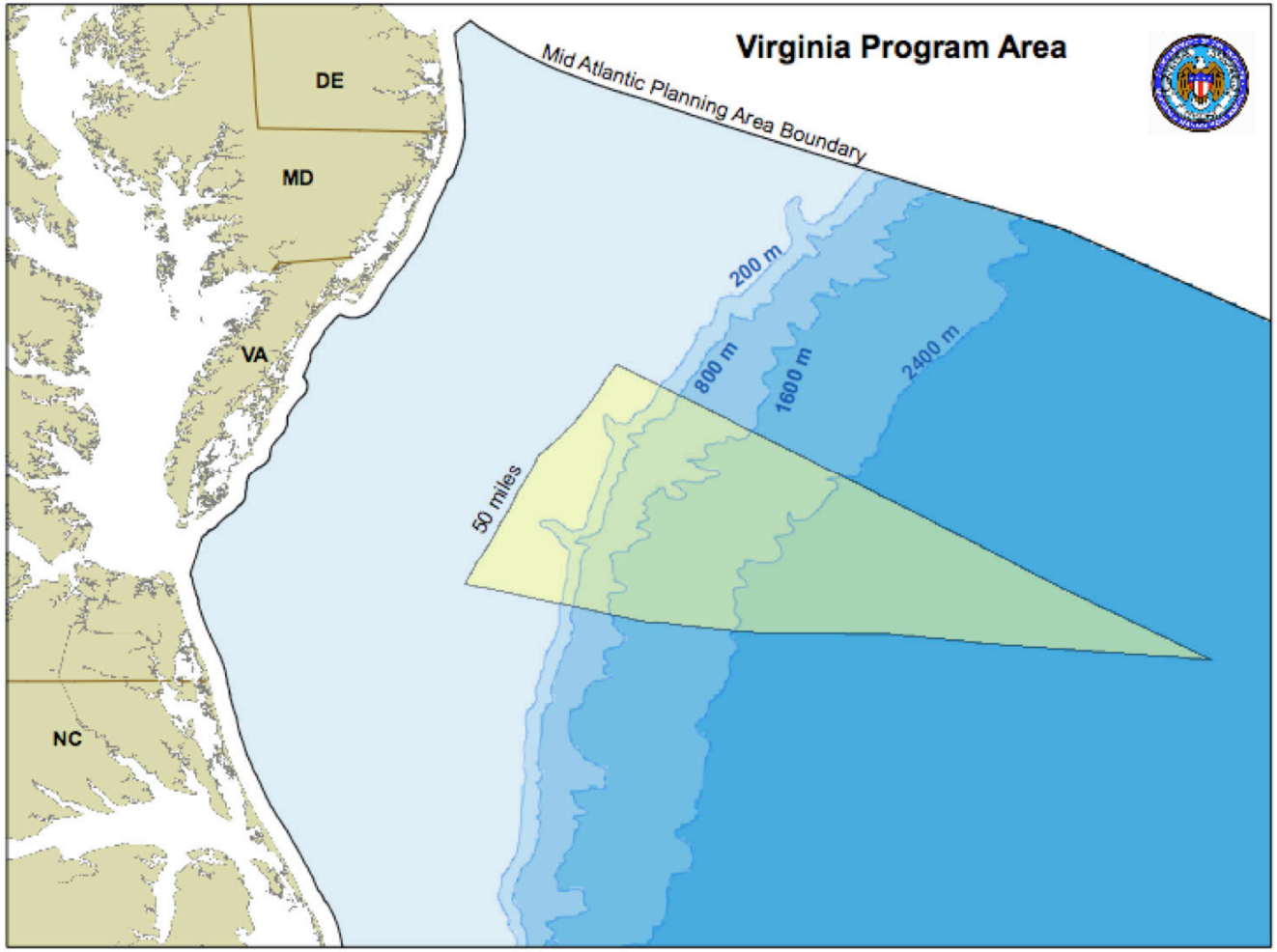
QHD 32-6 FPSO for CNOOC (2001)

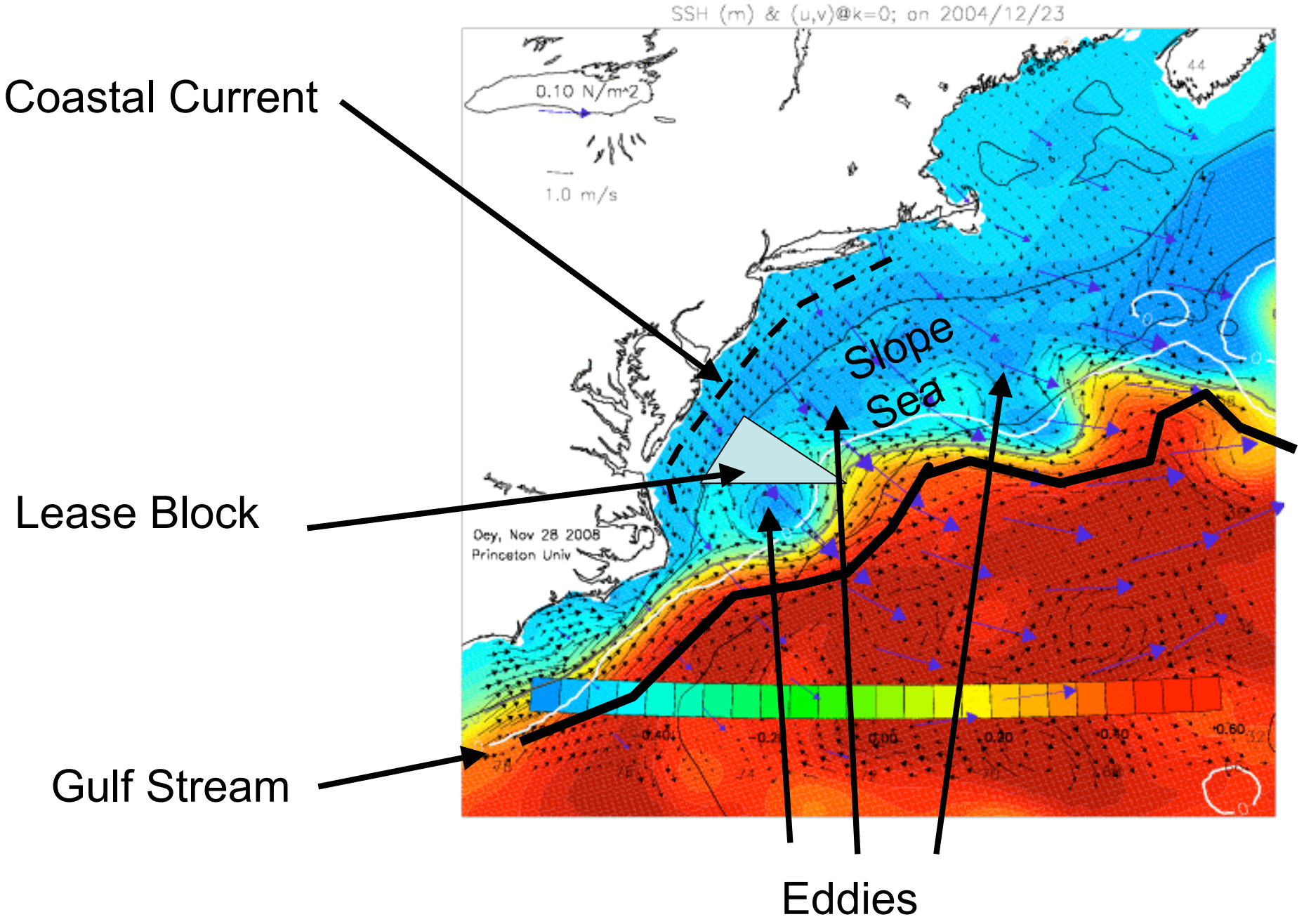

LNG SHUTTLE

Physical oceanography of the southern Mid-Atlantic Bight

Larry Atkinson (ODU) with help from Drs. Jose Blanco (ODU), Alan Blumberg (Stevens), Leo Oey (Princeton), Josh Kohut (Rutgers),

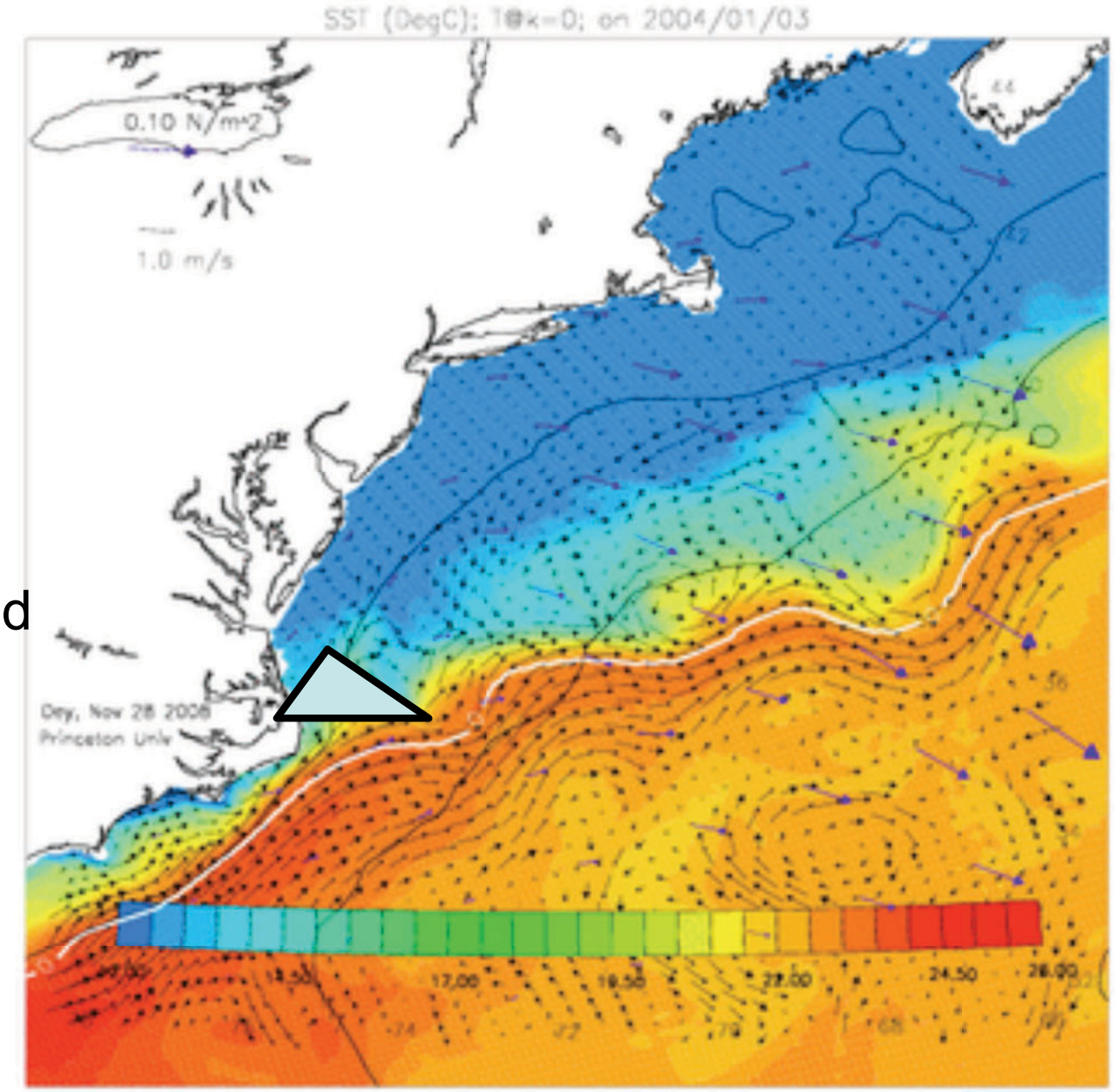
Area is outside most coastal processes and extends well into the deep sea




Coastal Current
Lease Block
Gulf Stream
Slope Sea
Eddies
SSH (m) & (u,v)@k=0; on 2004/12/23
0.10 N/m^2
1.0 m/s
Dey, Nov 28 2008
Princeton Univ

Movie of Sea Surface Temperature

Blue - cold
Red - Warm
Big blue arrows - wind



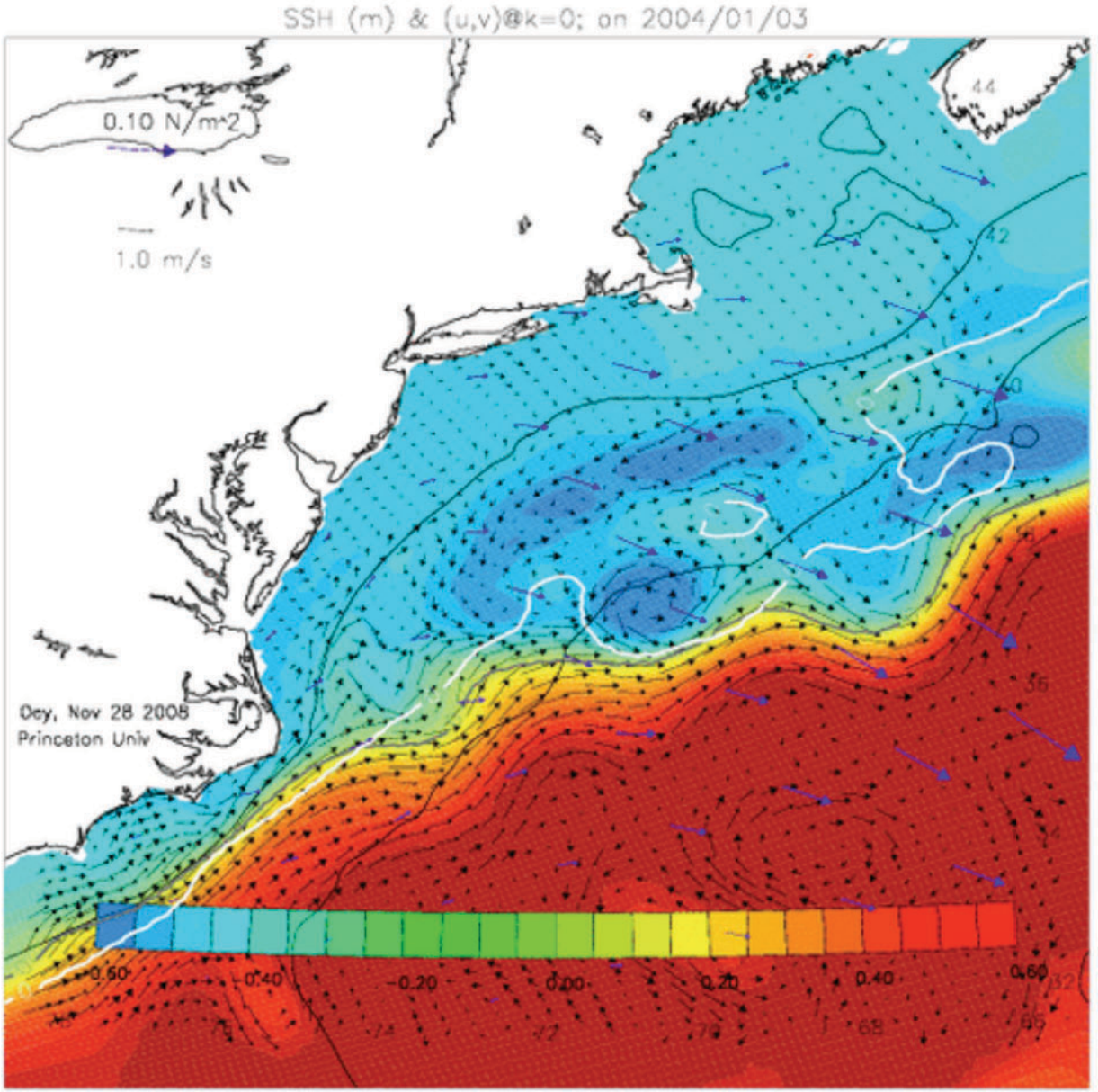
By Leo Oey

12/3/08

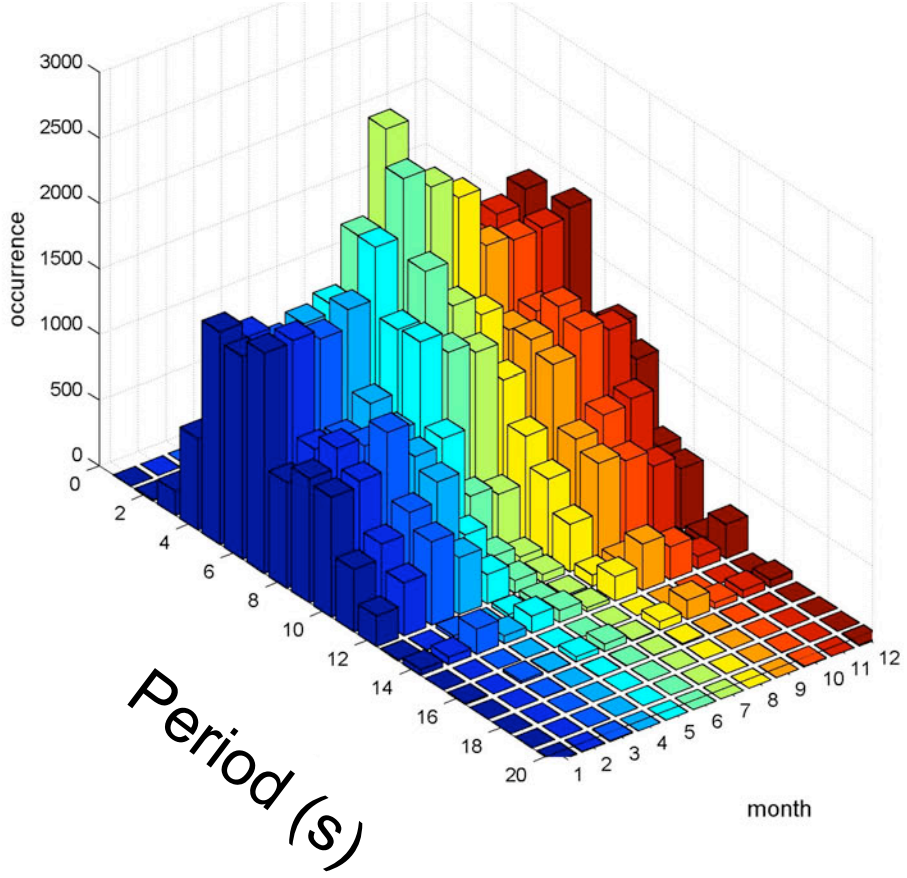
MMS Workshop - Virigina - Atkinson

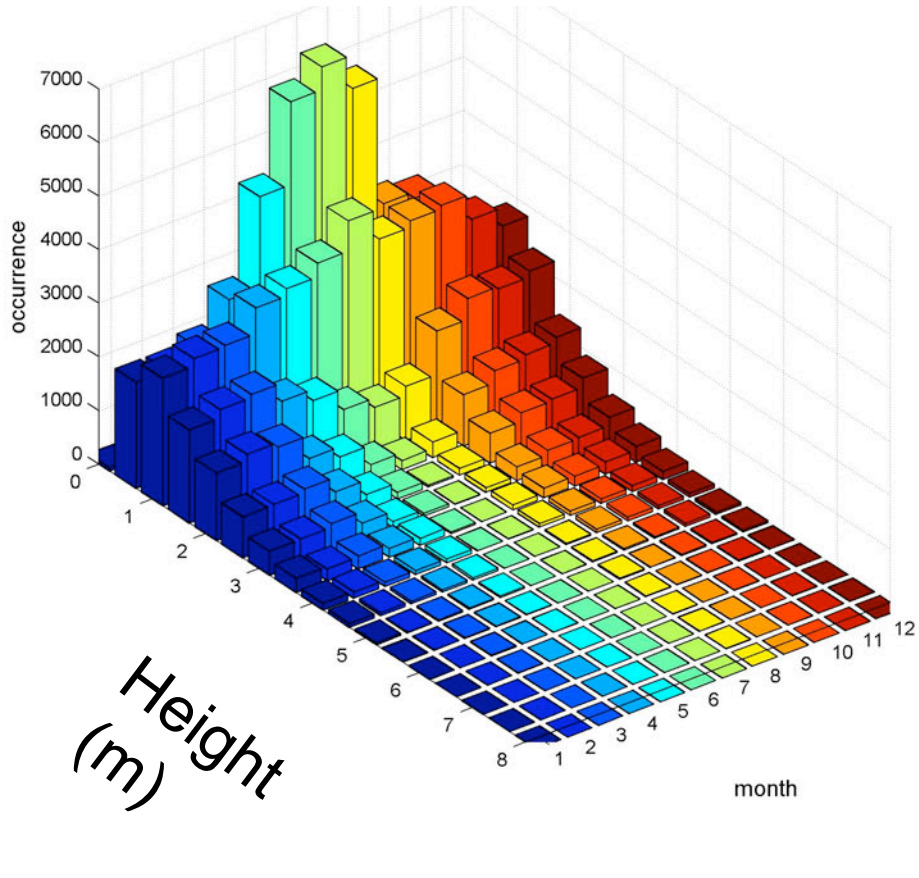
Sea surface height
Strong currents at big
Changes in color
Note Gulf Stream,
Coastal currents,
Eddies/rings.

See migration of
Eddies in Slope Sea.



Occurrence of wave dominant period and height by month (1990-2007) – Buoy 44014





Extreme events – Wind

50 m height wind speed (m/s) at 25, 50 and 100 years return period

Buoy 44014 - 15 yrs of data

	Wind speed	Gust
Um	19.7	24.9
Ur(25)	36.2	46.2
Ur(50)	38.4	49.1
Ur(100)	40.64	51.95

ws = hourly wind speed (eight-minute average on each hour)
gust= Peak 5 second gust speed (m/s) measured during eight-minute on each hour

Um : Mean value of maximum monthly wind speeds (m/s)
Ur(r) : Wind speed (m/s) with r year return period (r=25, 50 and 100 years)

Extreme events – Waves

Wave Heights predictions (m) from grouped data - (1990 - 2007) Buoy 44014

Peak Over Threshold (POT) model

Weimbull distribution

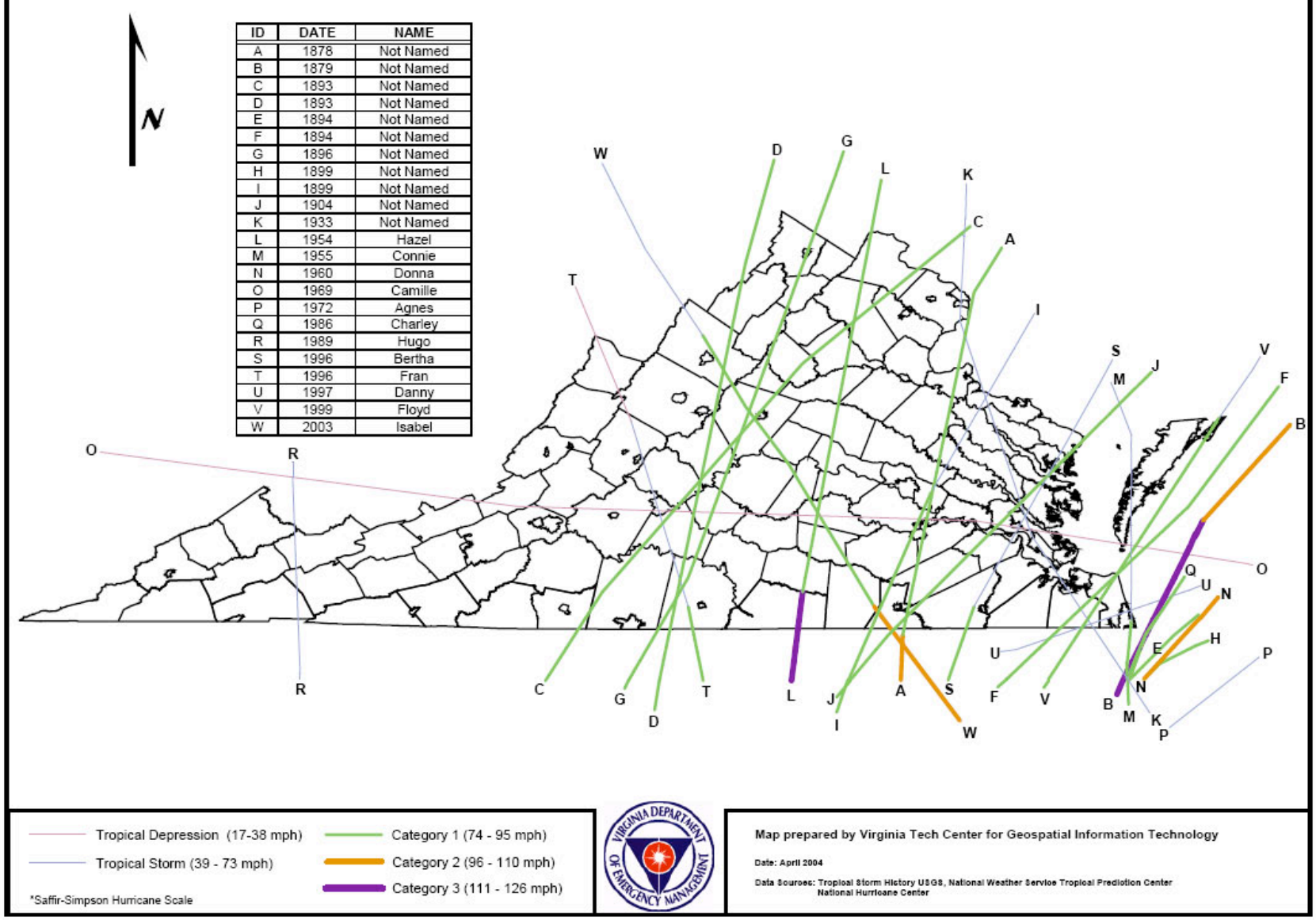
dt=14.9 yr

Return Period (yr)	20	50	100
POT, Z=4 (m), λ=20, (288 storms)	8.0	8.6	9.1
POT, Z=6 (m), λ=6, (2.7 storms)	8.8	9.6	10.3

Ht (m) for 95% interval for return period T (year)

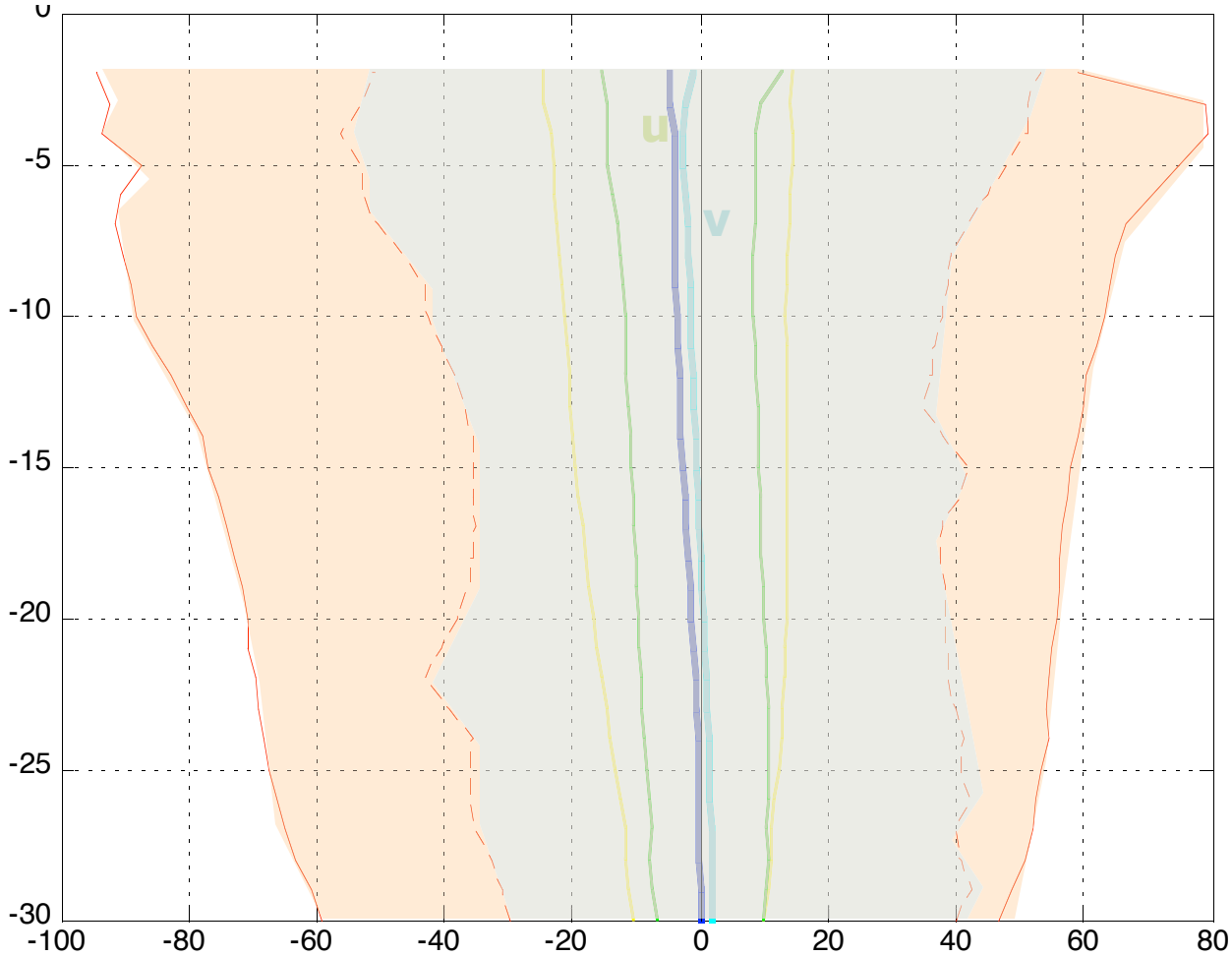
Hurricane Tracks in Virginia 1851-2003

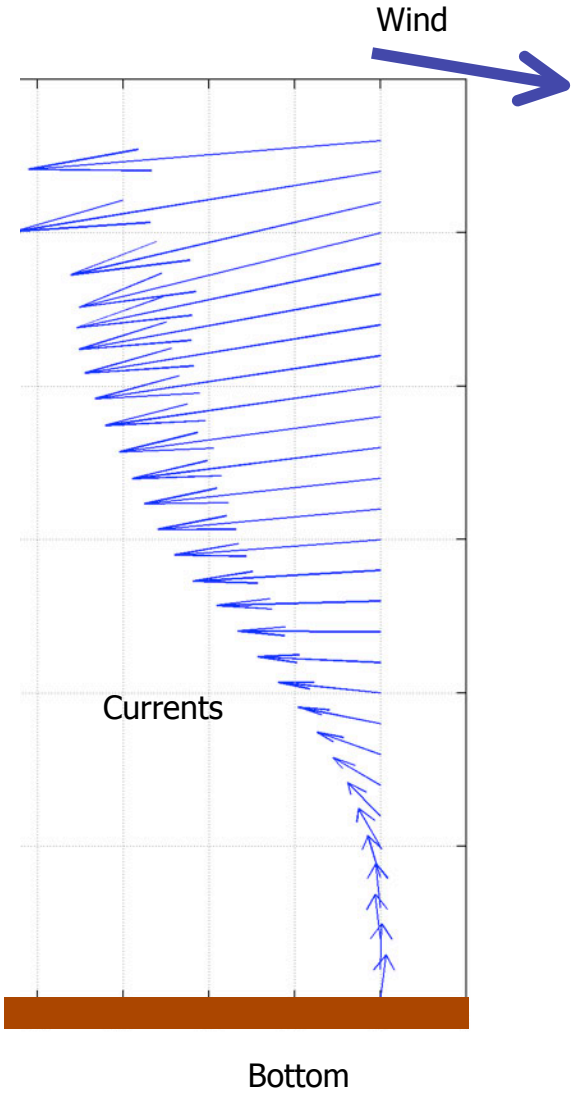
ID	DATE	NAME
A	1878	Not Named
B	1879	Not Named
C	1893	Not Named
D	1893	Not Named
E	1894	Not Named
F	1894	Not Named
G	1896	Not Named
H	1899	Not Named
I	1899	Not Named
J	1904	Not Named
K	1933	Not Named
L	1954	Hazel
M	1955	Connie
N	1960	Donna
O	1969	Camille
P	1972	Agnes
Q	1986	Charley
R	1989	Hugo
S	1996	Bertha
T	1996	Fran
U	1997	Danny
V	1999	Floyd
W	2003	Isabel



Currents mean profile over the Shelf

Data period – 01/2006 to 06/2007





Maximum current = 116 cm/s

u ± standard deviation

v ± standard deviation

An example of transport processes

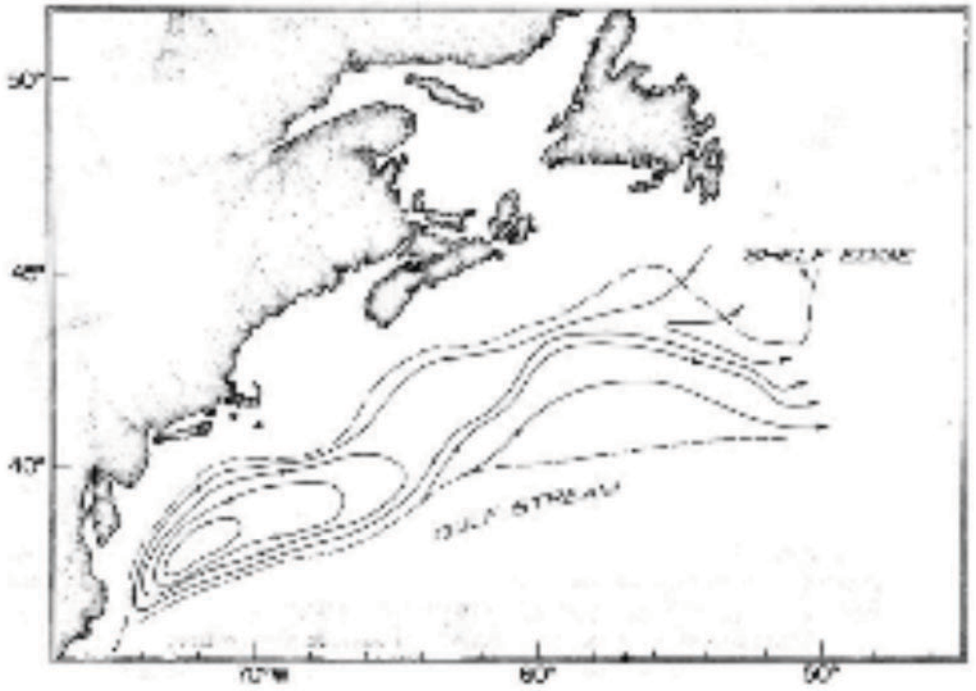
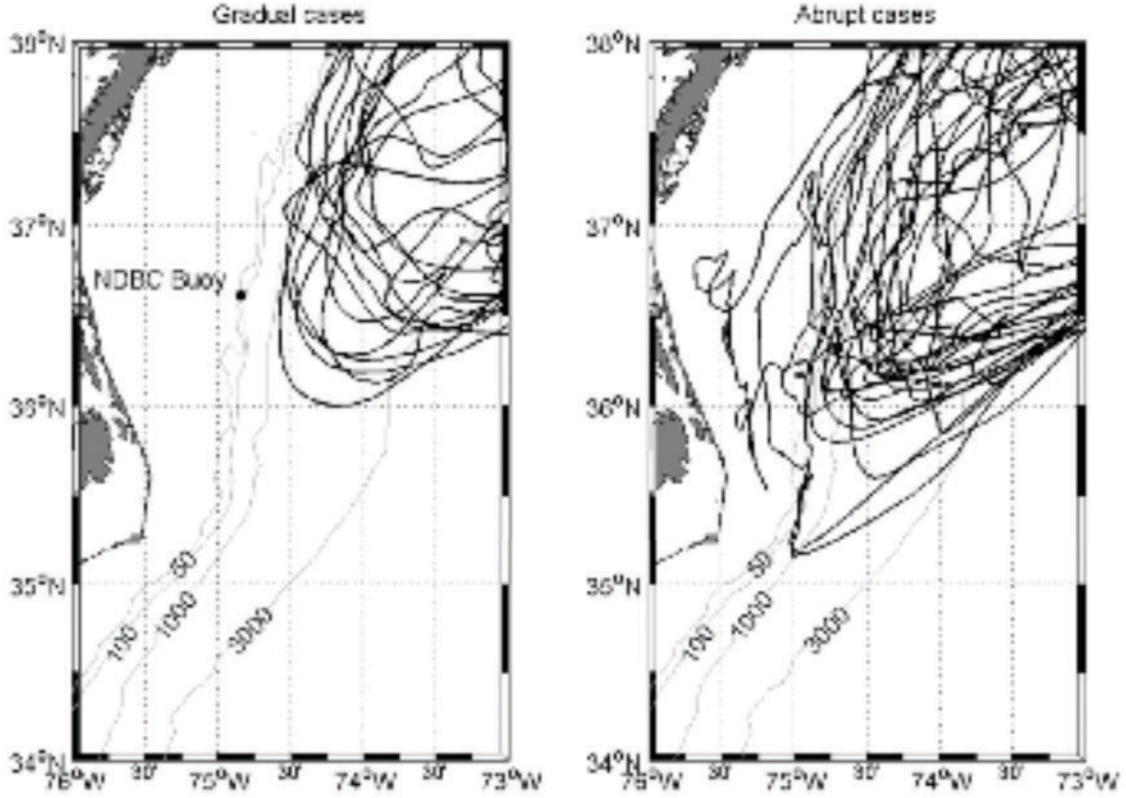


Fig. 1. A schematic figure of the slope gyre from Csanady and Hamilton (1988).

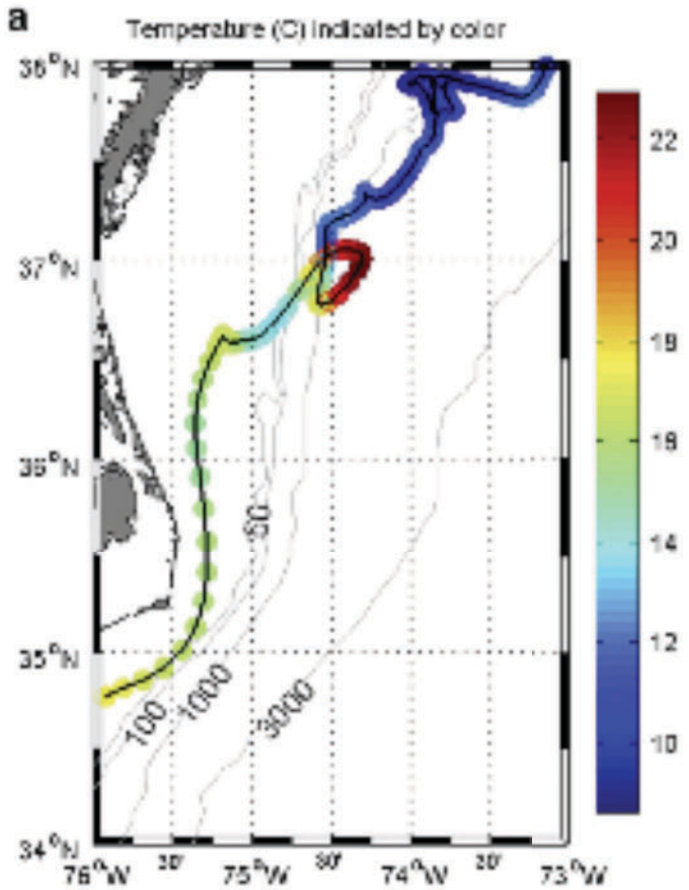
From “Lagrangian flow patterns north of Cape Hatteras using near-surface drifters” by Glen Gawarkiewicz *, Christopher A. Linder

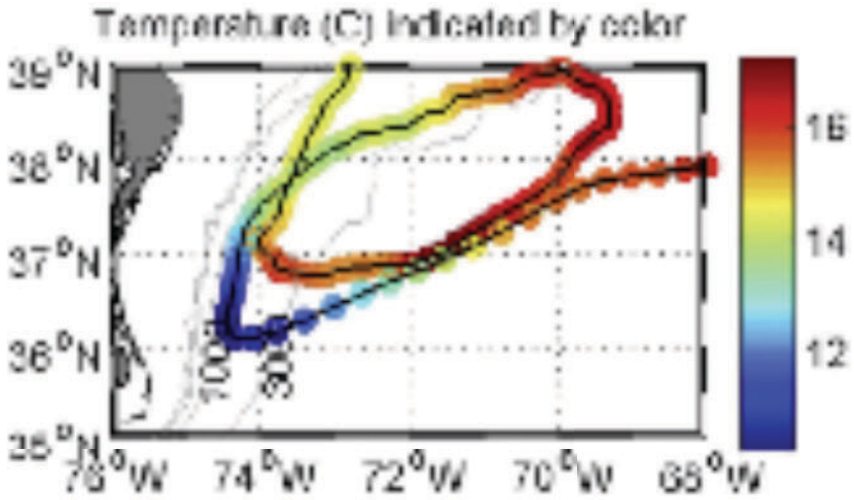
Drifter tracks show two modes of movement from outer shelf to Gulf Stream



From Gawarkiewicz

2 special cases: Movement in the SAB and Recirculation into the outer shelf and back out





From Gawarkiewicz

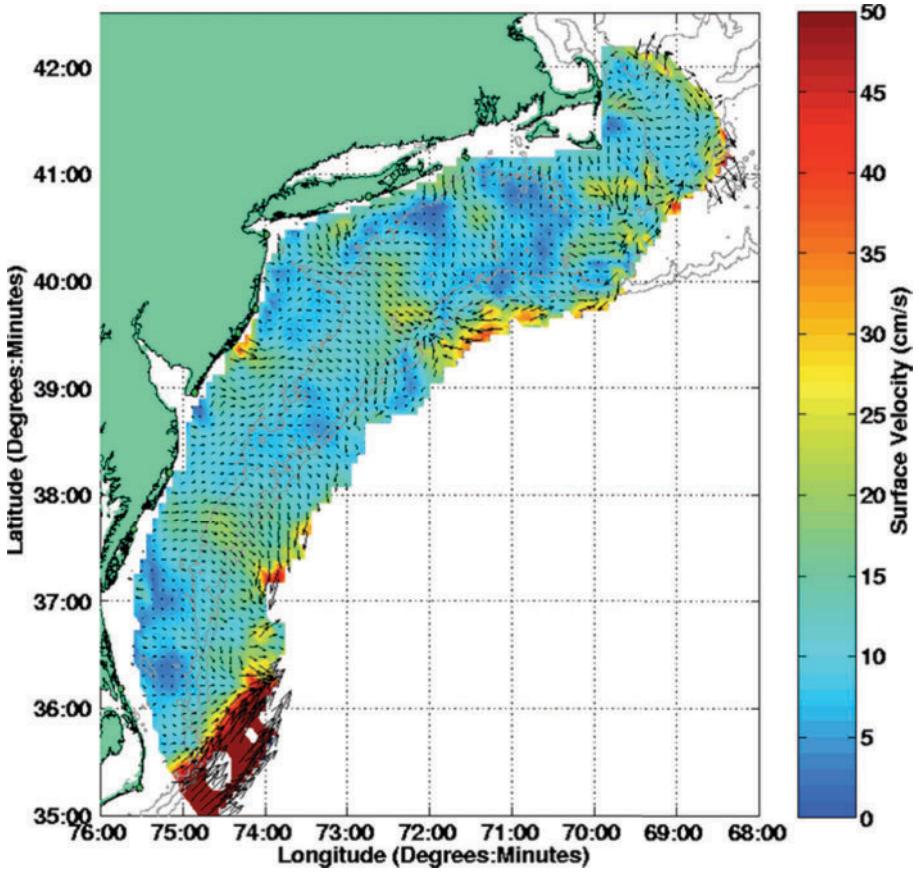
Lessons from Literature

- Several modes of transport in the area of interest.
- They can be observed and modeled.

Ocean Observing Assets

- NDBC Buoys
- Satellite: winds, altimetry (SSH), surface temperature (SST), ocean color.
- Coastal: NOAA COOPS systems
- MARCOOS: coastal currents with high frequency radar, glider runs and assimilating models.

MARCOOS High Frequency Radar Current coverage of area



Map every two hours. Data going to CG search and rescue

Operational Modeling

- NOAA Real-Time Ocean Forecast System (Atlantic)
- NOAA/NOS - Operational Forecast System (NOS plans to expand OFS grids offshore in the future)
- Navy Coastal Ocean Model (NCOM)

Comments/Thoughts

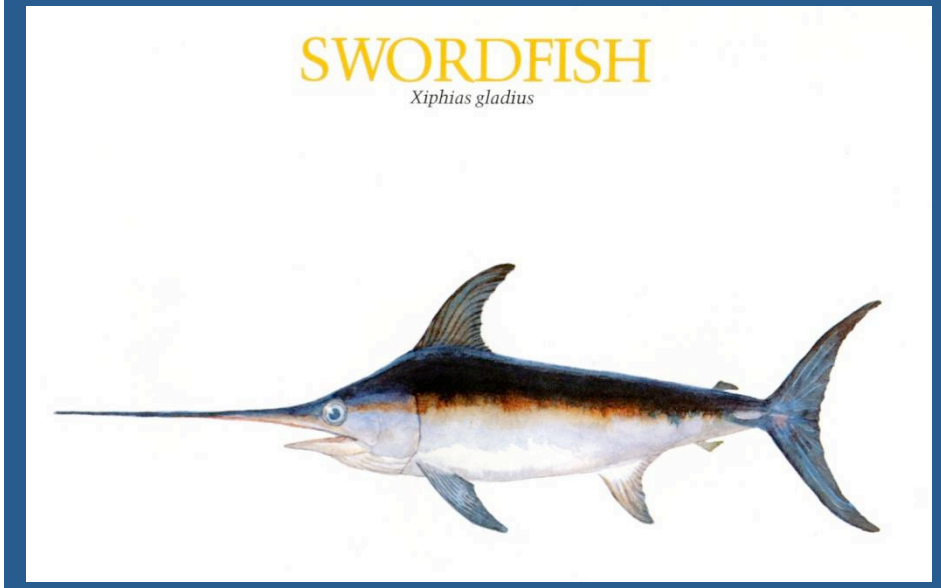
- Will MMS do studies in this area similar to those they did off Cape Hatteras for the Manteo blocks decades ago?
- Activity in the Virginia block will affect coastal waters off North Carolina and Maryland and not so much the Virginia coast.
- Do we plan for MAB wide impact studies?
- Regional associations (MACOORA) now exist and can be part of the solution.

Environmental Research Needs in Support of Potential Virginia Offshore Oil and Gas Activities

Pelagic Fishes

Richard W. Brill,
National Marine Fisheries Service,
Northeast Fisheries Science Center
& Virginia Institute of Marine Science

Photo: Kerstin Fritsches, University of Queensland



Atlantic surf clam

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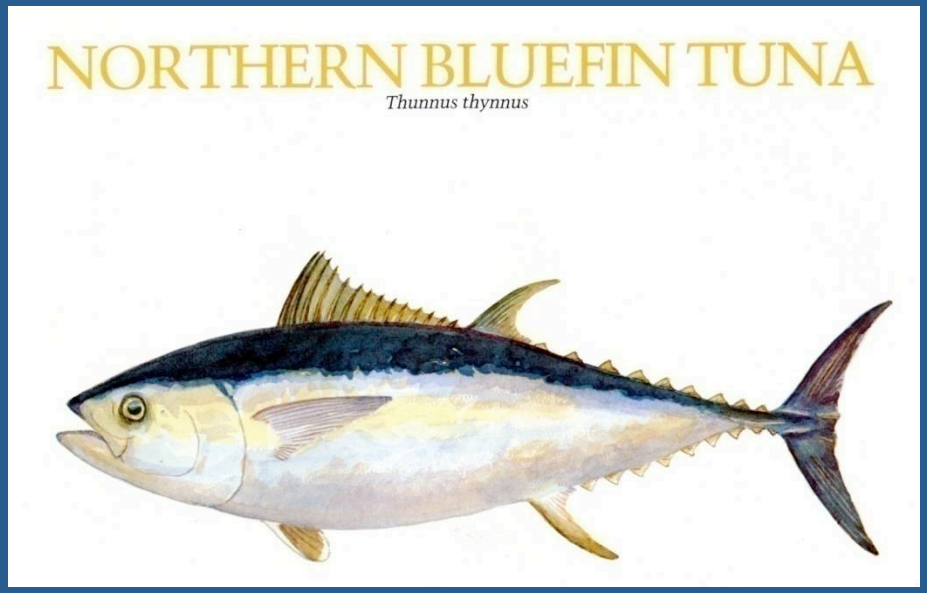
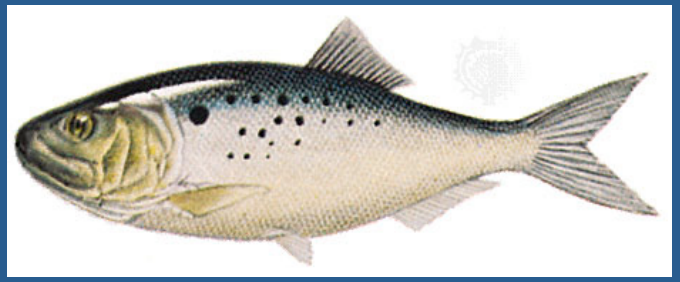
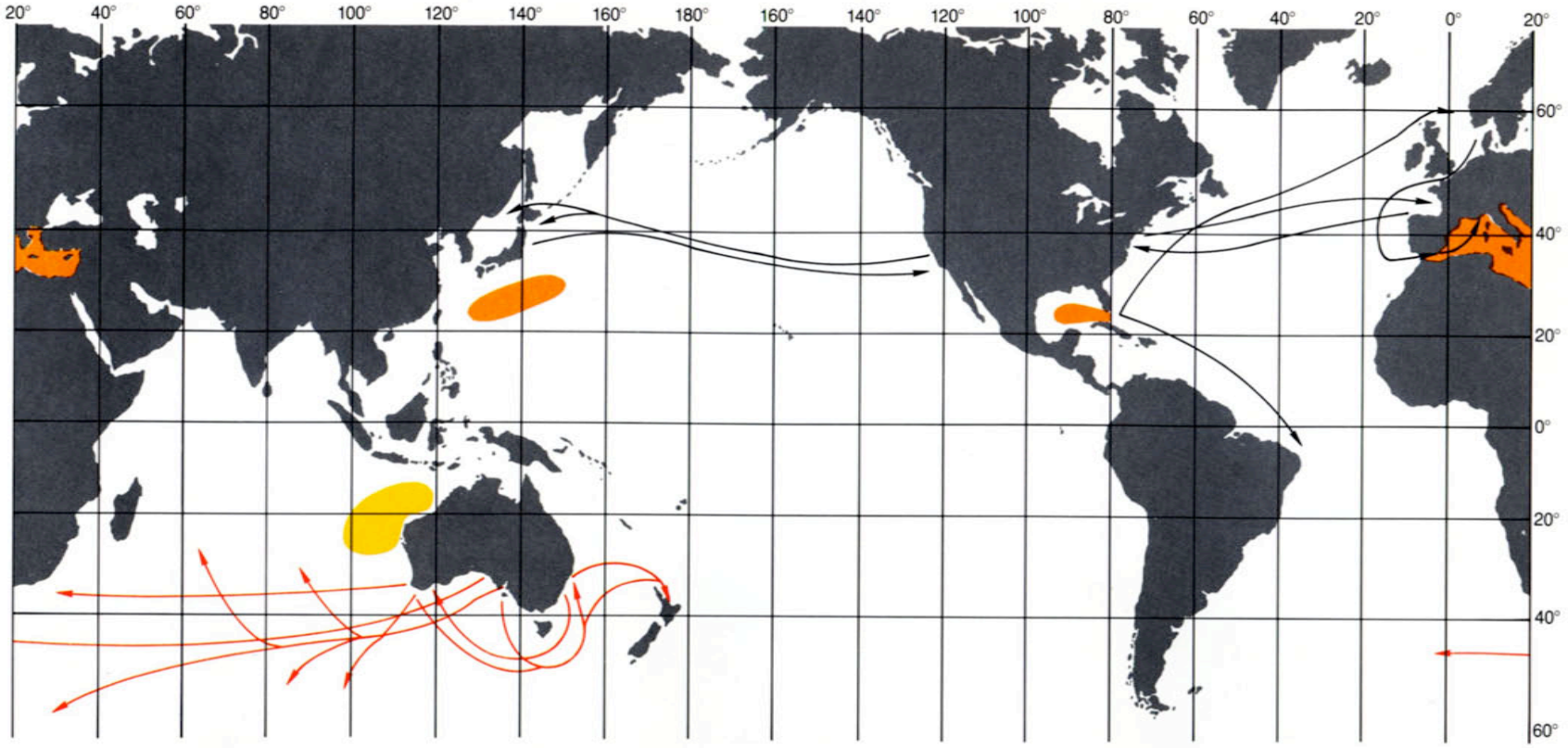


Atlantic menhaden





MIGRATIONS OF NORTHERN BLUEFIN TUNA
DETERMINED FROM RELEASES AND RECAPTURES OF TAGGED FISH.

MIGRATIONS OF SOUTHERN BLUEFIN TUNA
DETERMINED FROM RELEASES AND RECAPTURES OF TAGGED FISH.

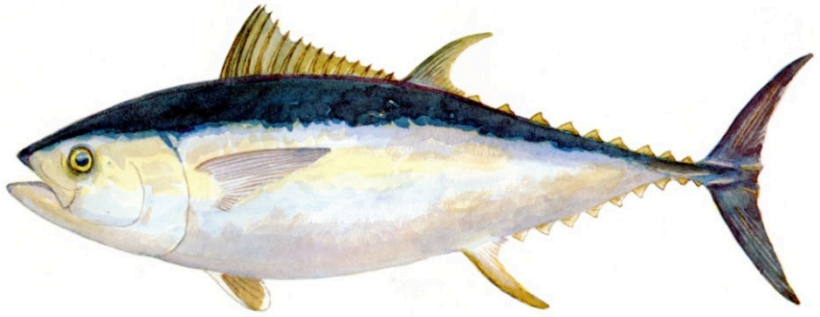
SPAWNING AREAS OF NORTHERN BLUEFIN TUNA

SPAWNING AREA OF SOUTHERN BLUEFIN TUNA

Geographic distribution and migrations of two species of bluefin tuna. Both the northern bluefin tuna and the southern bluefin tuna make extensive migrations. Although these species are distributed world-wide, like the albacore tuna, they return to restricted areas to spawn.

NORTHERN BLUEFIN TUNA

Thunnus thynnus



TUNA AND BILLFISH—*fish without a country*

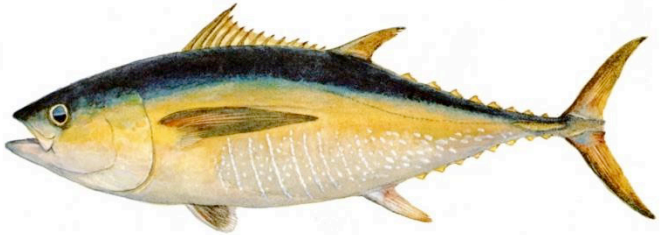
James Joseph | Witold Klawe | Pat Murphy

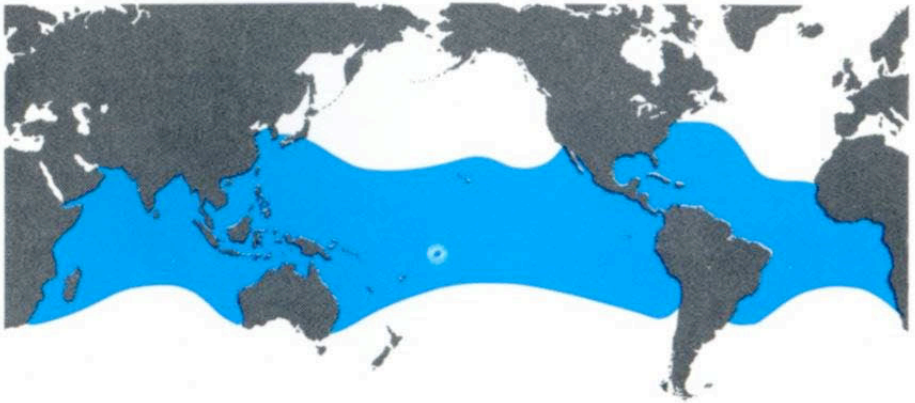
Paintings by: George Mattson

INTER-AMERICAN TROPICAL TUNA COMMISSION

YELLOWFIN TUNA

Thunnus albacares

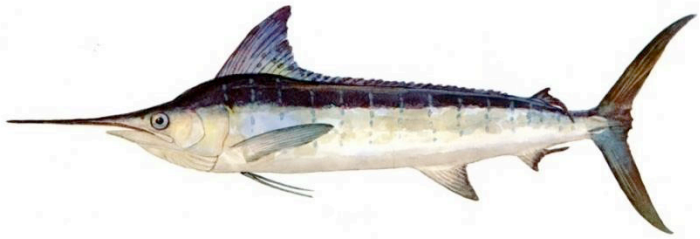




■ AREAS WHERE YELLOWFIN TUNA ARE CAUGHT WITH LONGLINE GEAR.

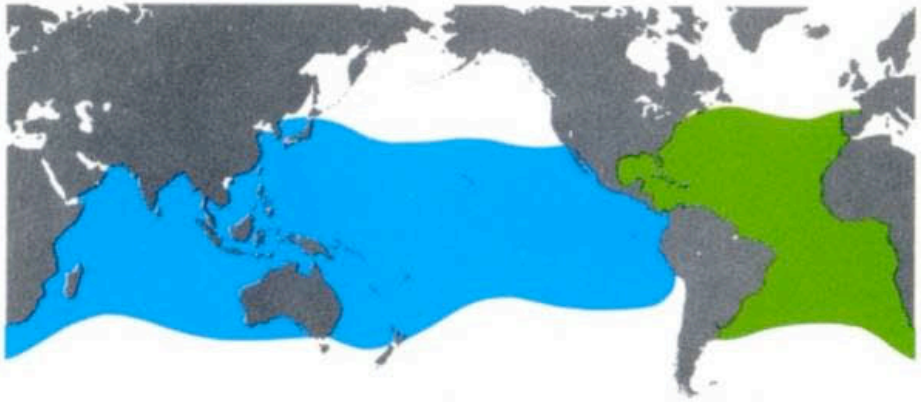
■ SPAWNING AREAS.

White marlin



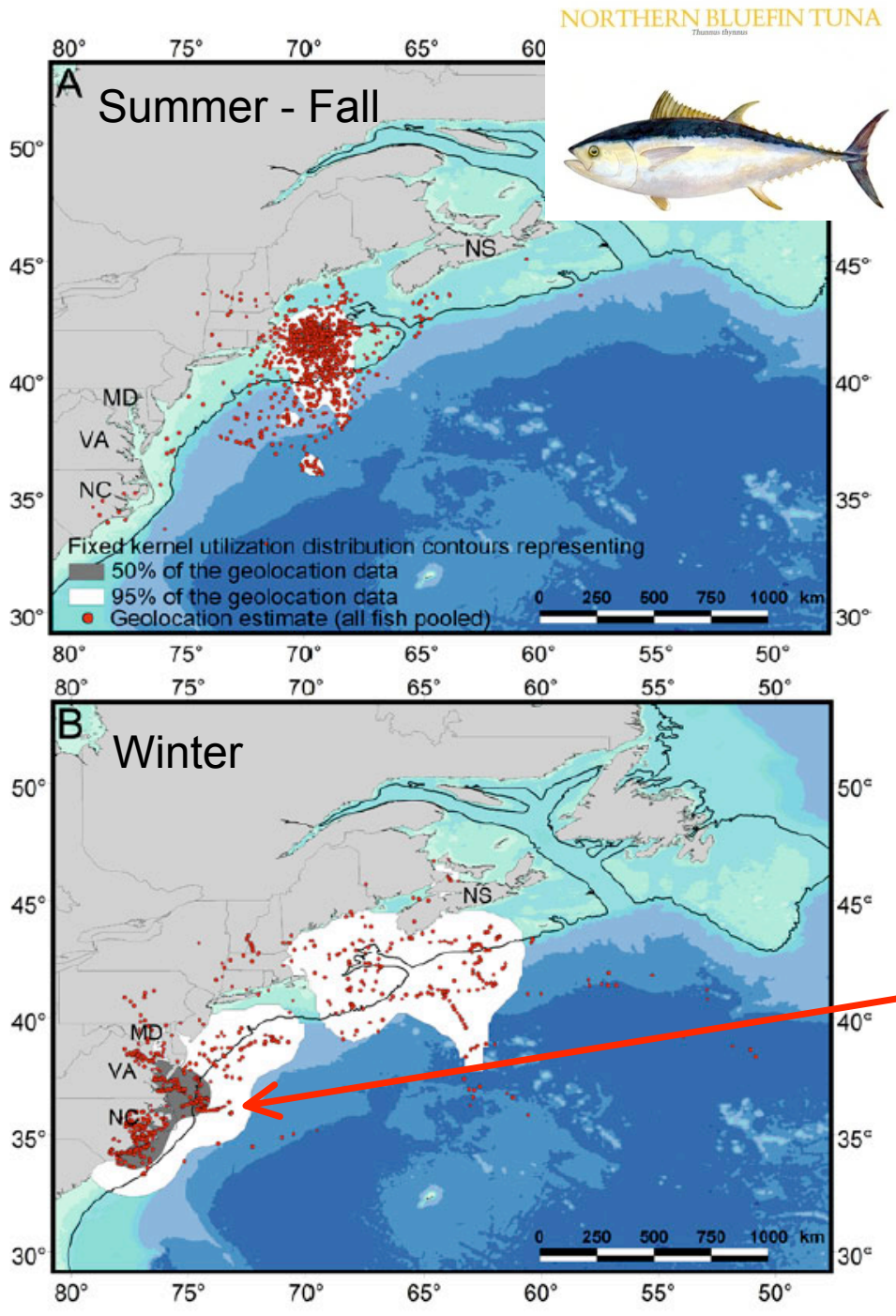
GEOGRAPHIC DISTRIBUTION OF STRIPED MARLIN.

GEOGRAPHIC DISTRIBUTION OF WHITE MARLIN.



SPAWNING AREA OF STRIPED MARLIN

SPAWNING AREA OF WHITE MARLIN

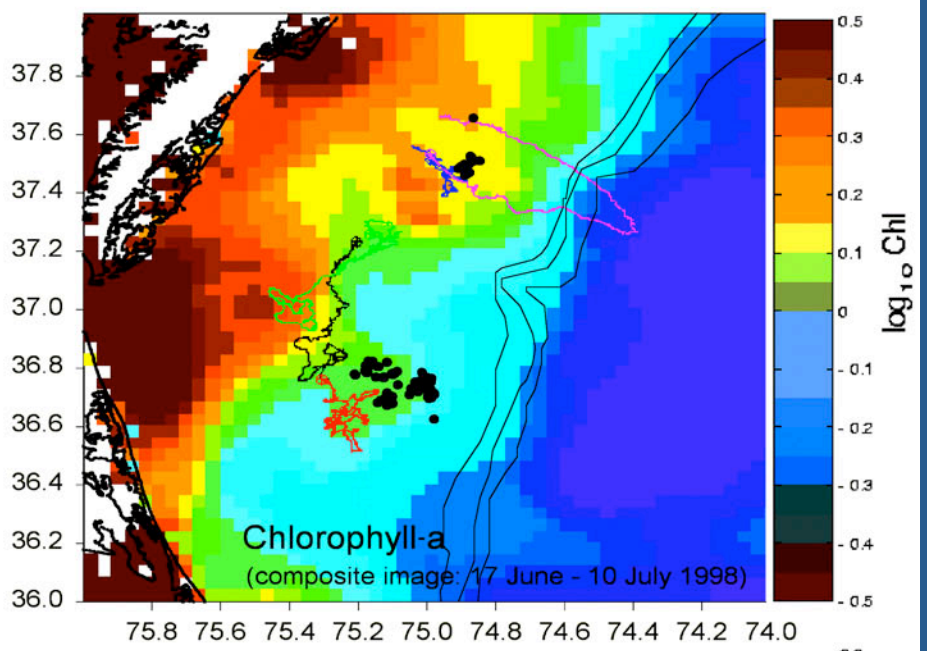


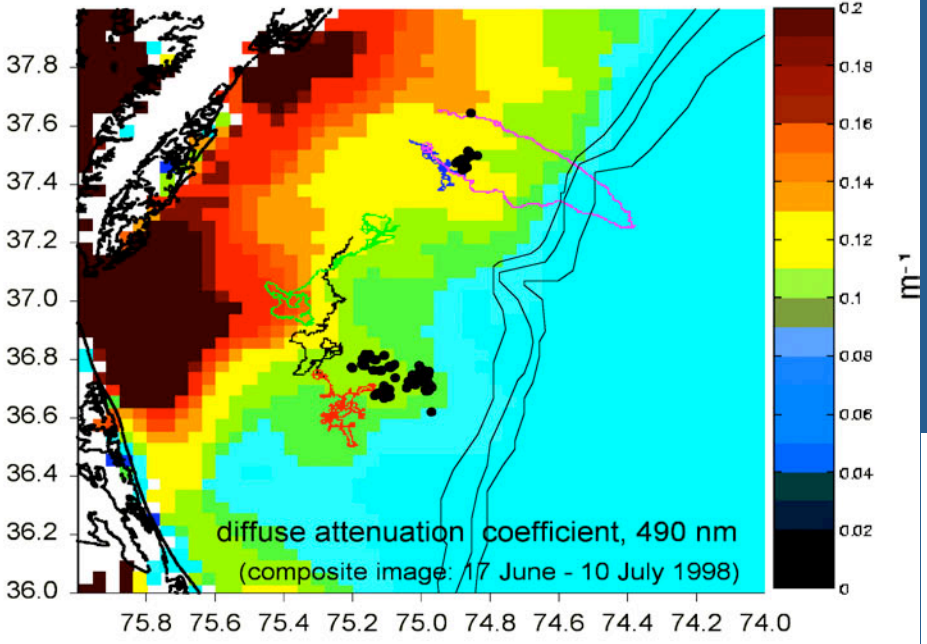
S. G. Wilson · M. E. Lutcavage · R. W. Brill
M. P. Genovese · A. B. Cooper · A. W. Everly

Movements of bluefin tuna (*Thunnus thynnus*) in the northwestern Atlantic Ocean recorded by pop-up satellite archival tags

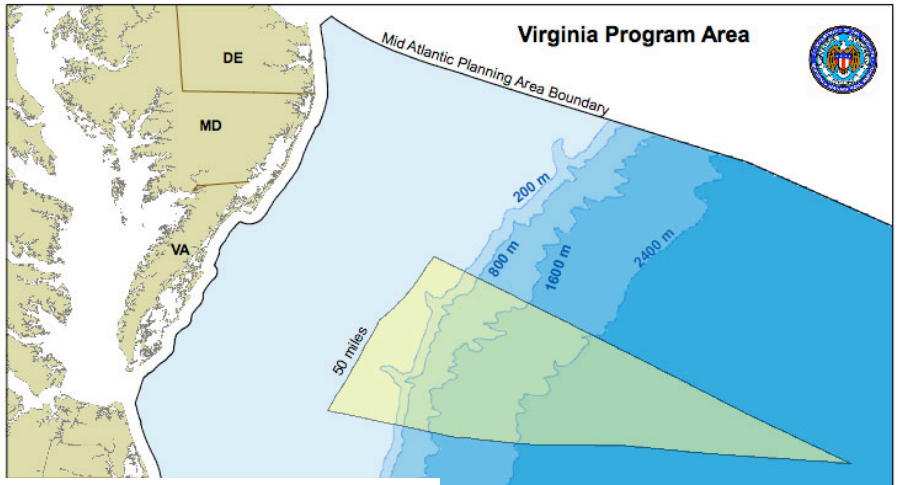
Marine Biology (2005) 146: 409–423

Adult bluefin tuna use Virginia – North Carolina inshore areas as winter feeding grounds.



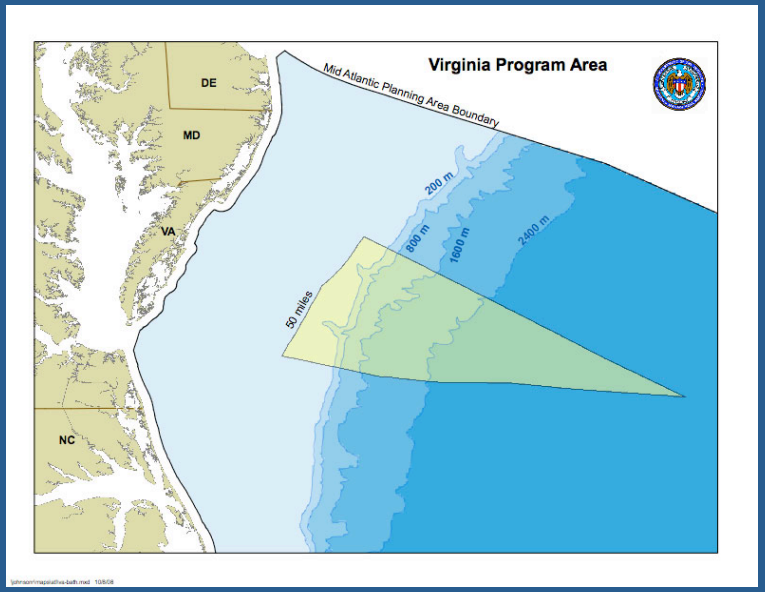


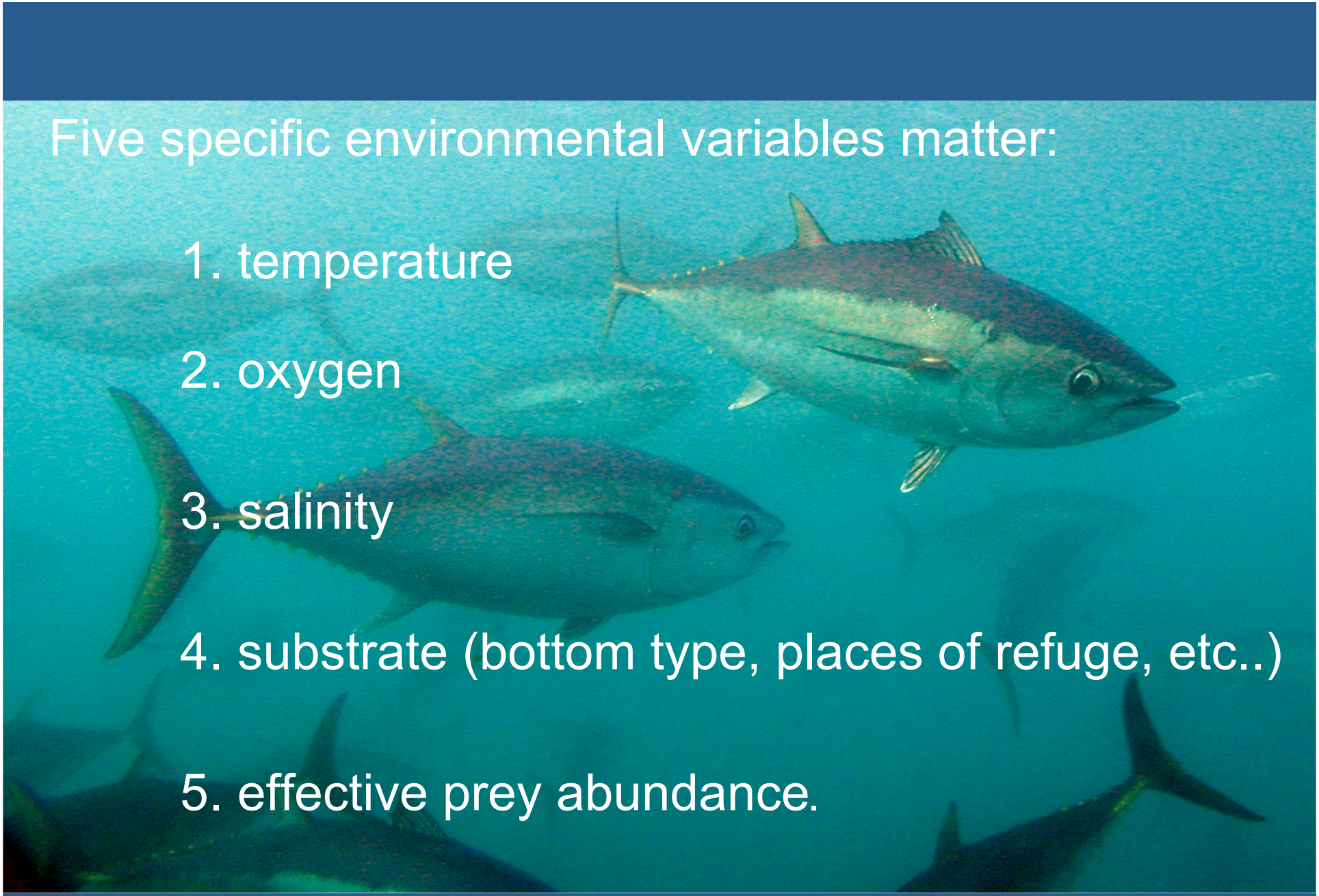
Juvenile bluefin tuna migrate north in the summer along the continental shelf.



Best guess…

Of the large pelagic fishes, bluefin tuna are the most likely to be impacted by the proposed offshore oil & gas development





Five specific environmental variables matter:

1. temperature
2. oxygen
3. salinity
4. substrate (bottom type, places of refuge, etc..)
5. effective prey abundance.

5. Effective prey abundance

(A) number of prey

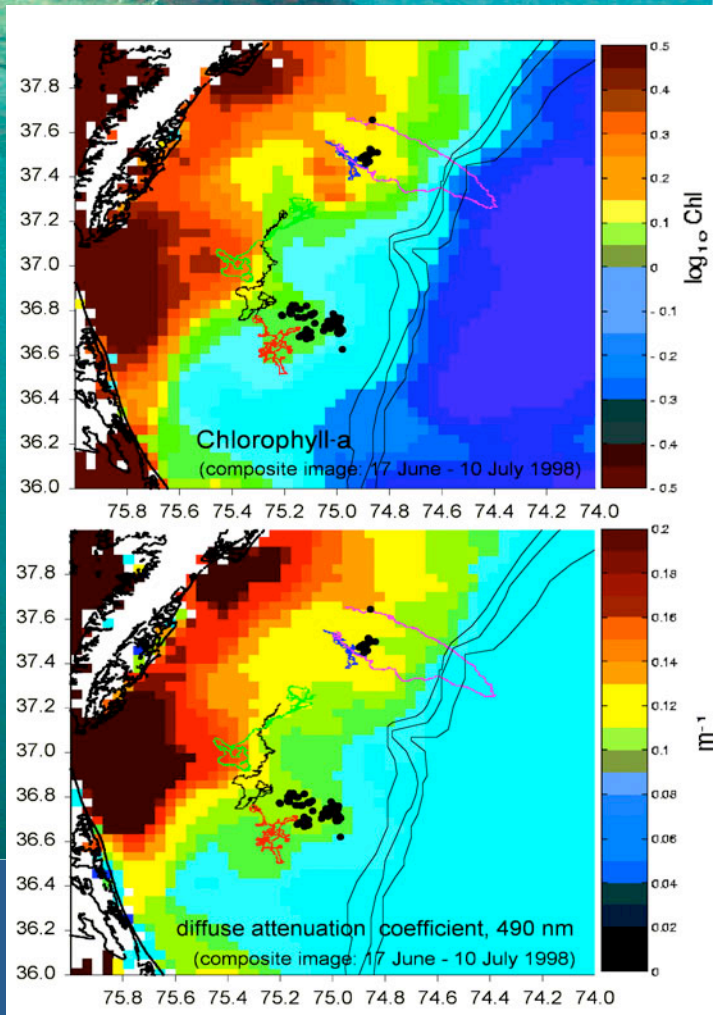
(B) prey availability

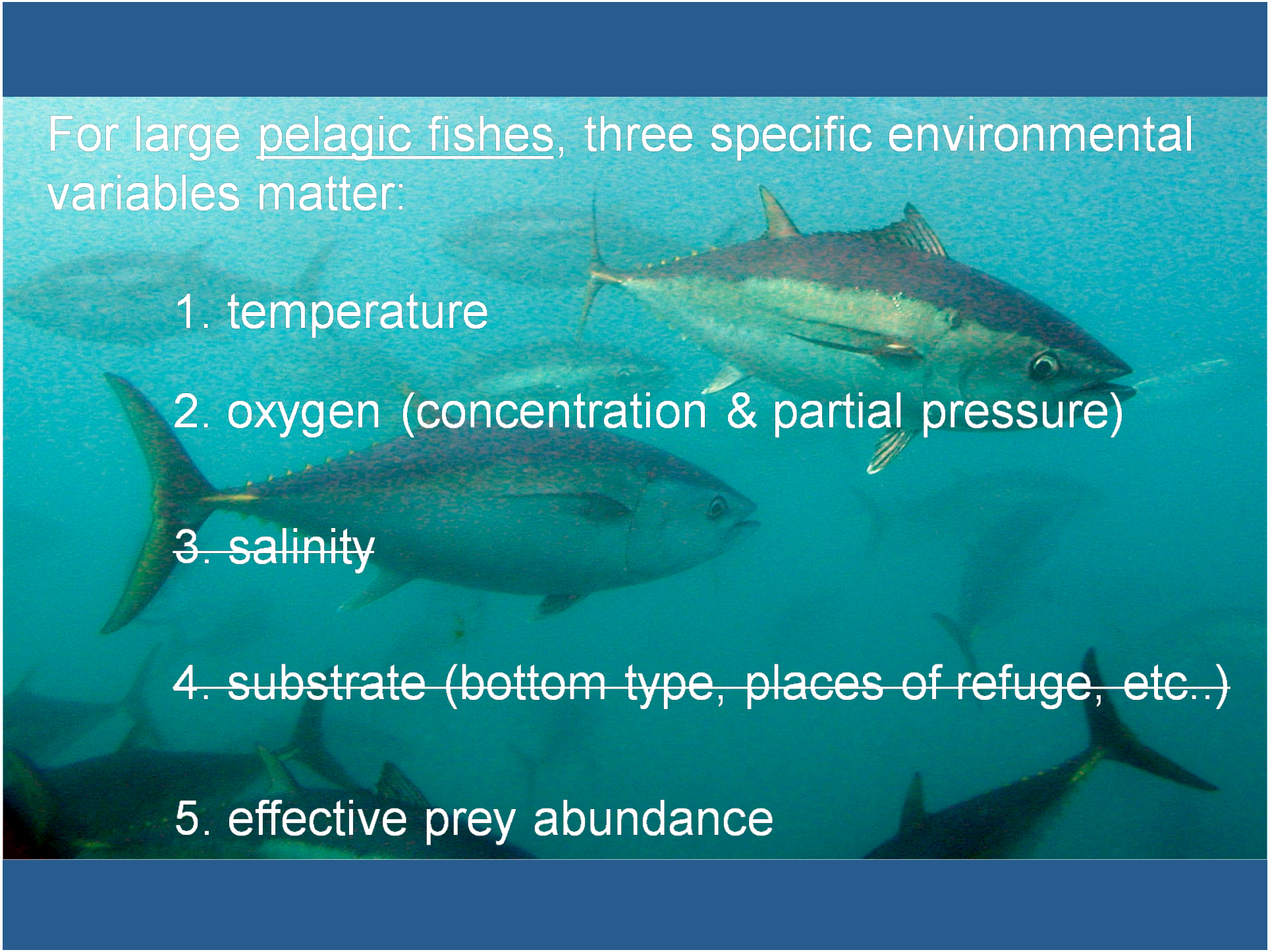
prey availability is a function of:

(a) visual environment

(b) olfactory environment

(c) auditory environment





For large pelagic fishes, three specific environmental variables matter:

1. temperature
2. oxygen (concentration & partial pressure)
3. ~~salinity~~
4. ~~substrate (bottom type, places of refuge, etc..)~~
5. effective prey abundance

Offshore oil exploration -- probable impacts on pelagic fishes:

~~1. temperature~~

~~2. oxygen~~

~~3. salinity~~

~~4. substrate (bottom type, places of refuge, etc..)~~

5. effective prey abundance

(A) number of prey

(B) prey availability

(a) visual environment

(b) olfactory environment

(c) auditory environment

NOAA Technical Memorandum NMFS-NE-

Impacts to Marine Fisheries Habitat from Nonfishing Activities in the Northeastern United States

Effective prey abundance -- (A) number of prey

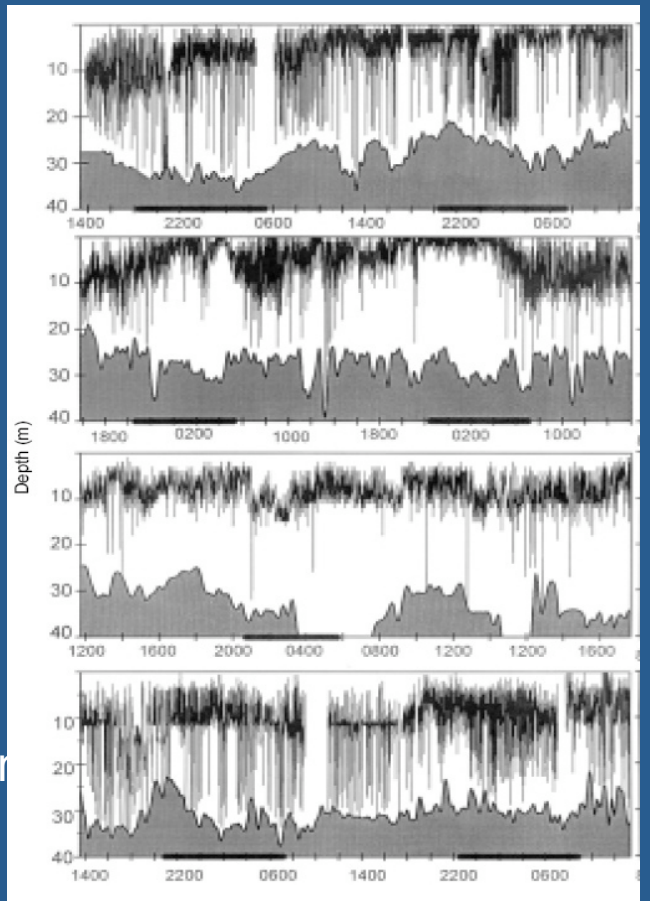
1. Disruption of entire pelagic communities (i.e., phytoplankton → zooplankton → tuna prey base) due to oil slicks from spills or wellhead blowouts

2. Alteration of bottom habitat from vessel anchoring, platform or artificial island construction, pipeline laying, dredging, etc.

3. Prey dispersal due to noise from drilling activities, construction, etc.

Bluefin tuna feed on sand eels

Vertical movement patterns
of juvenile bluefin tuna off Virgi



Effective prey abundance -- (B) prey availability

(a) visual environment

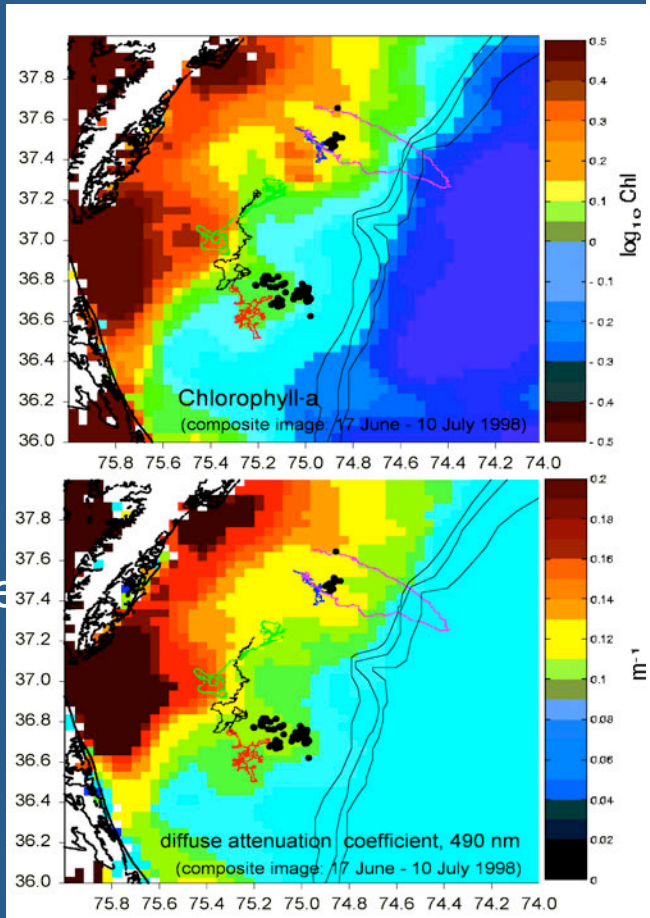
(b) olfactory environment

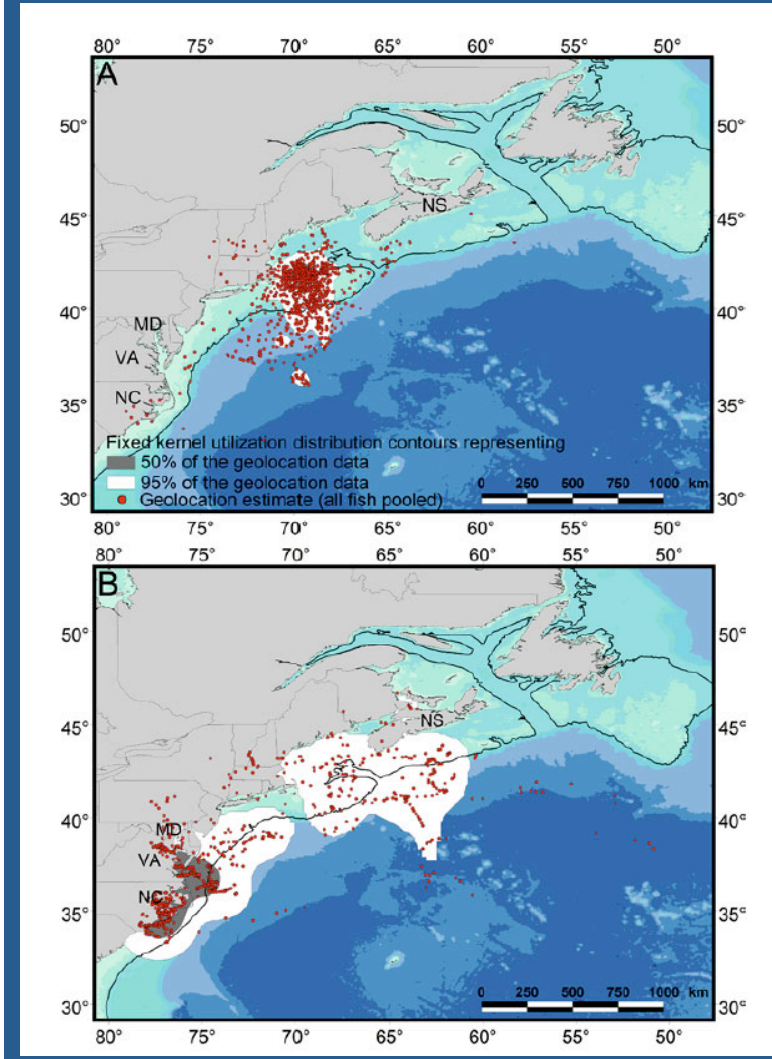
(c) auditory environment

Increases in suspended particles (reduce light penetration)

Contaminant discharge, spills, or wellhead blowouts
(effect olfactory environment and olfactory function)

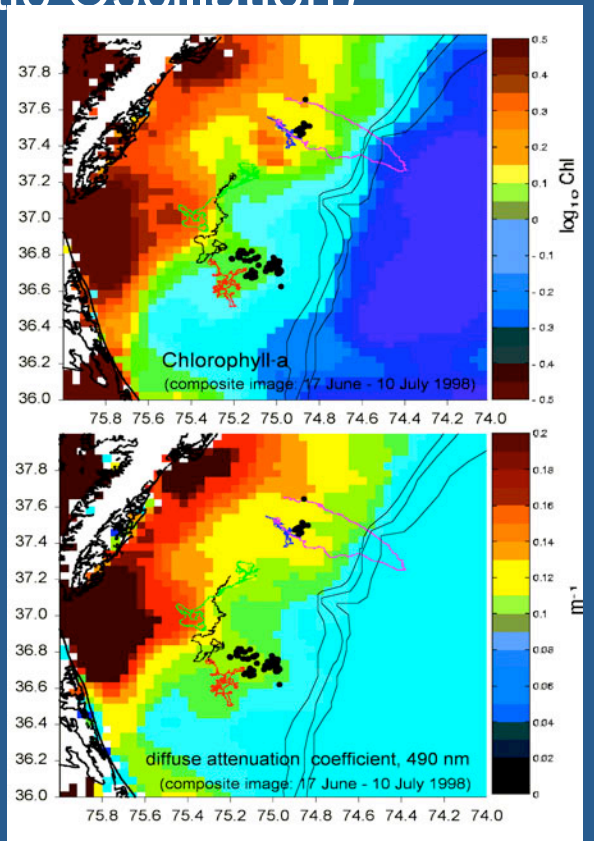
Noise (disrupt ability to locate prey, cause hearing impairme



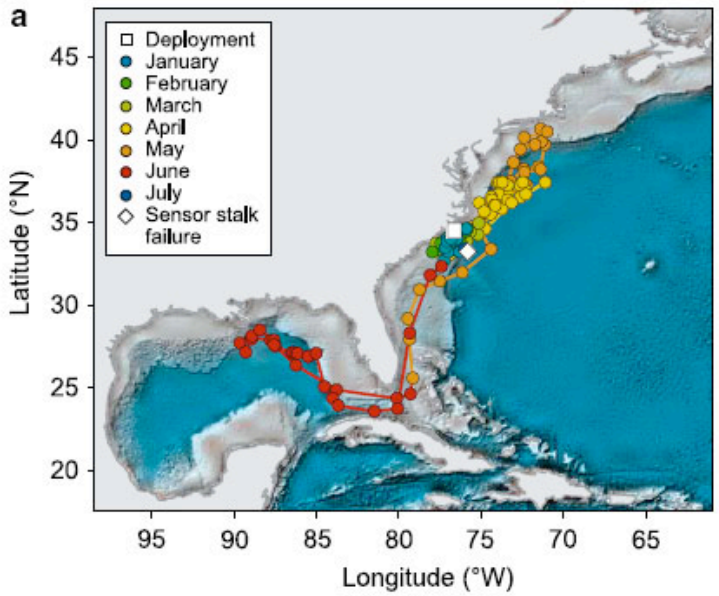


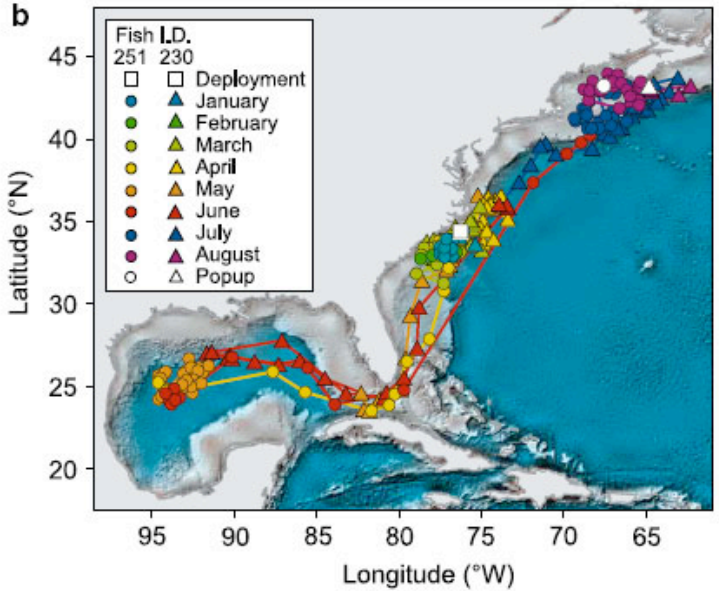
However…

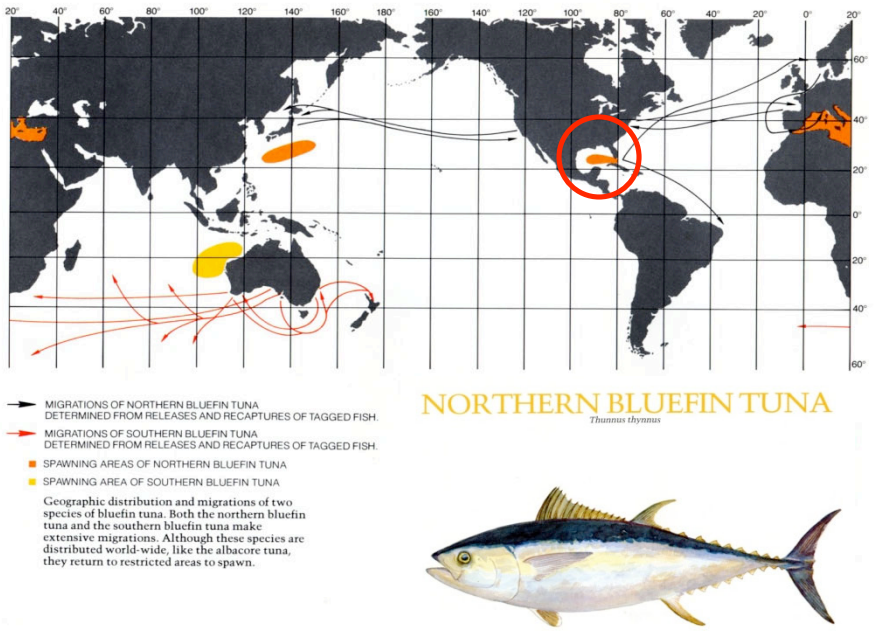
Specific movement patterns and distributions are highly variable and show multi-year, decadal, and longer cycles correlated with oceanographic cycles
(e.g., North Atlantic Oscillation)

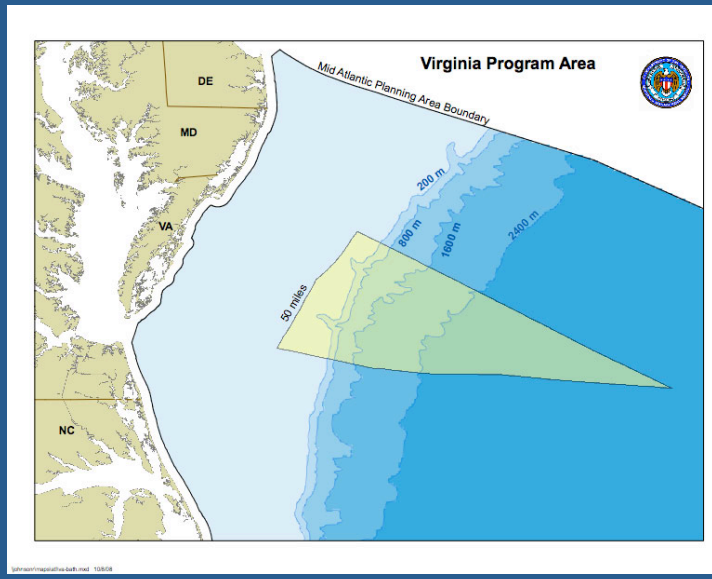


… equivocal whether the areas off Virginia impacted by proposed oil and gas development are “critical”









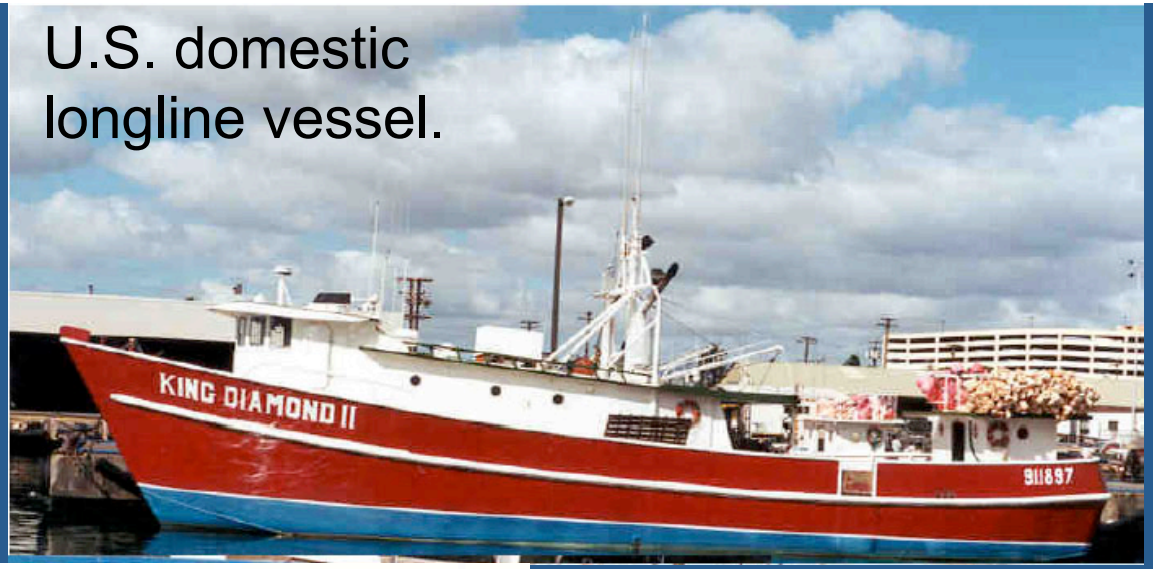
Annual migrations, diving behavior, and thermal biology of Atlantic bluefin tuna, *Thunnus thynnus*, on their Gulf of Mexico breeding grounds

Steven L. H. Teo · Andre Boustany · Heidi Dewar · Michael J. W. Stokesbury · Kevin C. Weng · Shana Beemer · Andrew C. Seitz · Charles J. Farwell · Eric D. Prince · Barbara A. Block

Mar Biol (2007) 151:1–18

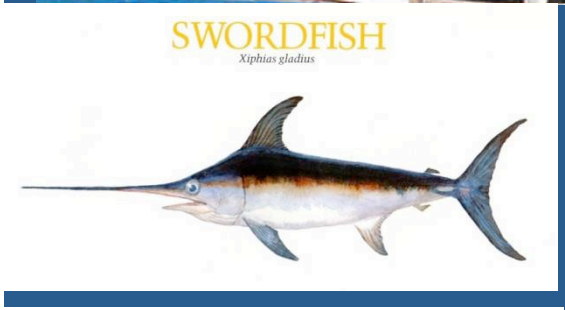
Could oil and gas development be problematic for fishers?

U.S. domestic longline vessel.

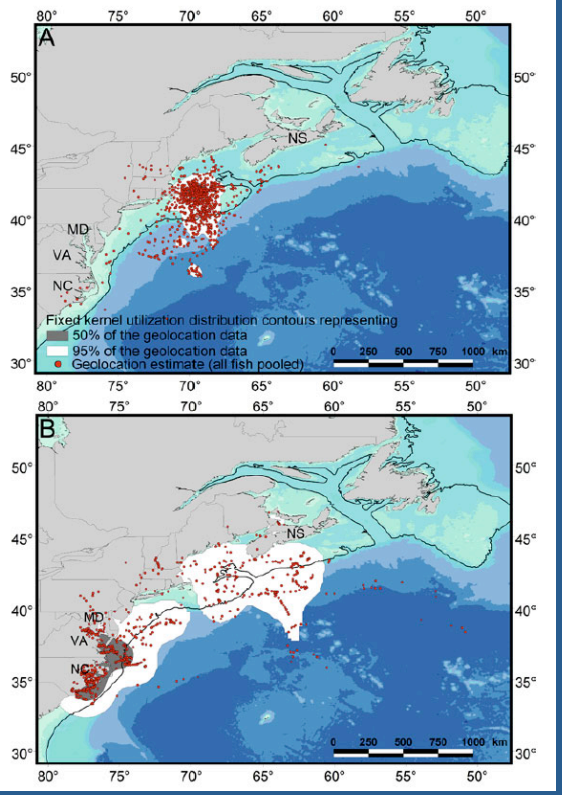


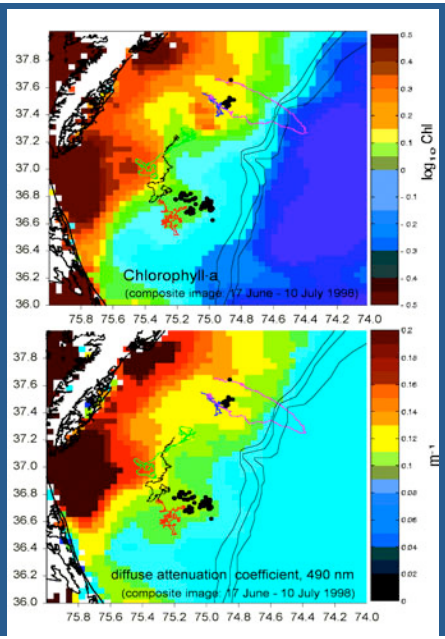
Equivocal for commercial fishing

highly mobile fleet pursuing highly mobile fishes



AREAS WHERE YELLOWFIN TUNA ARE CAUGHT WITH LONGLINE GEAR.





Not equivocal for recreational fishing because of very limited mobility of the fleet,

and “popularity” of bluefin tuna

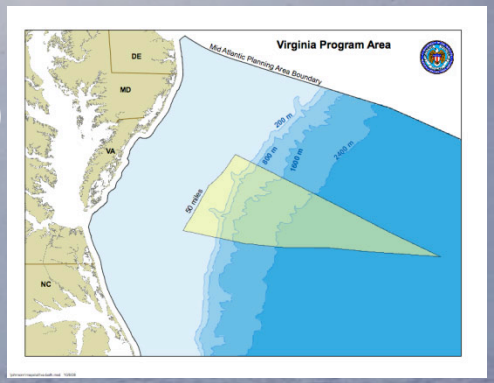
…not equivocal for recreational fishing industry

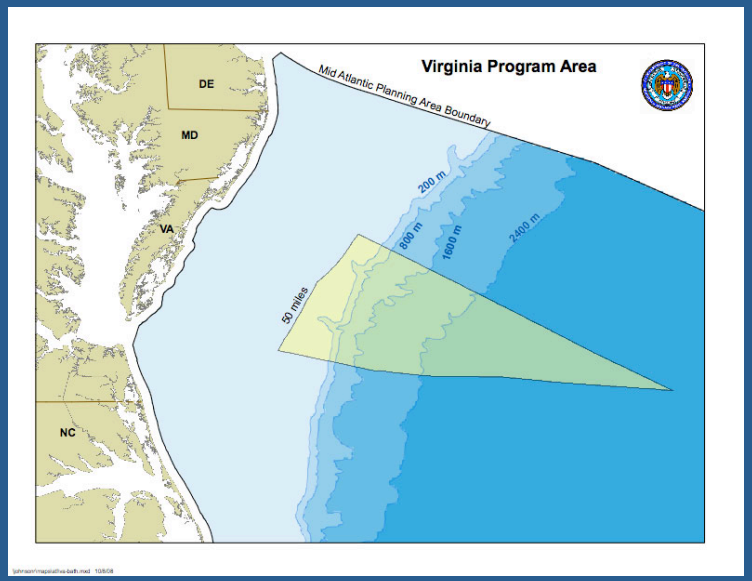
problematic for policy makers…

=

People of affluence and influence

(in proximity to Washington DC)





Summary

Potential Impacts of Virginia Offshore Oil and Gas Activities:

Equivocal for pelagic fishes (even bluefin tuna)

Equivocal for commercial fishers (longline)

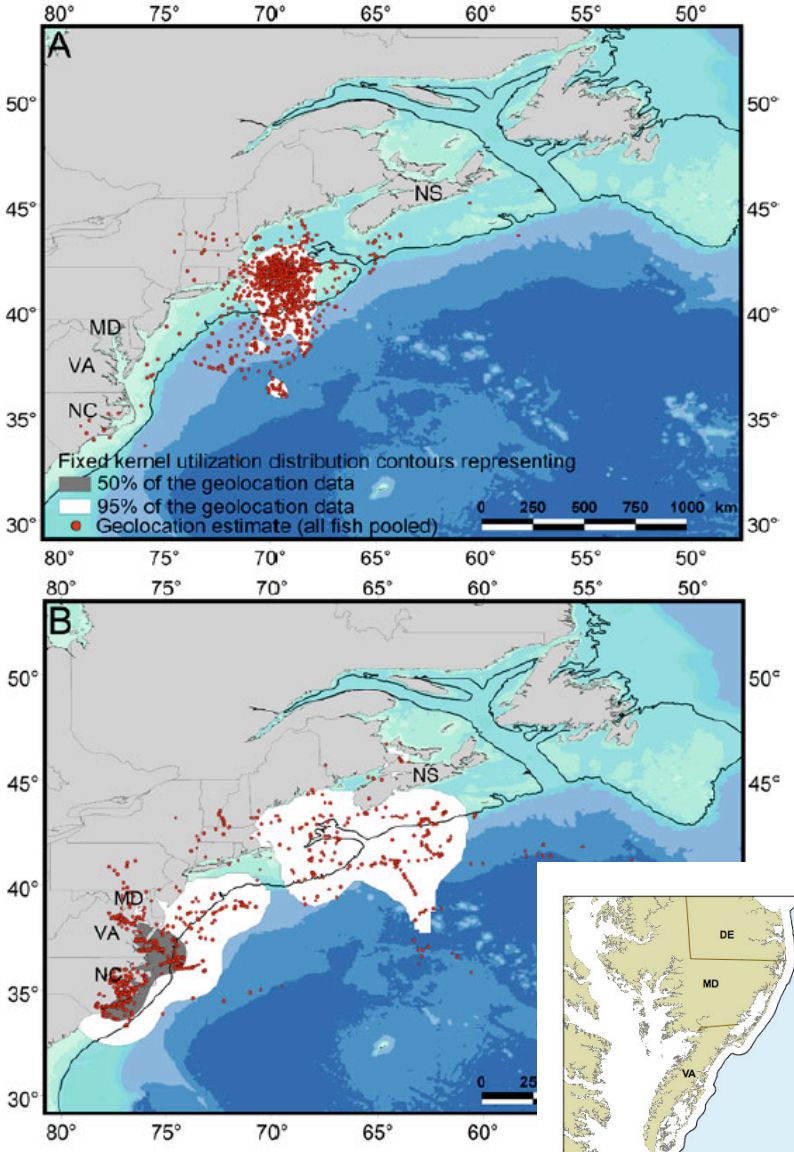
Not Equivocal for recreational fishing

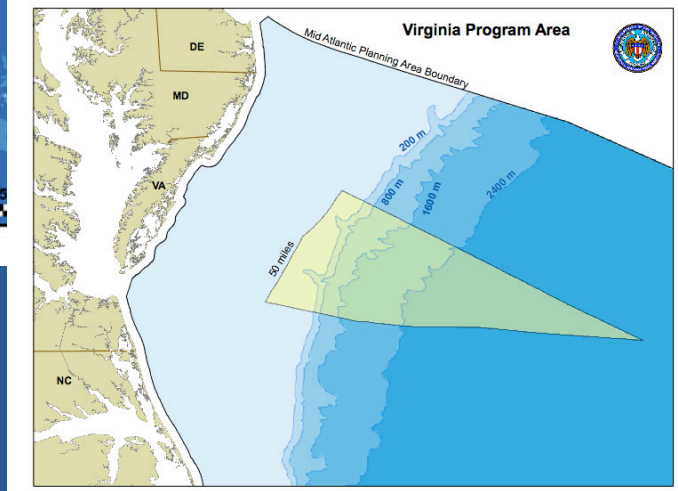
Popup Satellite Archival Tag

Light-based geolocation accurate to:

± 1 to 2° in latitude

± 0.5° in longitude





Long-term fluctuations in the eastern Atlantic and Mediterranean bluefin tuna population

Christelle Ravier and Jean-Marc Fromentin

ICES Journal of Marine Science, 58: 1299–1317. 2001
doi:10.1006/jmsc.2001.1119, available online at http://www.idealibrary.com on IDEAL®

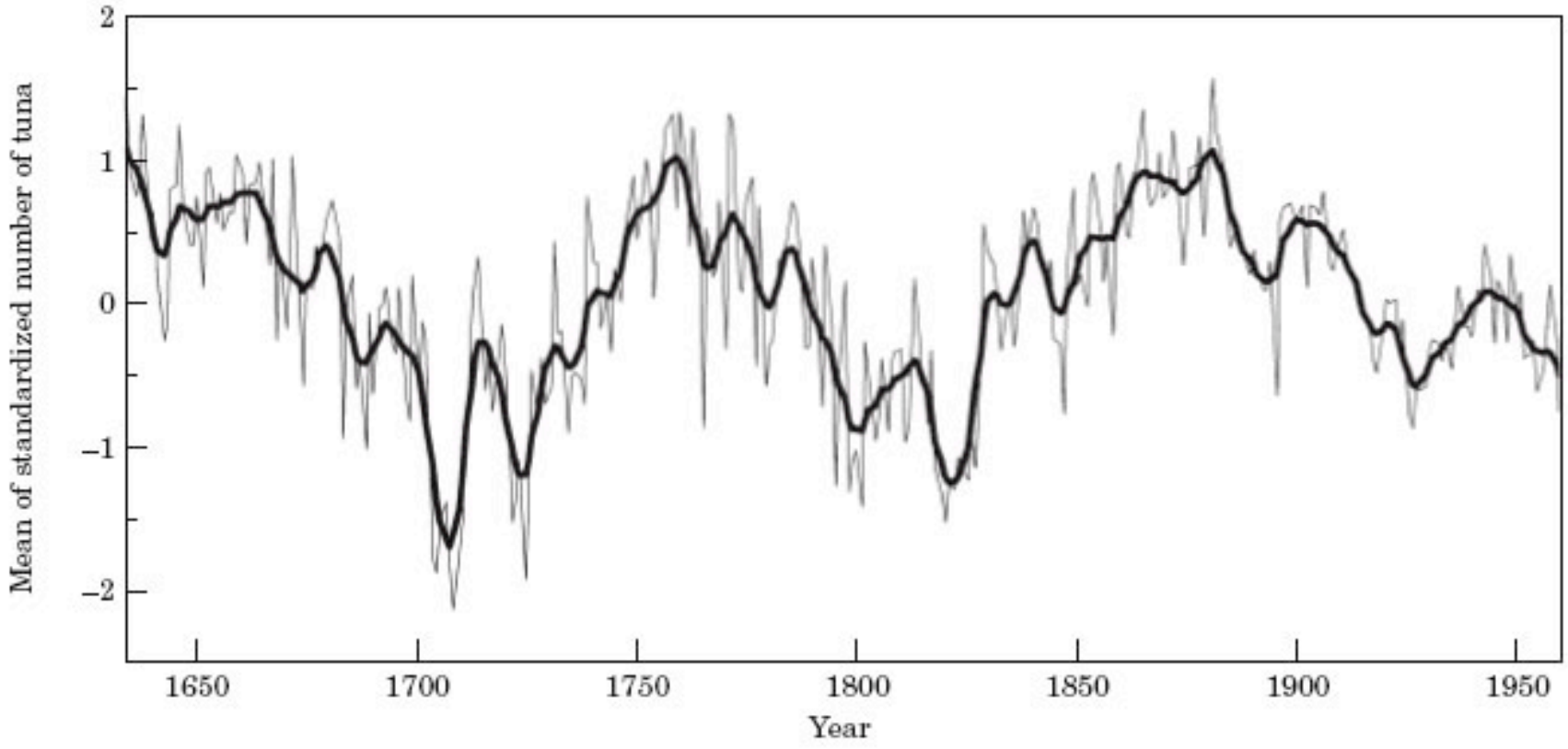
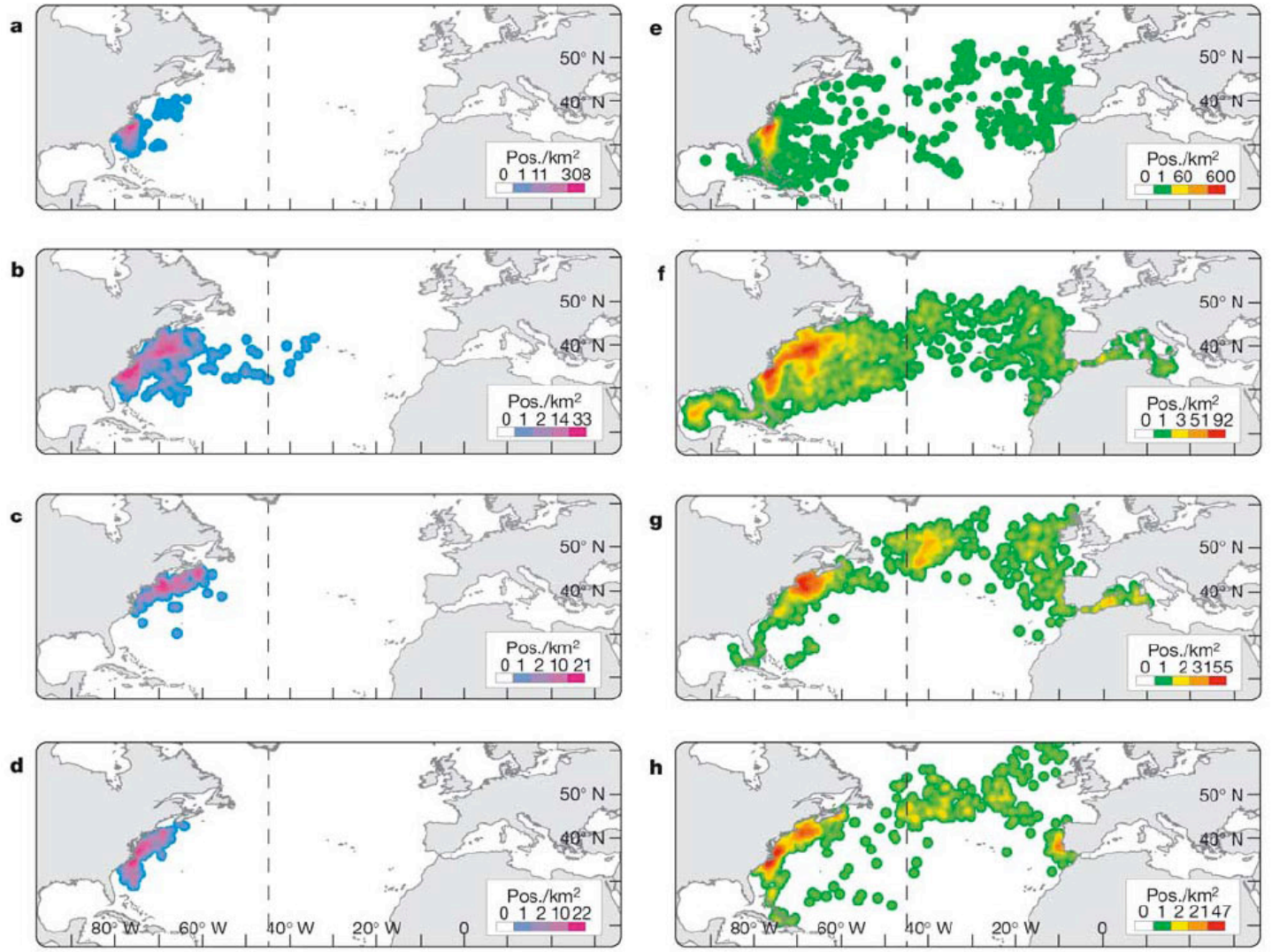


Figure 8. Synthetic series (thin line) computed as mean of the standardized values of the different time-series. The trend (bold line), estimated by Eigen Vector Filtering (see the text), constitutes an index of long-term fluctuations in abundance.



Adult bluefin tuna used Virginia – North Carolina & New England inshore areas as winter feeding grounds.

Electronic tagging and population structure of Atlantic bluefin tuna

Barbara A. Block[1], Steven L. H. Teo[1]*, Andreas Walli[1]*, Andre Boustany[1]*, Michael J. W. Stokesbury[1,3], Charles J. Farwell[2], Kevin C. Weng[1], Heidi Dewar[1] & Thomas D. Williams[2]

NATURE | VOL 434 | 28 APRIL 2005

BENTHIC FISH/FISHERIES ISSUES

Kenneth W. Able
Marine field Station
Institute of Marine and Coastal Sciences
Rutgers University

Figure 1. Middle Atlantic Bight study area with important localities mentioned in the text.

ECOLOGICAL SETTINGS

- Continental shelf waters strongly influenced by seasonal variation in temperatures
- Outer continental shelf margin influenced by submarine canyons and Gulf Stream
- Fish fauna is highly migratory
- Larval supply has multiple sources
- Diverse assemblages of fishes

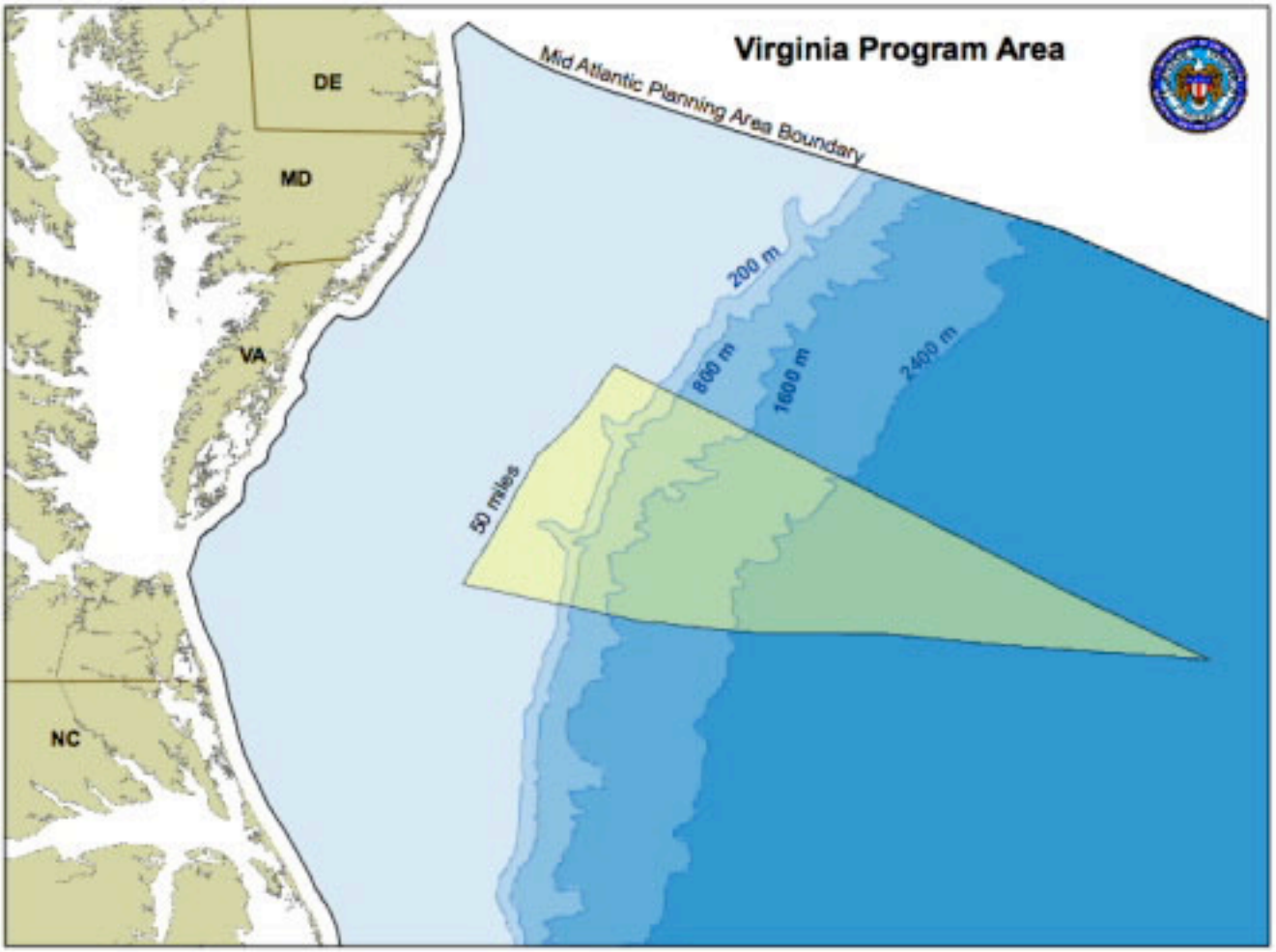
Figure 6. Composite distribution of age 1+ juvenile and adult and YOY *Alosa pseudoharengus* during seasonal cruises of the National Marine Fisheries Service groundfish survey. Details of sampling effort and geographical landmarks indicated in Fig. 1.

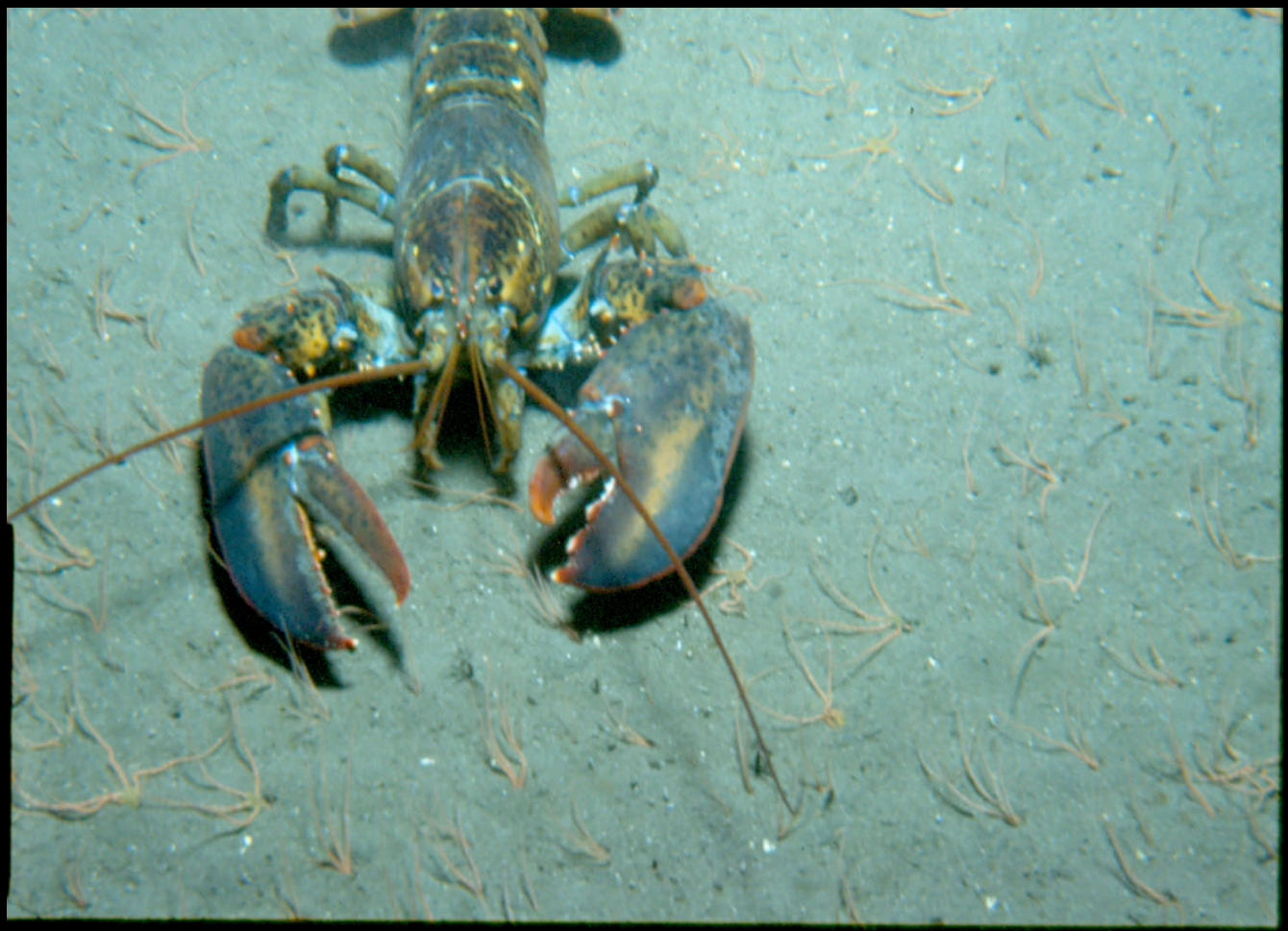
Figure 15. Composite distribution of age 1+ and YOY *Centropristis striata* during seasonal cruises of the National Marine Fisheries Service groundfish survey. Details of sampling effort and geographical landmarks indicated in Fig. 1.

Figure 9. Composite distribution of age 1+ and YOY *Anchoa mitchilli* during seasonal cruises of the National Marine Fisheries Service groundfish survey. Details of sampling effort and geographical landmarks indicated in Fig. 1.

Figure 19. Composite distribution of age 1+ and YOY *Cynoscion regalis* during seasonal cruises of the National Marine Fisheries Service groundfish survey. Details of sampling effort and geographical landmarks indicated in Fig. 1.

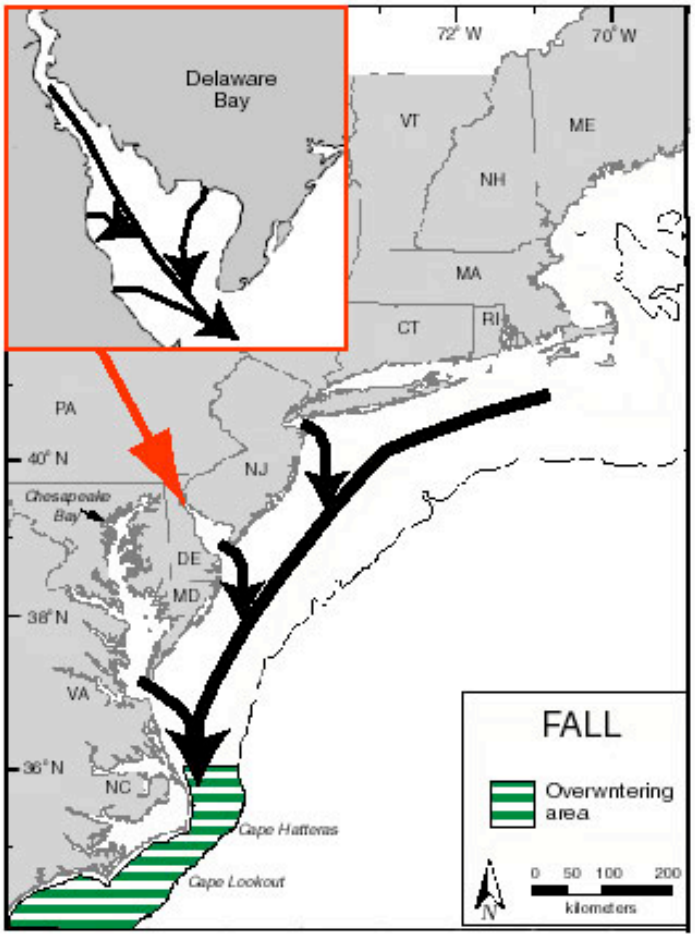
Figure 14. Composite distribution of age 1+ and YOY *Morone saxatilis* during seasonal cruises of the National Marine Fisheries Service groundfish survey. Details of sampling effort and geographical landmarks indicated in Fig. 1.

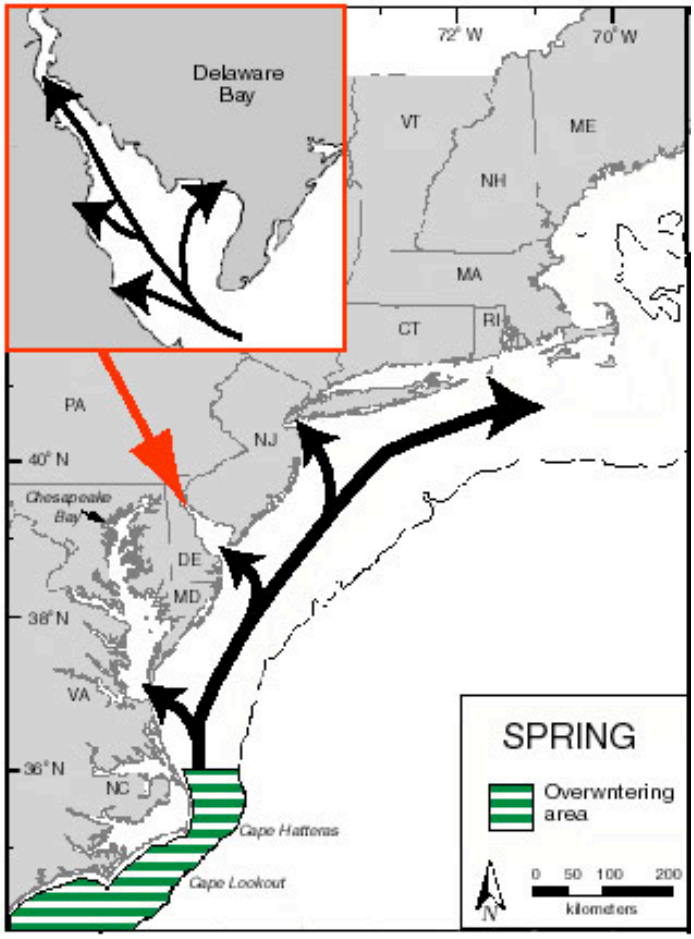

Virginia Program Area
Mid Atlantic Planning Area Boundary
DE
MD
VA
NC
200 m
800 m
1600 m
2400 m
50 miles



INFORMATION GAPS

- Response of fishes to oil and gas platforms
- Response of fishes to seasonal variability in thermal regimes
- Responses variability due to climate change


Delaware Bay
72° W
70° W
VT
ME
NH
MA
CT
RI
PA
40° N
NJ
Chesapeake Bay
DE
MD
38° N
VA
36° N
NC
Cape Hatteras
Cape Lookout
FALL
Overwntering area
0 50 100 200
kilometers
N


Delaware Bay
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MD
38° N
VA
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NC
Cape Hatteras
Cape Lookout
SPRING
Overwntering area
0 50 100 200
kilometers
N

Workshop on Environmental Research Needs in Support of Potential Virginia Offshore Oil and Gas Activities

~ Benthos ~

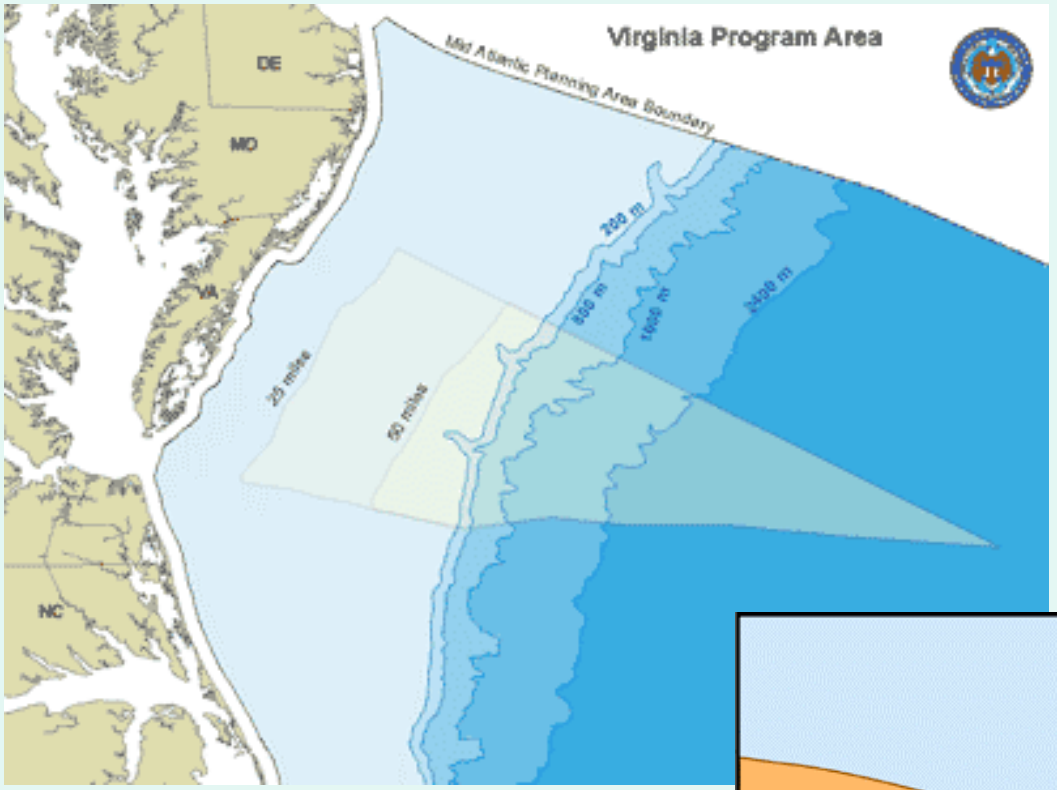
Linda C. Schaffner, Professor
Department of Biological Sciences
Virginia Institute of Marine Science
linda@vims.edu

December 3, 2008

Outline

- MMS Offshore Program Area
- The benthos - a few fundamentals
- Benthic habitats, including Essential Fish Habitat (EFH), Habitats of Particular Concern (HAPC), commercial species and more…
- Potential effects of exploration, drilling and normal operations on benthic ecosystems
- Potential effects of oil spills on benthic ecosystems
- Breakout sessions

Virginia Offshore Program Area as presented by MMS



- Outer continental shelf to deep sea
- Region includes Norfolk and Washington Canyons
- Potential effects of onshore activities and pipelines across the shelf and into nearshore areas must also be considered

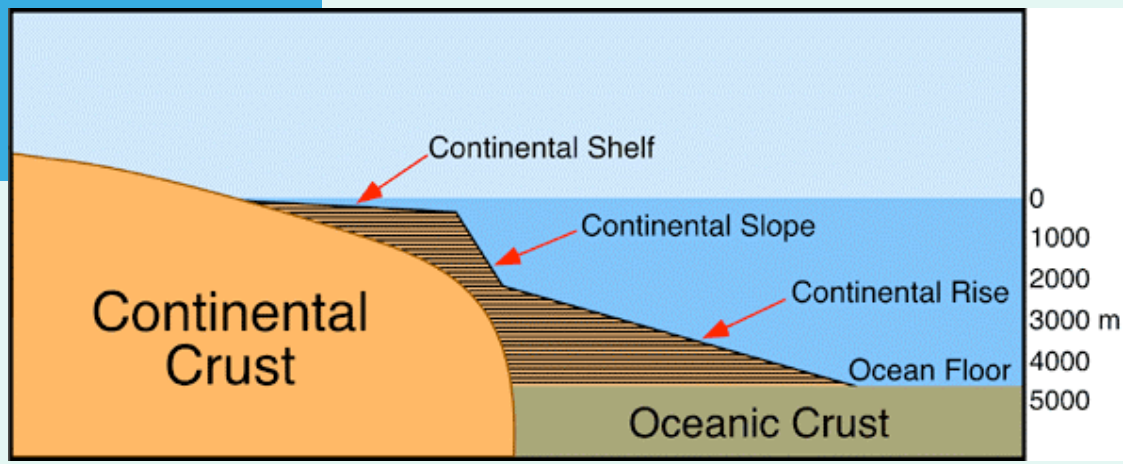


image from PhysicalGeology.net

Outline

- MMS Offshore Program Area
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- Benthic habitats, including Essential Fish Habitat (EFH), Habitats of Particular Concern (HAPC), commercial species and more…
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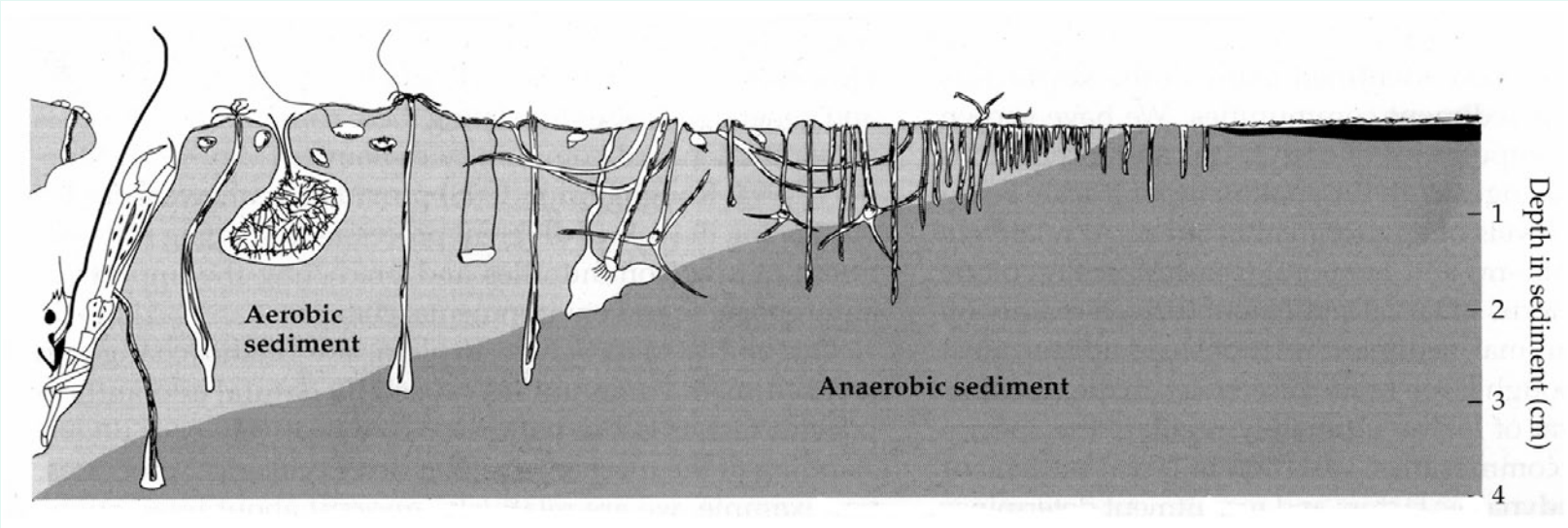
The Benthic Effect

- The term benthos is used for habitats, organisms, and the processes they modulate in, on, or very near the bottom.
- The benthic organisms regulate or modify most physical, chemical, geological and biological processes in shallow waters and becomes more dependent on pelagic processes as depth increases.

The benthos serves as the "memory of the ecosystem"

- Materials reaching bottom are mostly decomposed, but some remain as part of a permanent record.
- Benthic organisms "sample and integrate" events
- As a result, sediments and resident benthic organisms are among the most common monitoring tools used to detect environmental degradation

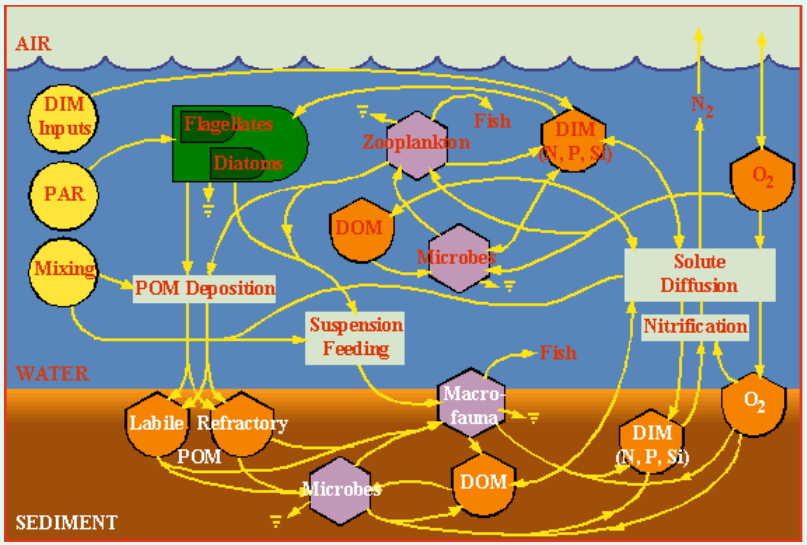


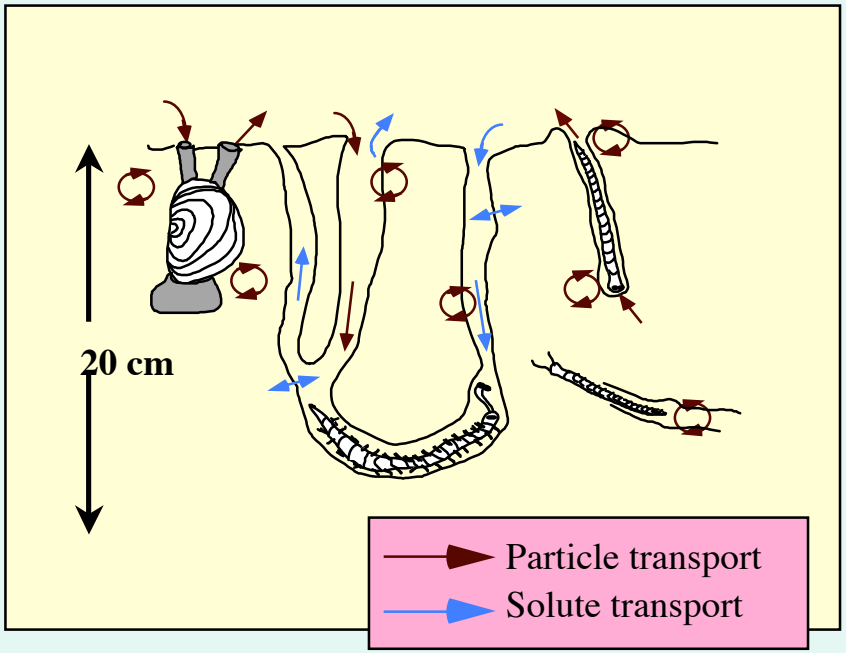
Healthy ⟷ Degraded

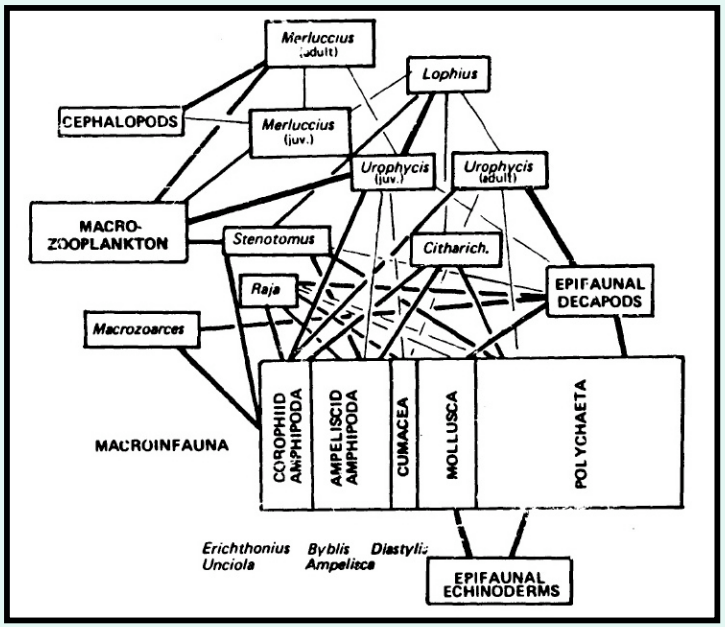
(figure from Pearson and Rosenberg 1978)

The benthos provides key ecosystem functions

- Benthic organisms have major effects on nutrient cycling, carbon transformations and pollutant fate, especially on shelf and in nearshore regions
- Secondary production by benthic organisms provides essential links to higher trophic levels







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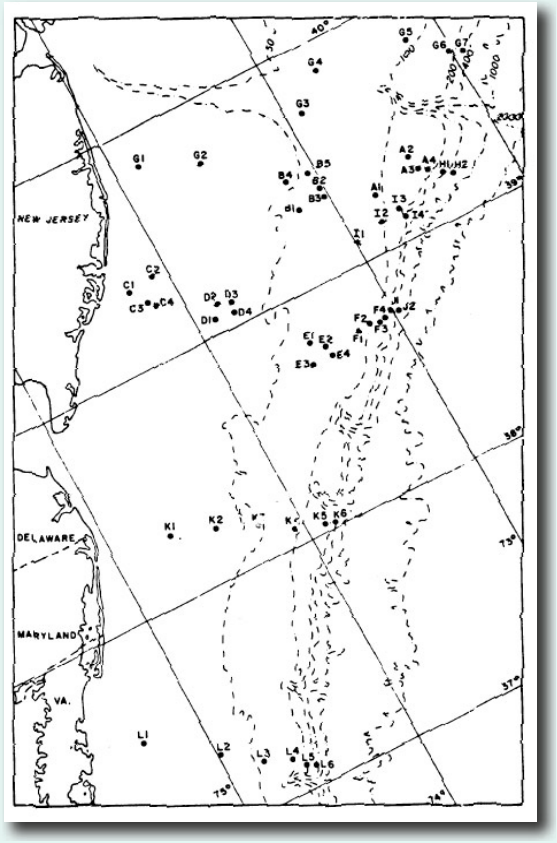
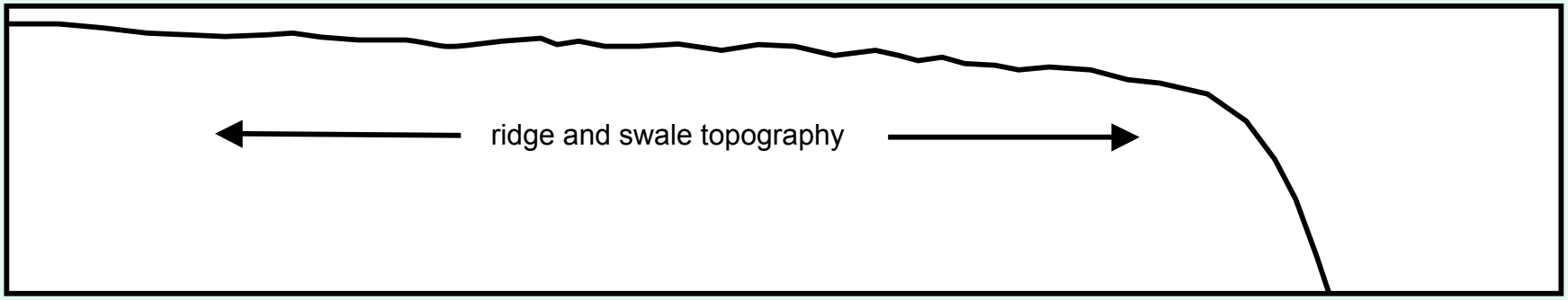
- Breakout sessions

Benthic Habitats - some examples, not a comprehensive review

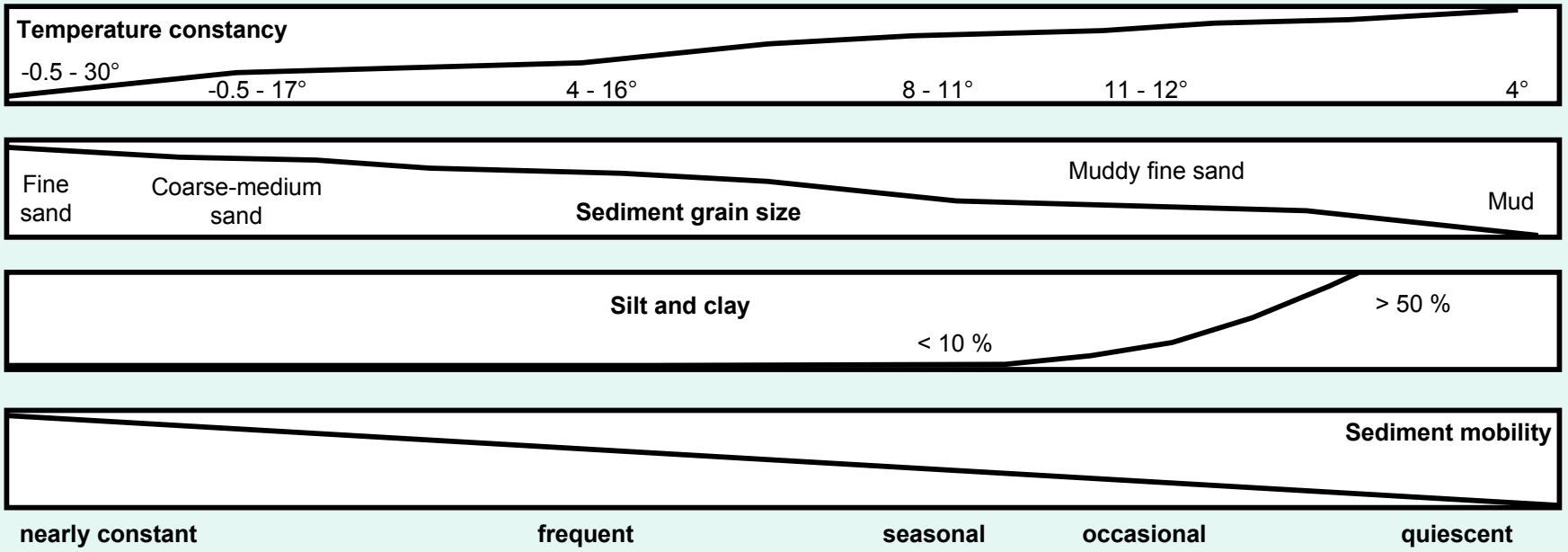
- General trends across the shelf/upper slope from VIMS BLM study in late 1970s (mostly off NJ, one transect in Virginia)
  - Physical environment
  - Hydrocarbons, metals, bacteria
  - Benthic assemblages
- Habitats of Particular Concern (HAPC)
- “Priority Areas” identified by NRDC
- Commercial species - e.g. scallop
- Nearshore areas potentially impacted by onshore activities and pipelines



Cross Shelf - Physical Environment

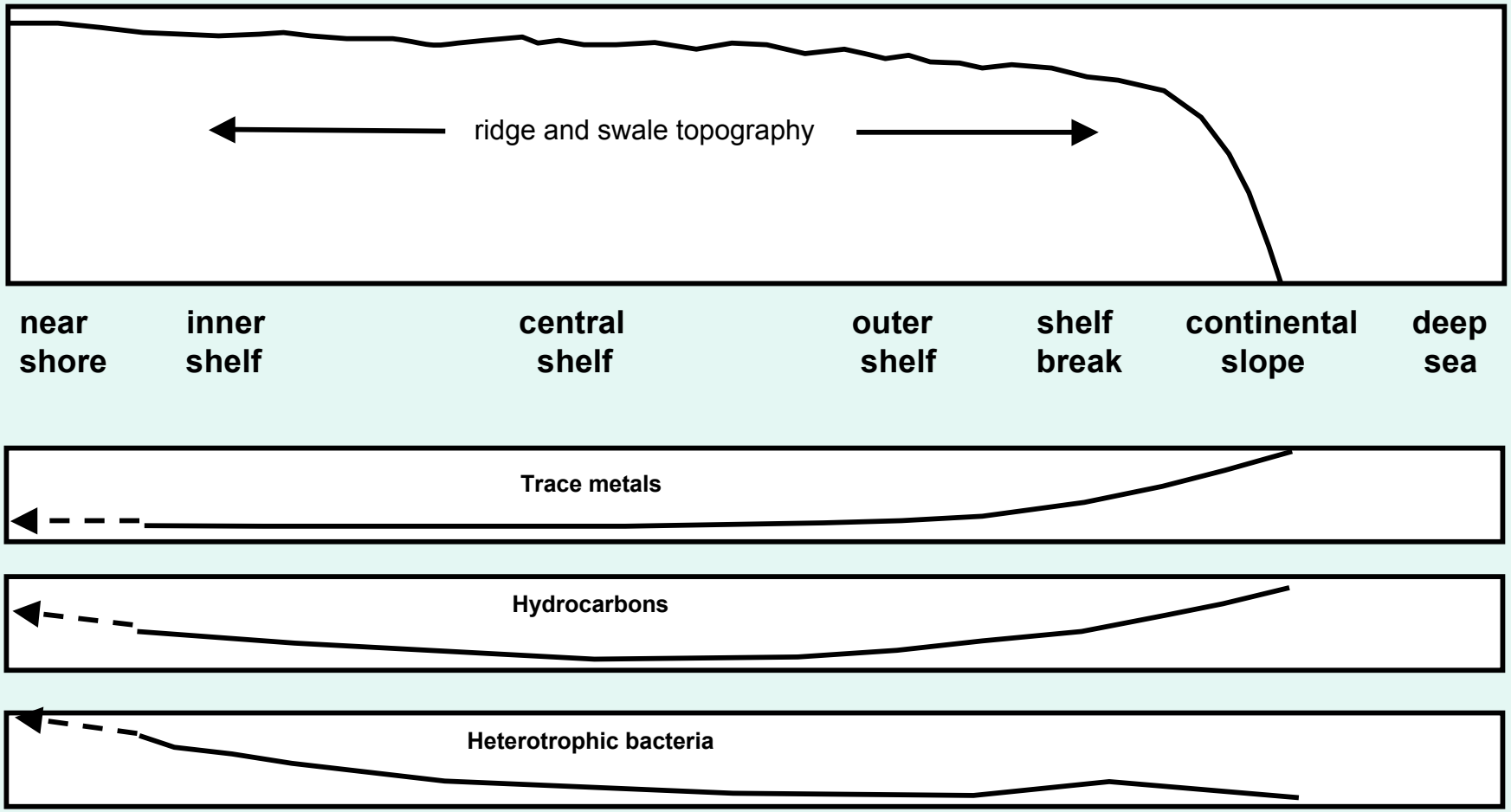


near shore | **inner shelf** | **central shelf** | **outer shelf** | **shelf break** | **continental slope** | **deep sea**



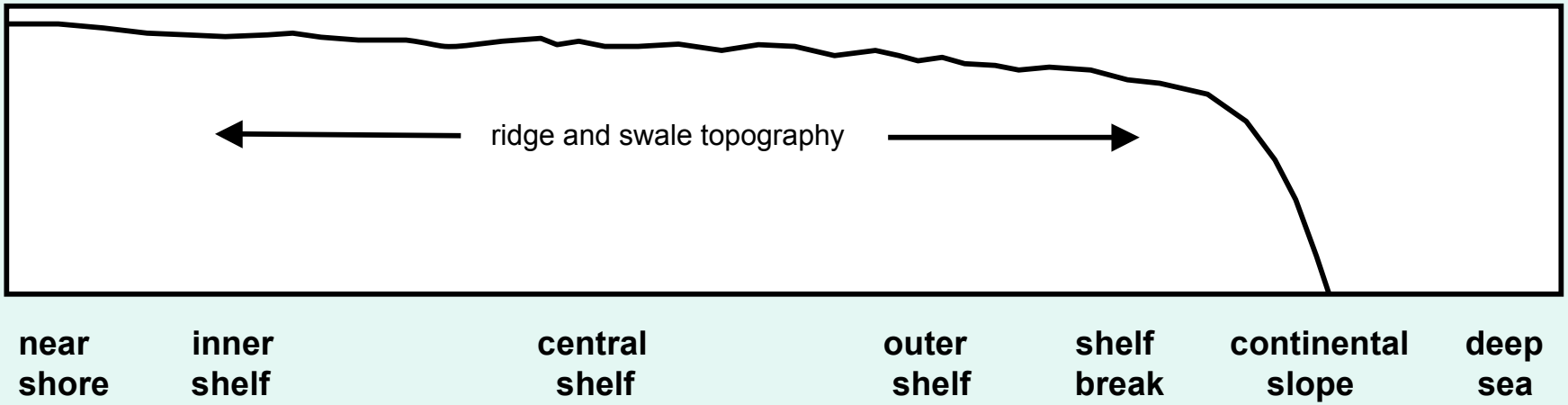
Modified from VIMS (1979)

Cross Shelf - Sediment Associated Metals, Hydrocarbons, Bacteria



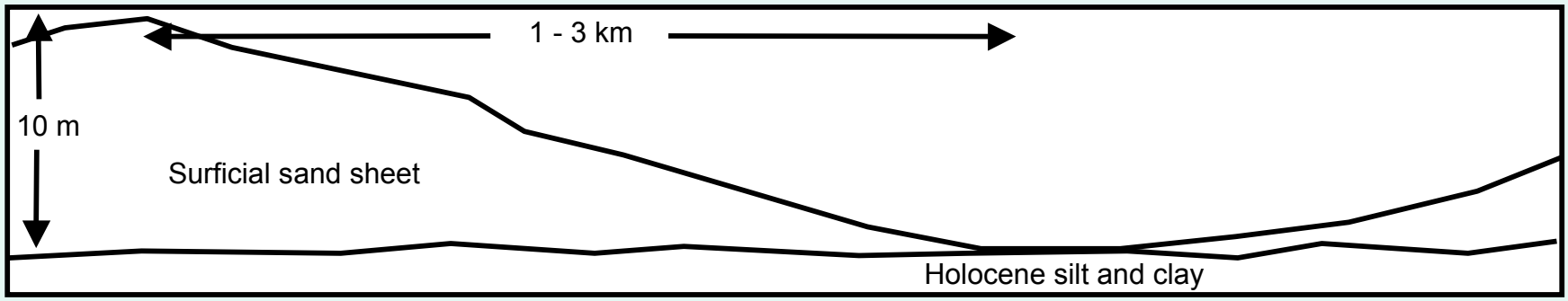
Modified from VIMS (1979)

Shelf - Benthic Assemblages



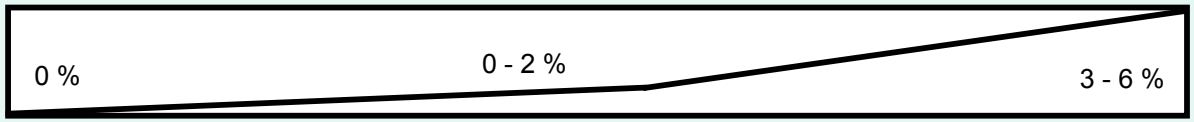
Modified from VIMS (1979)

Ridge - Swale Topography



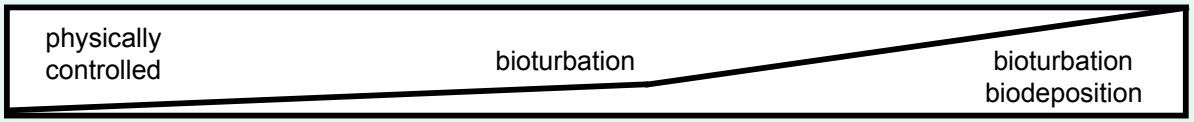
Ridge **Flank** **Swale**

Sediment grain size



Silt and clay

Sediment mobility



Important biogenic processes

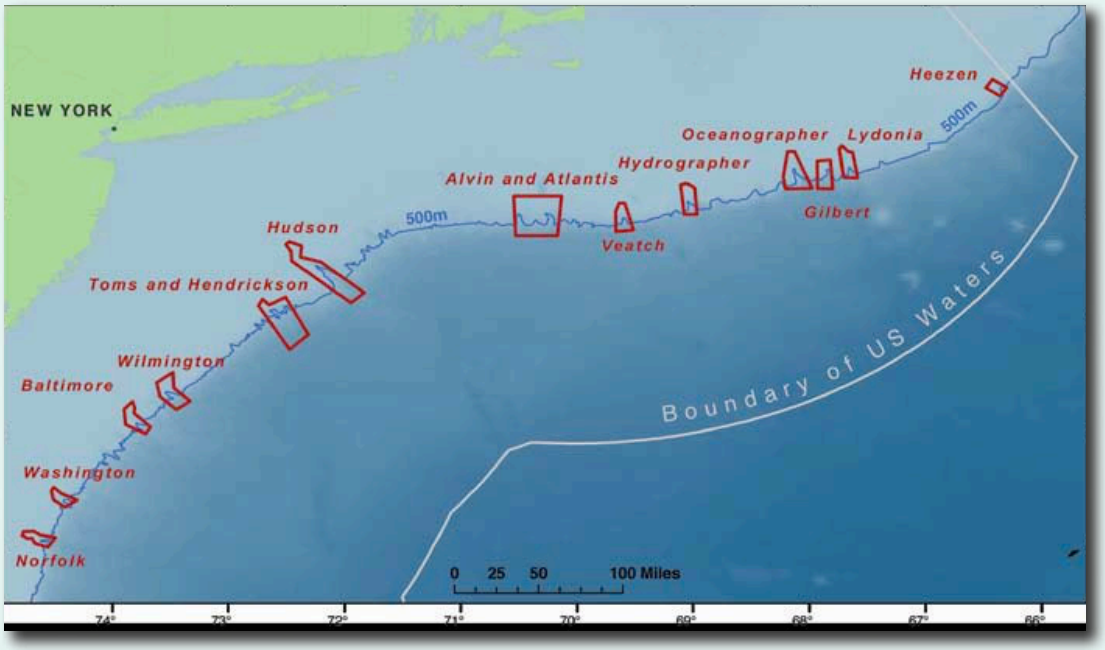
Macrobenthos density, biomass and species richness

Modified from VIMS (1979)

Submarine Canyons

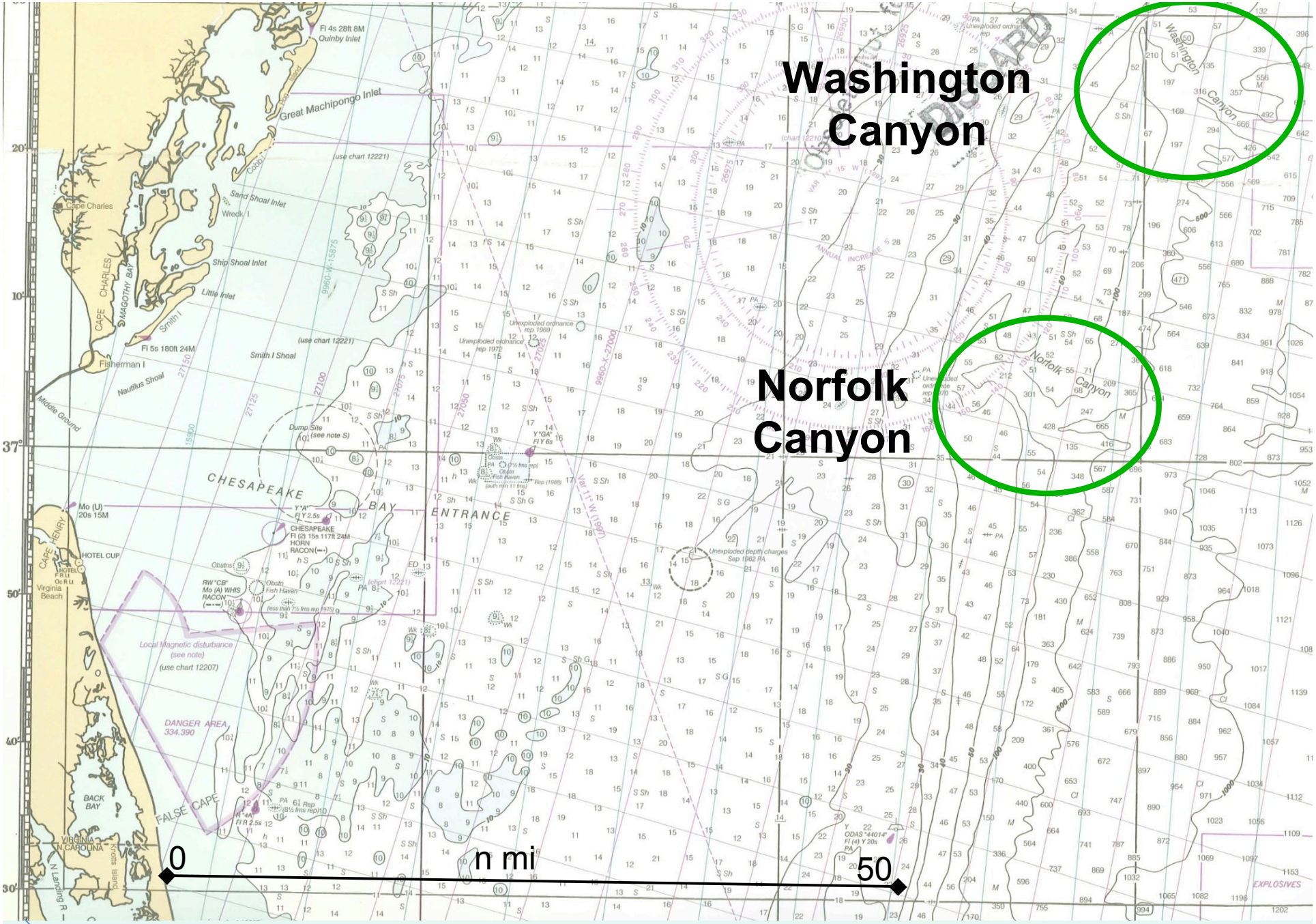
- Fifteen canyons in the North Atlantic were recognized by the New England Fisheries Management Council in June 2007 as Essential Fish Habitat (EFH) and "Habitat Areas of Particular Concern" (HAPC)
- These include Washington and Norfolk canyons, which are in the Virginia Offshore Program Area

- In addition to fishing issues, some canyons were selected because of the unique biological communities found there --- for example, deep-water corals, sponges and sea fans --- and because many of these complex structures are vulnerable to disturbance.



New England Fishery Management Council Report - http://www.nefmc.org/actions/council_reports/council-report-jun07.pdf

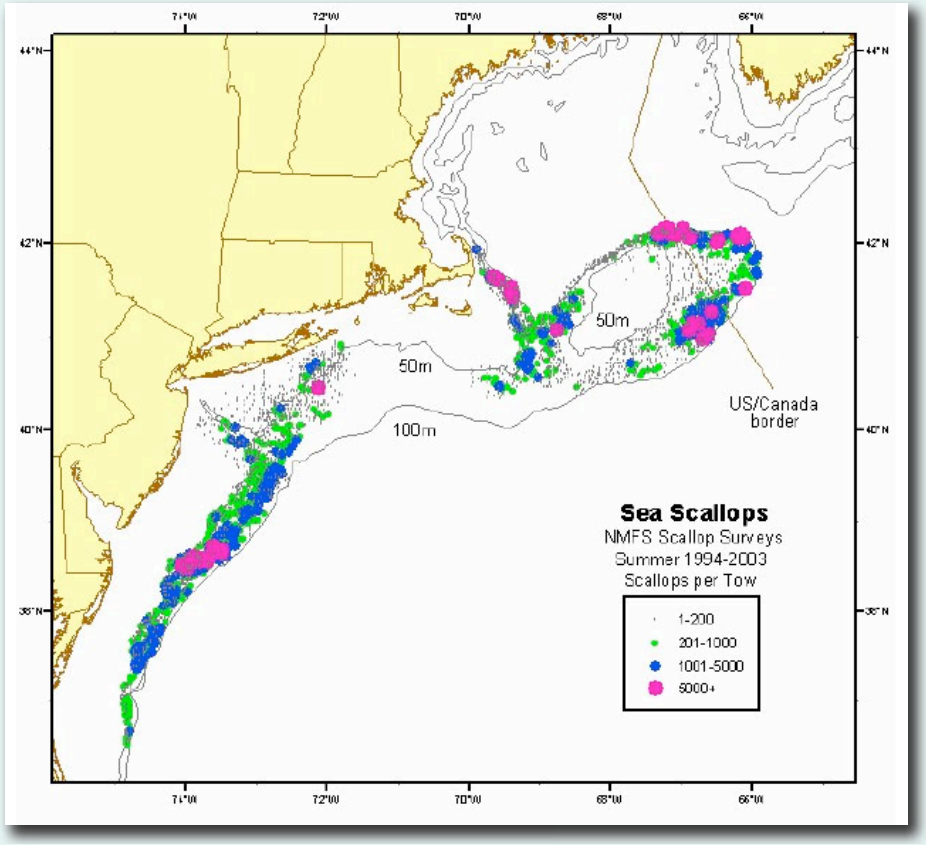
http-//www.oceana.org/fileadmin/oceana/uploads/reports/NewEnglandTrawlReport_low.pdf


Washington Canyon
Norfolk Canyon
0
n mi
50

Commercial species: Sea Scallop

- Geographic range: In the Northwest Atlantic Ocean, from Newfoundland to North Carolina
- Habitat : Adult scallops form dense aggregations called "beds" on the ocean floor. Commercially valuable scallop beds are usually found at depths between 59 and 360 feet.
- Life span: Up to 20 years

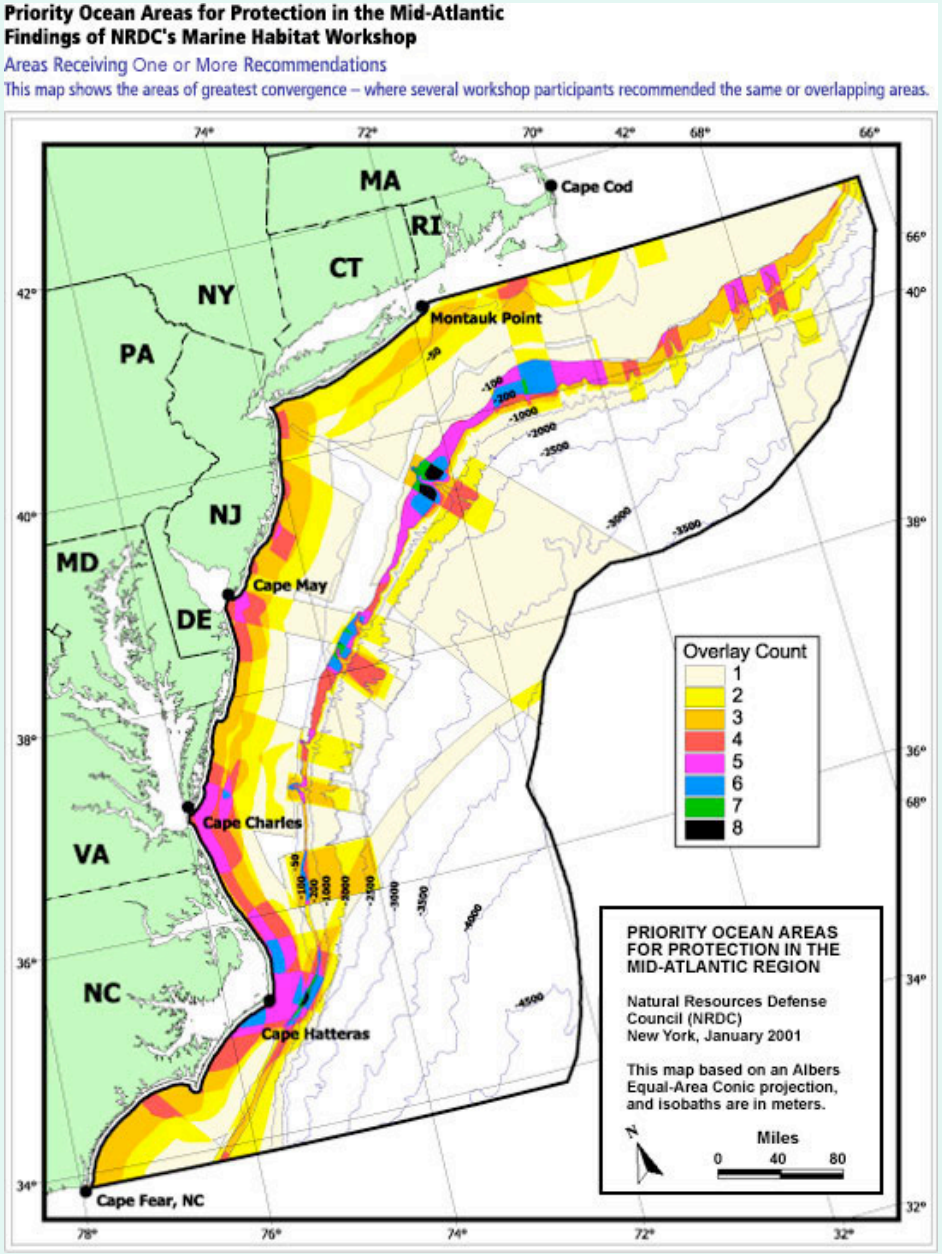
- Other species to consider? Surf clam?



http://www.nmfs.noaa.gov/fishwatch/species/atl_sea_scallop.htm

“Priority Ocean Areas”

- Specialized habitat areas identified by experts for attributes:
  - High biodiversity
  - High abundance
  - Migration pathways
  - Nursery or spawning areas
  - Endangered or threatened species
  - Fisheries
- Virginia - priority areas include:
  - Submarine canyons
  - A 35-kilometer corridor (extending from shore) of nearshore waters, encompassing many subareas of importance.
  - The continental shelf/slope break area, from the 100-meter to the 400-meter isobath



http://www.nrdc.org/water/oceans/priority/poainx.asp

Nearshore areas

- Highly productive
- Diversity of habitat types
- Often serve as nursery areas
- Foraging areas for adult fish, crabs, birds
- All are relatively sensitive to disturbance

Outline

- MMS Offshore Program Area
- Benthos - a few fundamentals
- Benthic habitats, including Essential Fish Habitat (EFH), Habitats of Particular Concern (HAPC), commercial species and more…
- Potential effects of exploration, drilling and normal operations on benthic ecosystems
- Potential effects of oil spills on benthic ecosystems
- Breakout sessions

Potential Effects in Space and Time

- Potential for adverse effects with all activities:
  - Exploration - effects likely to be temporary and localized
  - Drilling and Construction - localized to widespread, short to long-term
  - Normal Operations - relatively localized?, long-term
  - Influenced by engineering and advanced technologies
- Influenced by level of activity
  - Accidental release of oil (should drilling for oil occur)
  - Potential for wide-spread and long-term effects
  - Heavily influenced by nature, which can not be controlled

Effects of Drilling and Normal Operations on Benthic Habitats, Organisms and Processes

- From drilling activities:
  - direct disruption of benthic habitats (e.g. production activities, deposition of drill cuttings)
  - toxicity due to drilling muds - OBMs, SBMs, WBMs??
  - long term, cumulative impacts on biodiversity and benthic productivity depending on level of activities
- From development of new infrastructure (e.g. onshore processing and pipelines):
  - direct disruption of benthic habitats (e.g. nursery areas, migration corridors, SAV, wetlands, oysters)
  - indirect effects via changes in water quality and watershed impacts that change physical environment (e.g. runoff)
  - long term and cumulative impacts on biodiversity and benthic productivity depending on level of activities

Effects of Oil Spills

- Emerging perspective - effects can be pervasive and long-lasting
- Chronic effects at all levels, including communities and ecosystems

Peterson, C.H. et al. 2003. Long-term ecosystem response to the Exxon Valdez oil spill. Science 302: 2082-2086

Table 1. Changing paradigms in oil ecotoxicology, moving from acute toxicity based on single species toward an ecosystem-based synthesis of short-term direct plus longer-term chronic, delayed, and indirect impacts.

Old paradigm	Emerging appreciation
Physical shoreline habitat	
Oil that grounds on shorelines other than marshes dominated by fine sediments will be rapidly dispersed and degraded microbially and photolytically.	Oil degrades at varying rates depending on environment, with subsurface sediments physically protected from disturbance, oxygenation, and photolysis retaining contamination by only partially weathered oil for years.
Oil toxicity to fish	
Oil effects occur solely through short-term (~4 day) exposure to water-soluble fraction (1- to 2-ringed aromatics dominate) through acute narcosis mortality at parts per million concentrations.	Long-term exposure of fish embryos to weathered oil (3- to 5-ringed PAHs) at ppb concentrations has population consequences through indirect effects on growth, deformities, and behavior with long-term consequences on mortality and reproduction.
Oil toxicity to seabirds and marine mammals	
Oil effects occur solely through short-term acute exposure of feathers or fur and resulting death from hypothermia, smothering, drowning, or ingestion of toxics during preening.	Oil effects also are substantial (independent of means of insulation) over the long term through interactions between natural environmental stressors and compromised health of exposed animals, through chronic toxic exposure from ingesting contaminated prey or during foraging around persistent sedimentary pools of oil, and through disruption of vital social functions (care giving or reproduction) in socially organized species.
Oil impacts on coastal communities	
Acute mortality through short-term toxic exposure to oil deposited on shore and the shallow seafloor or through smothering accounts for the only important losses of shoreline plants and invertebrates.	Clean-up attempts can be more damaging than the oil itself, with impacts recurring as long as clean-up (including both chemical and physical methods) continues. Because of the pervasiveness of strong biological interactions in rocky intertidal and kelp forest communities, cascades of delayed, indirect impacts (especially of trophic cascades and biogenic habitat loss) expand the scope of injury well beyond the initial direct losses and thereby also delay recoveries.

Outline

- MMS Offshore Program Area
- The benthos - a few fundamentals
- Benthic habitats, including Essential Fish Habitat (EFH), Habitats of Particular Concern (HAPC), commercial species and more…
- Potential effects of exploration, drilling and normal operations on benthic ecosystems
- Potential effects of oil spills on benthic ecosystems
- Breakout sessions

Breakout Sessions

- Session 1 - Review existing information and begin identify key datasets, reports, published works. Identify information gaps.
- Session 2 - What key areas of research are needed? Why?
- Session 3 - Develop one or two substantive ideas. The group will be asked to provide background for the potential study, objectives and approach. How would MMS use the information? Aspects such as feasibility, opportunities for partnering with other agencies, etc., should also be addressed.
- Session 4 - Draft a summary presentation.

"I don't know why I don't care about the bottom of the ocean, but I don't."

Protected and Endangered Species

Scott D. Kraus, PhD New England Aquarium

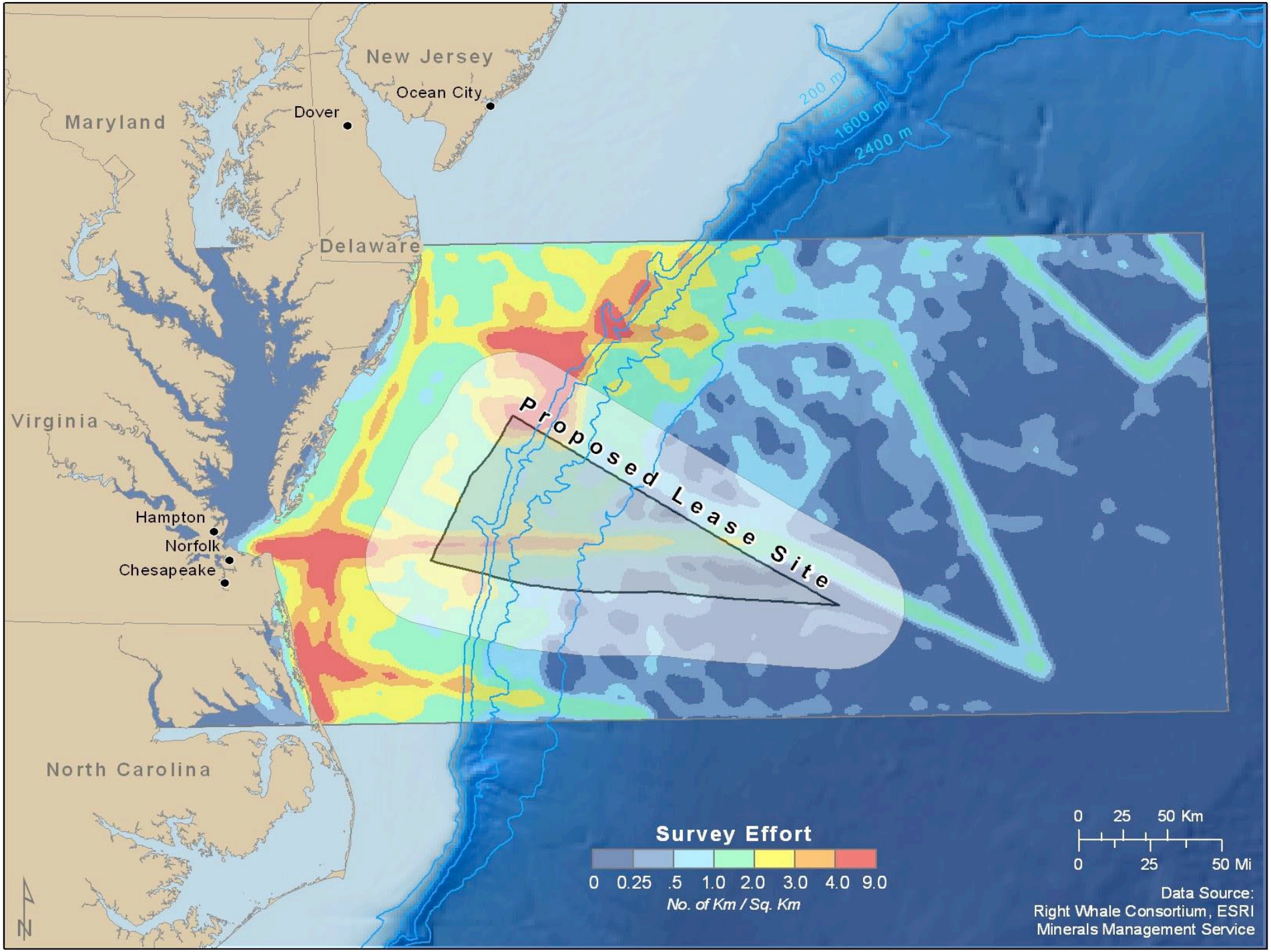
Marine Mammals

Sea Turtles

Vessel Traffic (collisions)

Noise (Exploration, operations, vessels)

Water and Air Pollution (oil and gas emissions)


New Jersey
Ocean City
Dover
Maryland
Delaware
200 m
1600 m
2400 m
Virginia
Proposed Lease Site
Hampton
Norfolk
Chesapeake
North Carolina
Survey Effort
0 0.25 .5 1.0 2.0 3.0 4.0 9.0
No. of Km / Sq. Km
0 25 50 Km
0 25 50 Mi
N
Data Source:
Right Whale Consortium, ESRI
Minerals Management Service

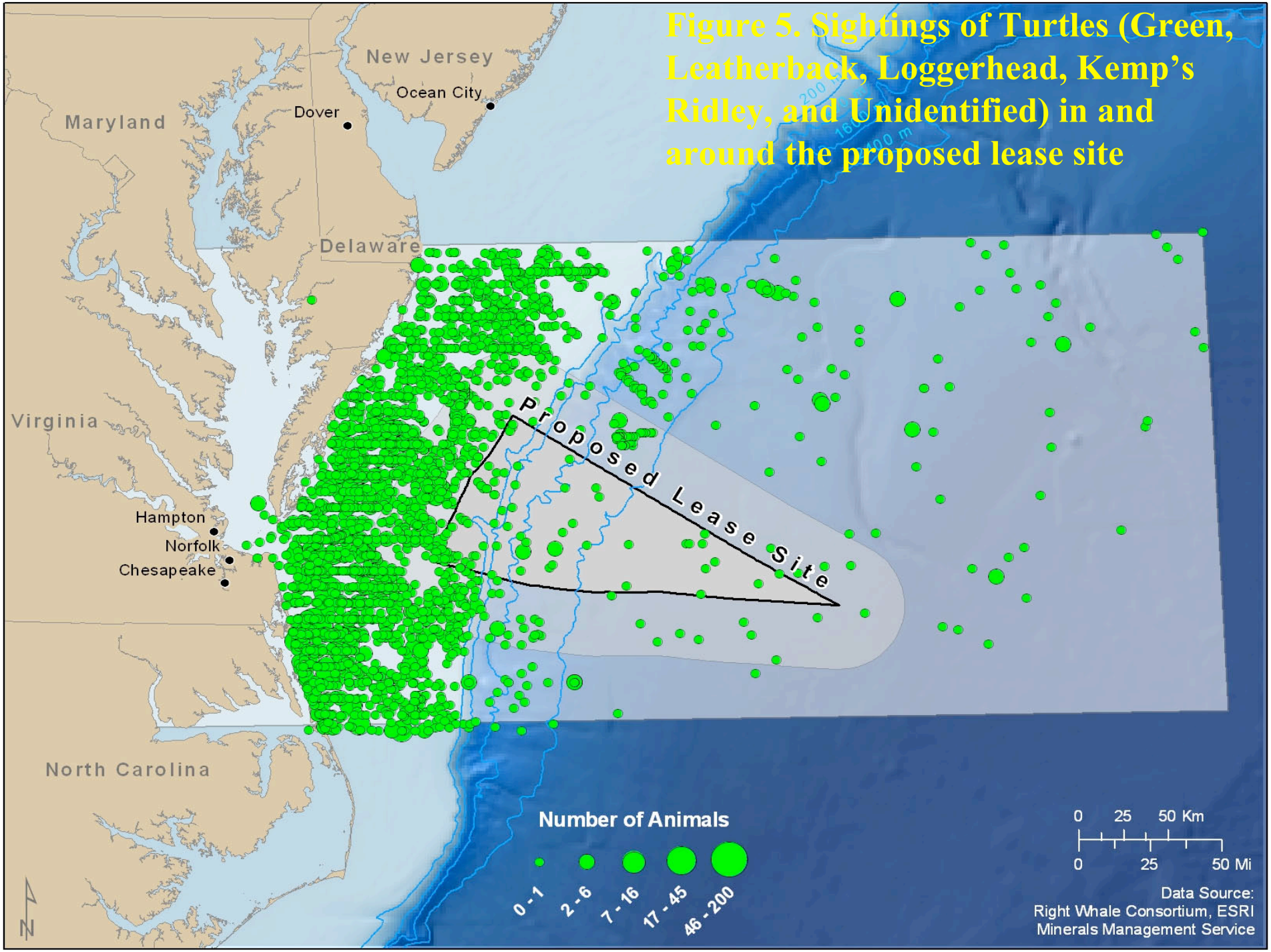


Figure 5. Sightings of Turtles (Green, Leatherback, Loggerhead, Kemp's Ridley, and Unidentified) in and around the proposed lease site

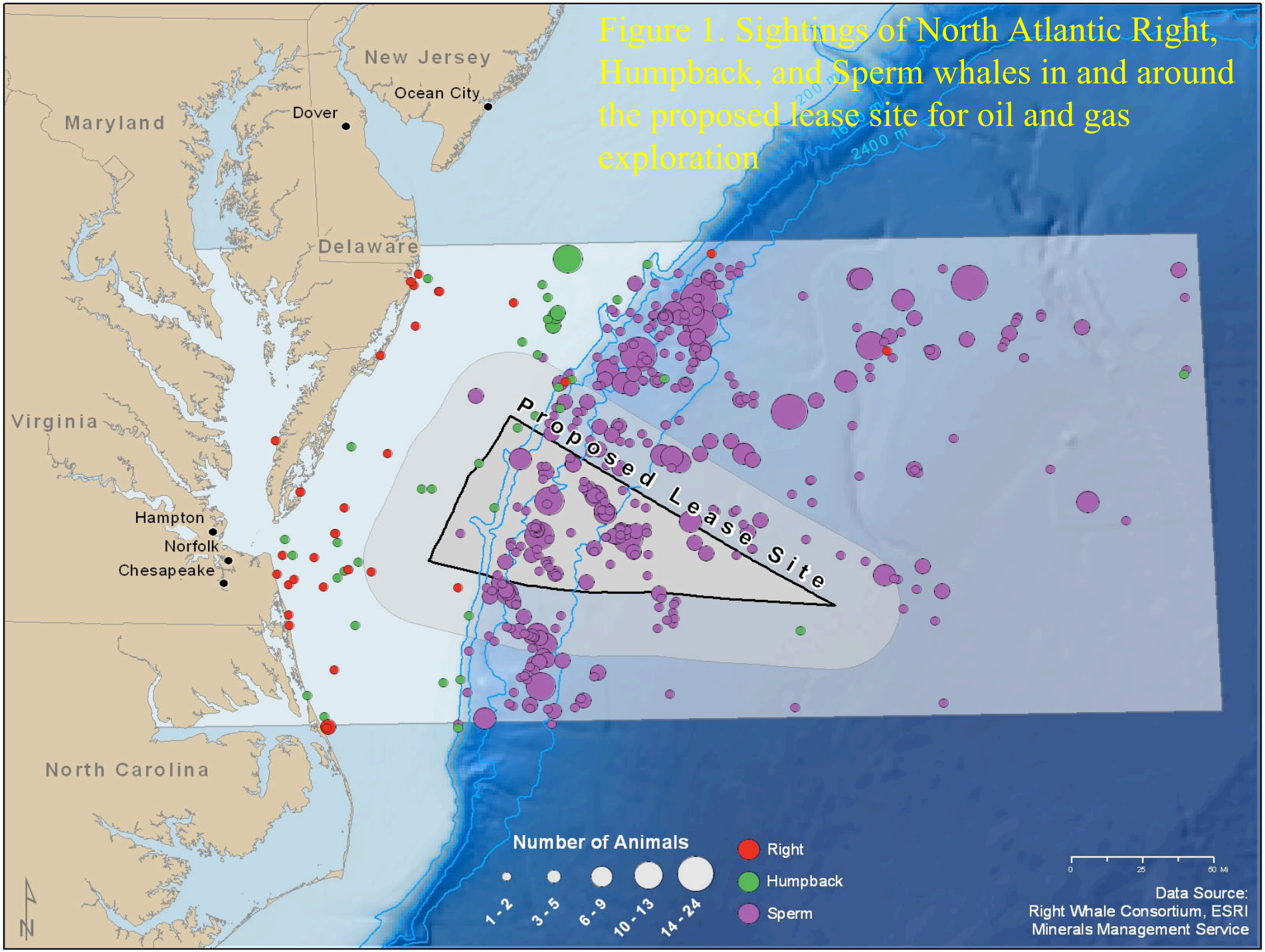


Figure 1. Sightings of North Atlantic Right, Humpback, and Sperm whales in and around the proposed lease site for oil and gas exploration

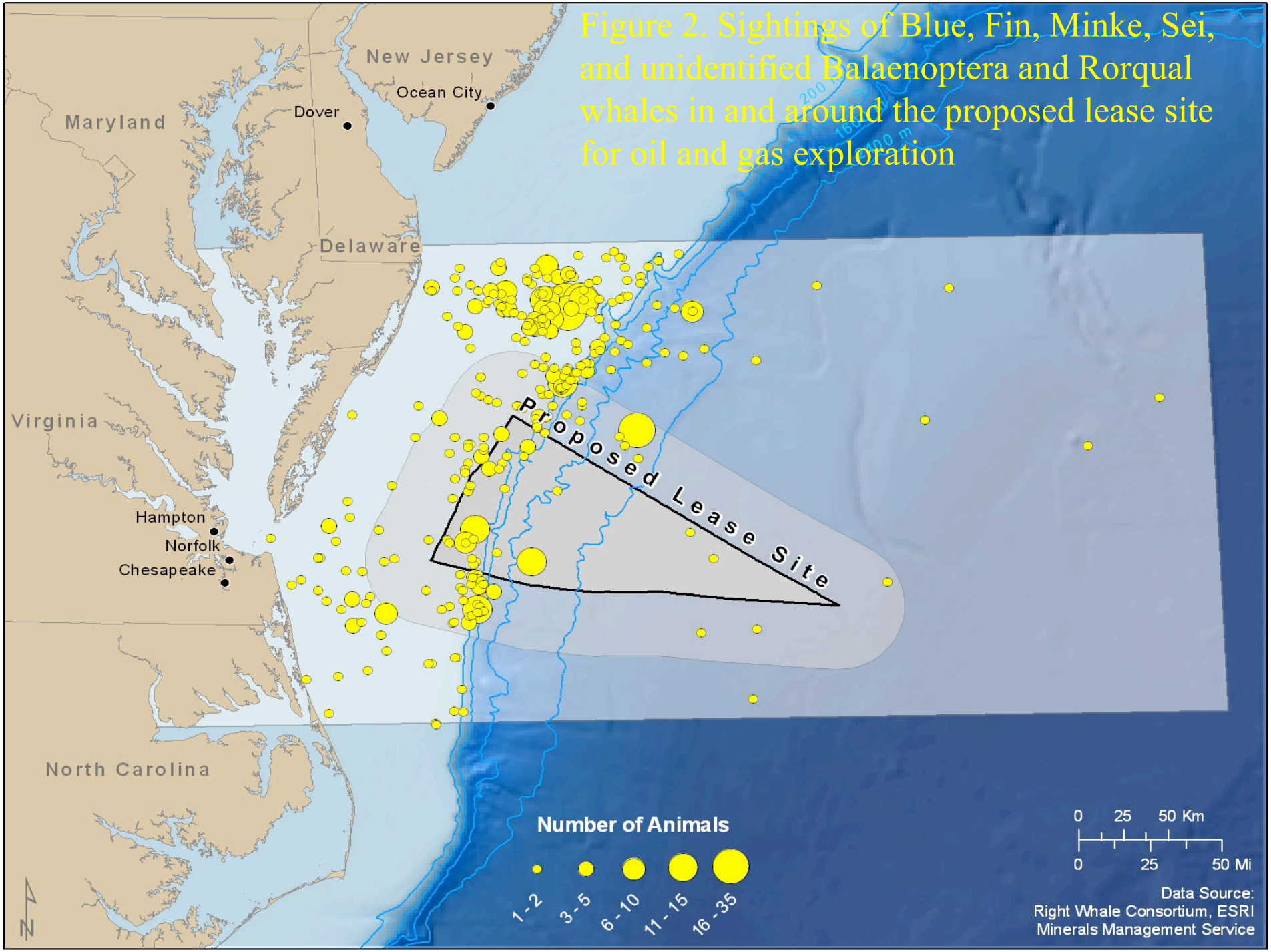


Figure 2. Sightings of Blue, Fin, Minke, Sei, and unidentified Balaenoptera and Rorqual whales in and around the proposed lease site for oil and gas exploration

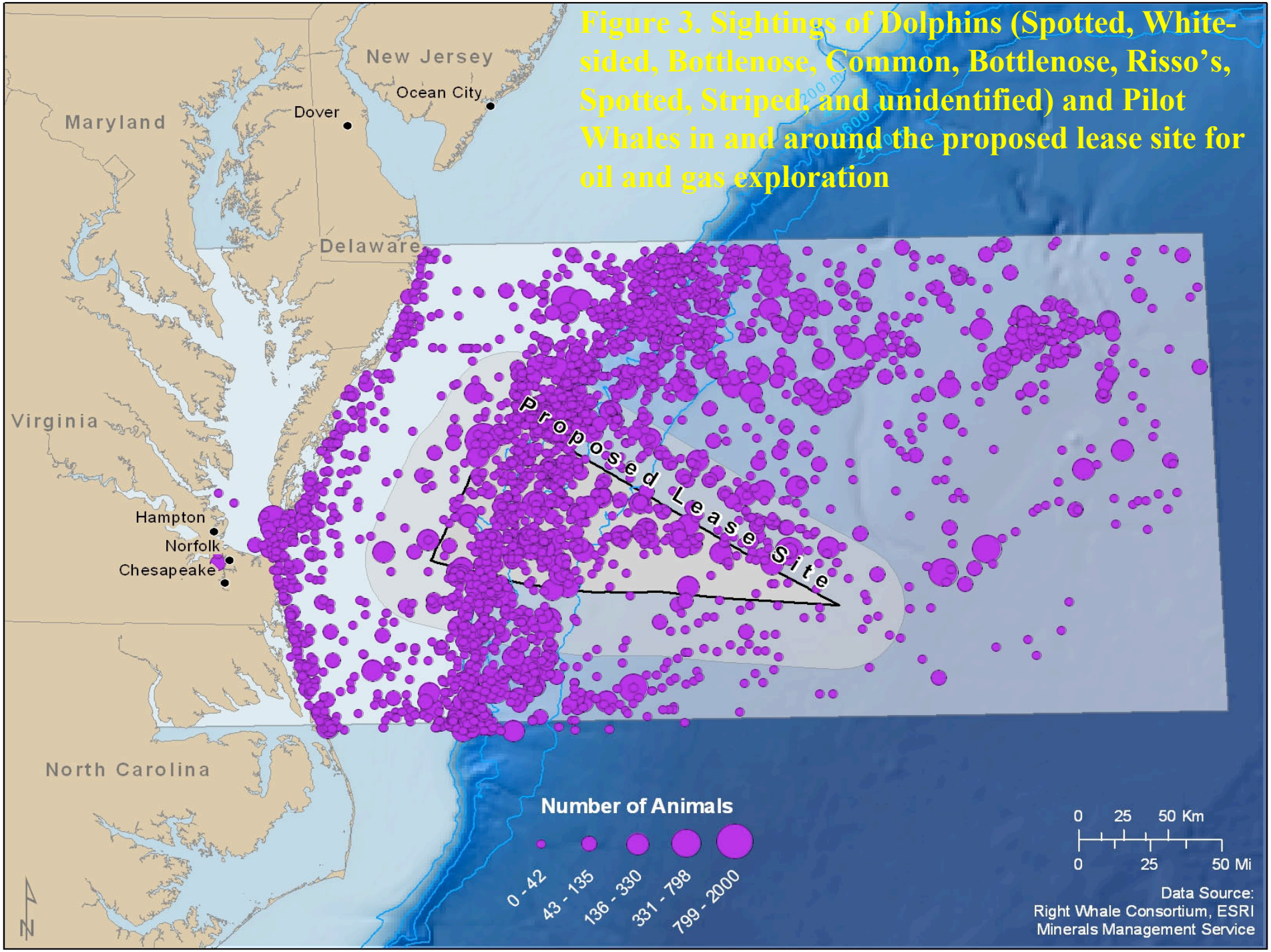


Figure 3. Sightings of Dolphins (Spotted, White-sided, Bottlenose, Common, Bottlenose, Risso's, Spotted, Striped, and unidentified) and Pilot Whales in and around the proposed lease site for oil and gas exploration

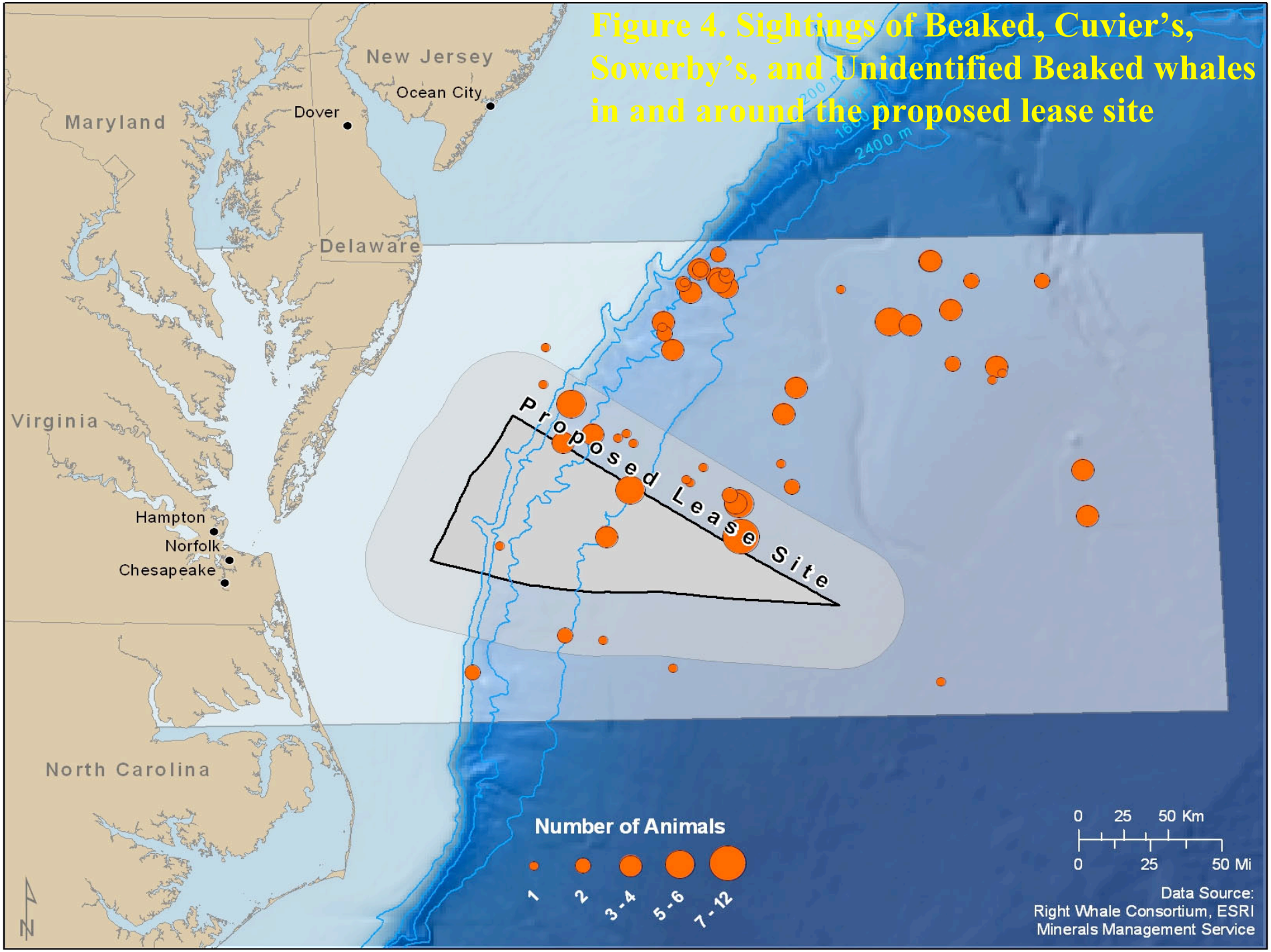
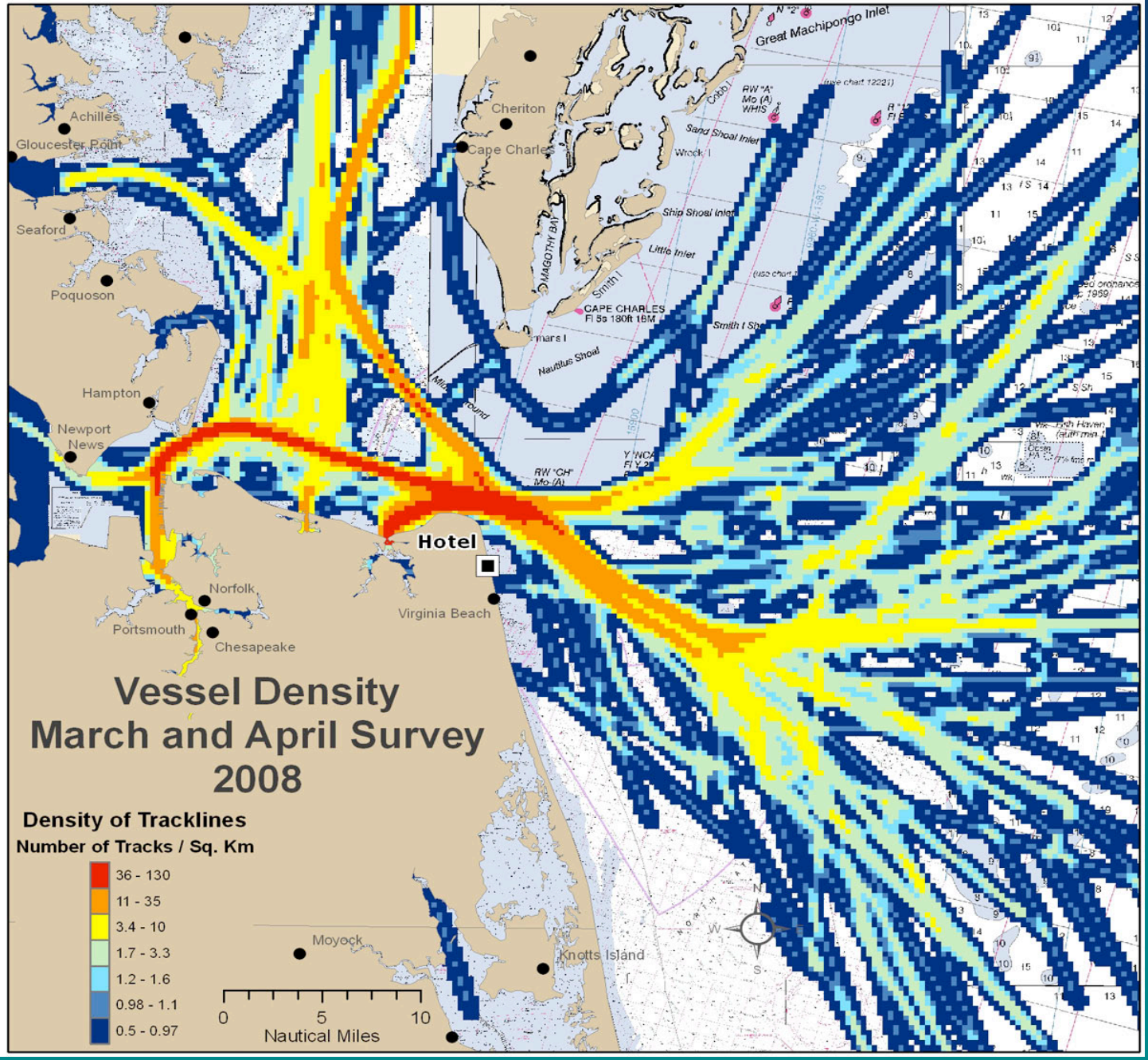
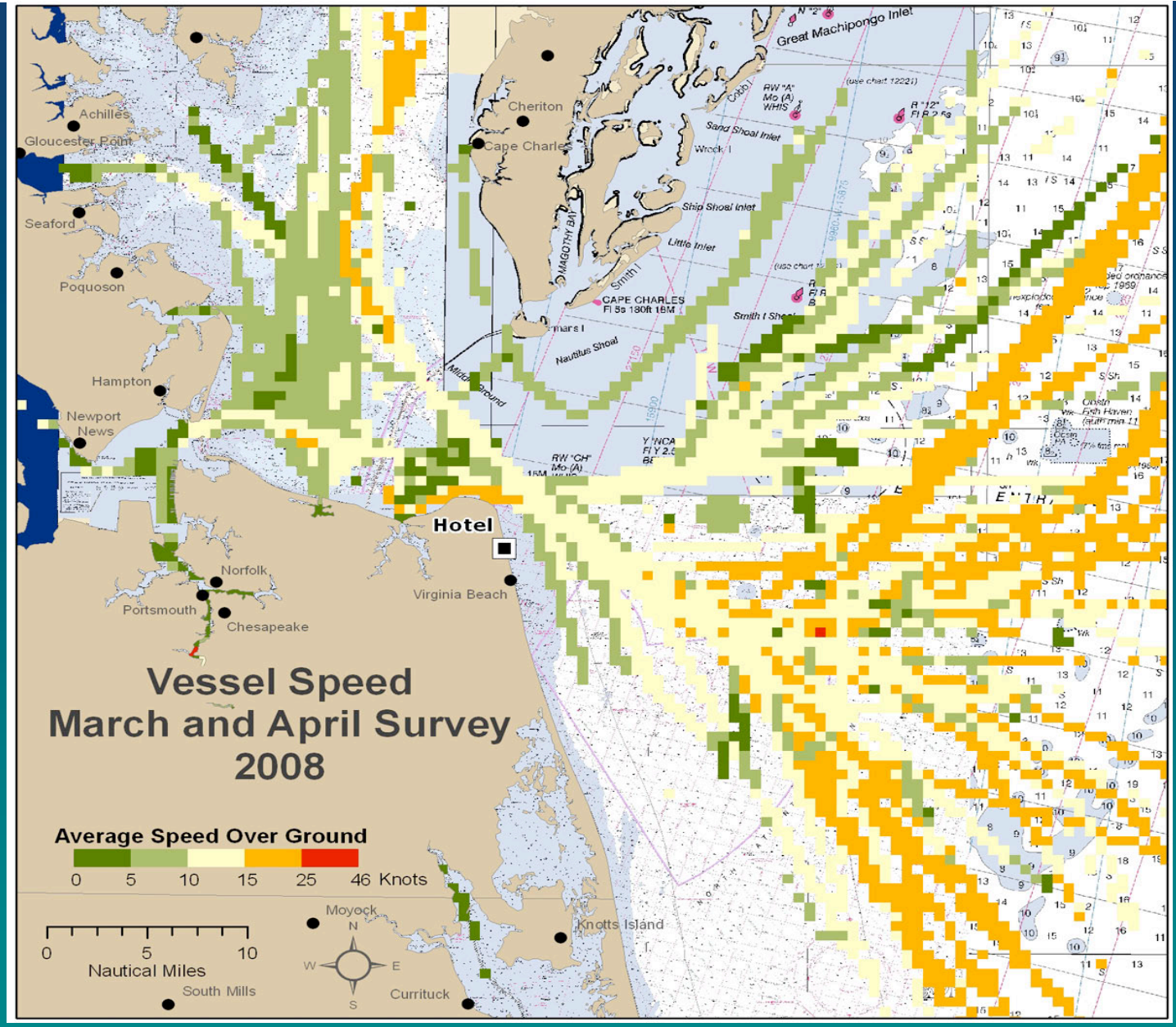


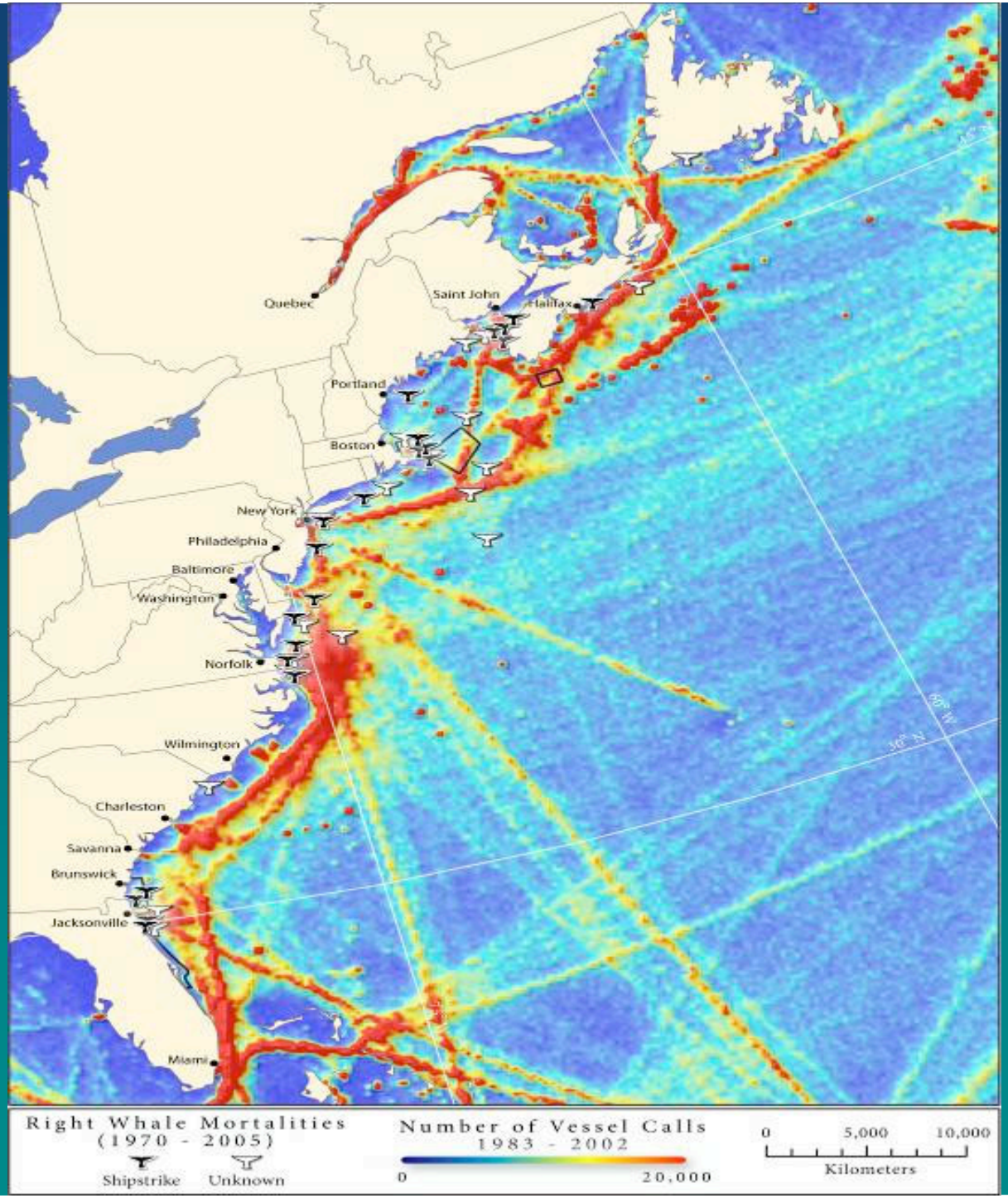
Figure 4. Sightings of Beaked, Cuvier's, Sowerby's, and Unidentified Beaked whales in and around the proposed lease site



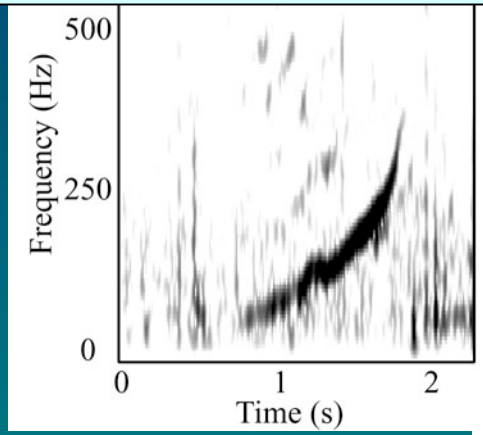


The Problem of Right Whales vs Ships

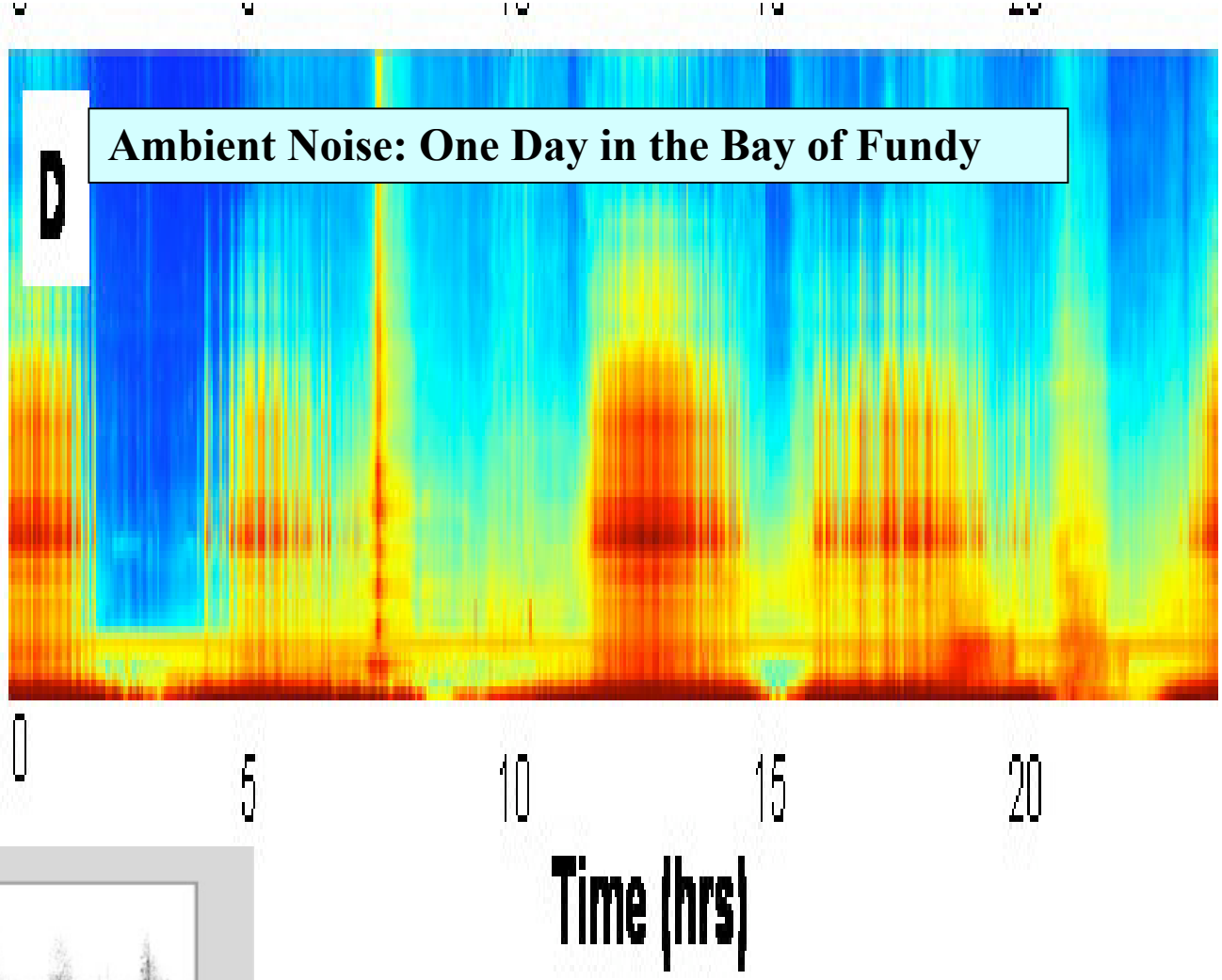
Co-occurrence: Right whale habitat in the western North Atlantic is nearly a perfect overlap with high-density shipping areas.

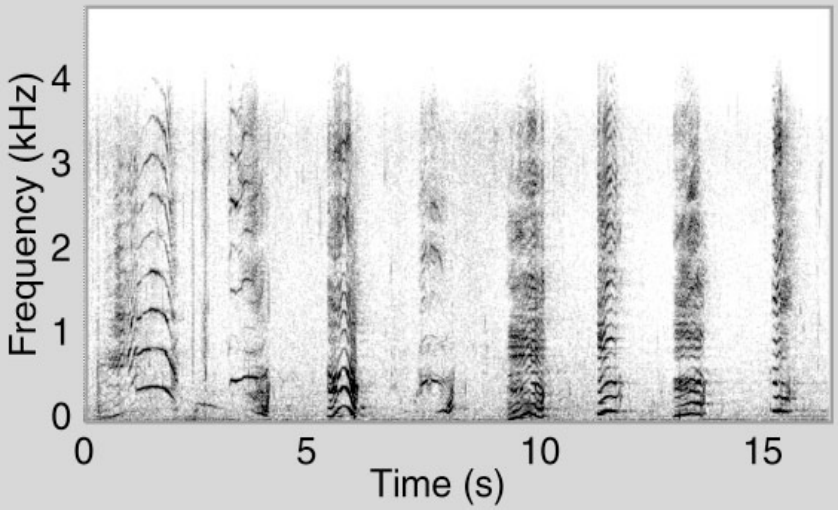


A Contact Call – How Right Whales Say "Whats Up"

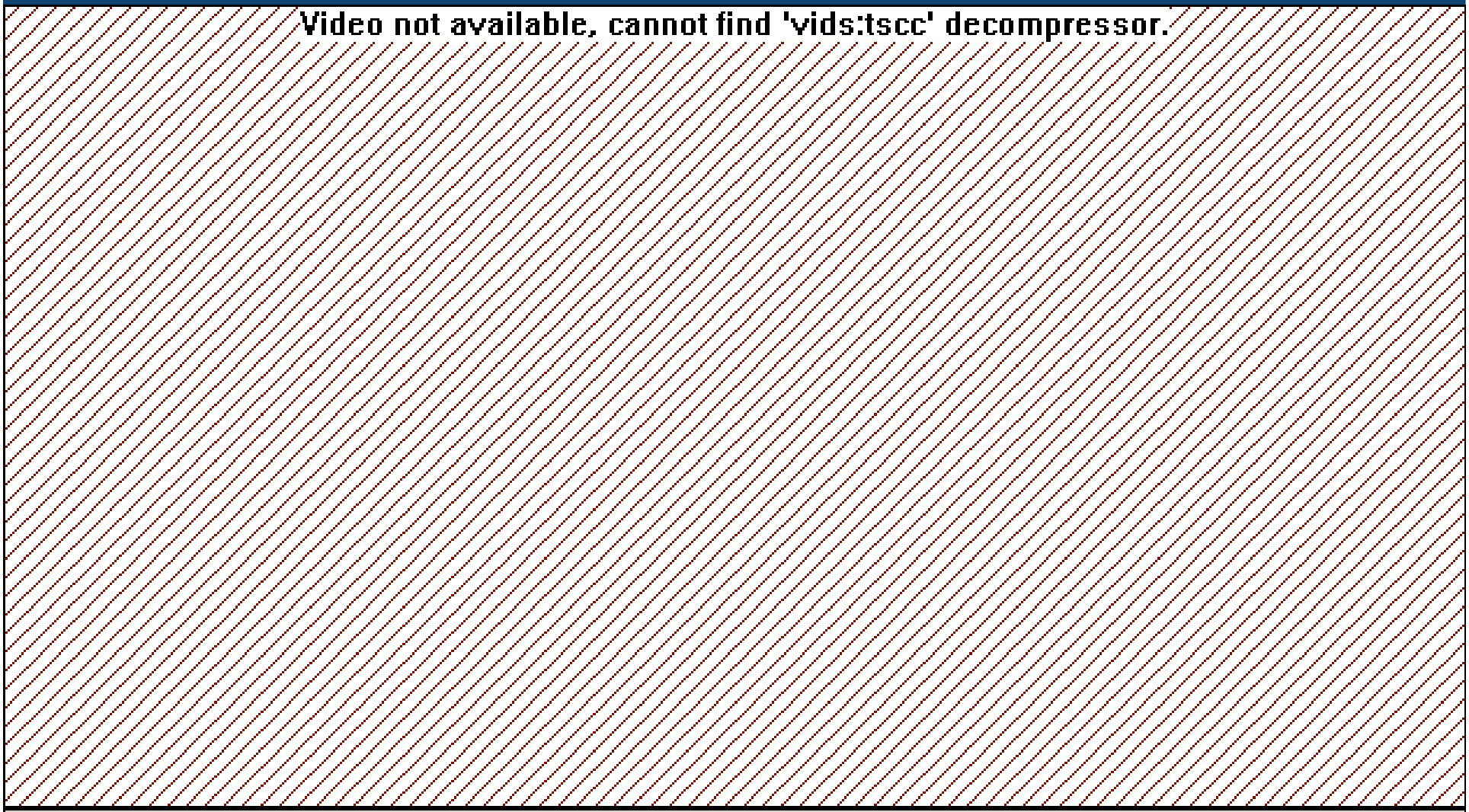


Ambient Noise: One Day in the Bay of Fundy

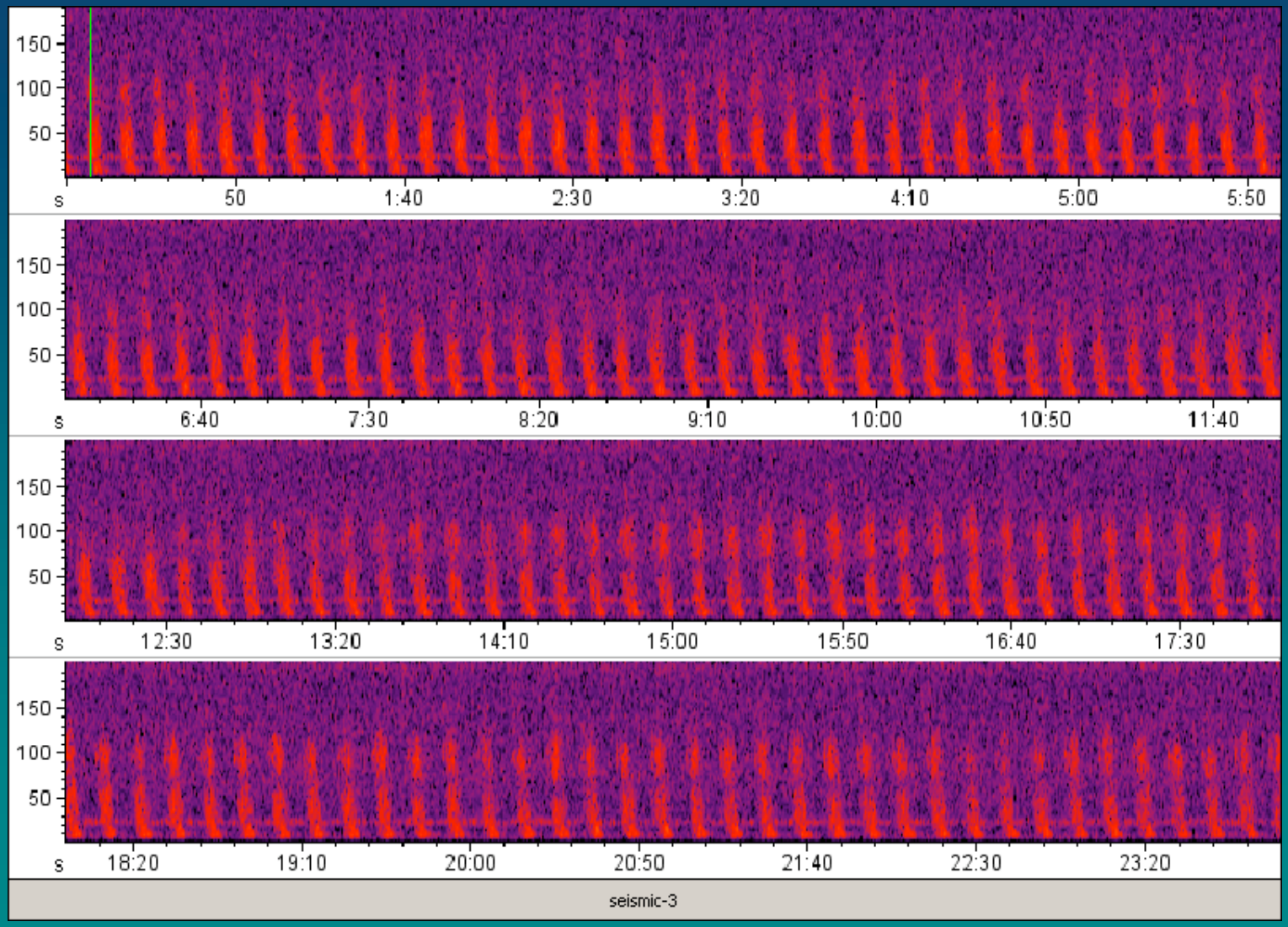




Sounds from a Courtship Group Focal Female



Seismic-4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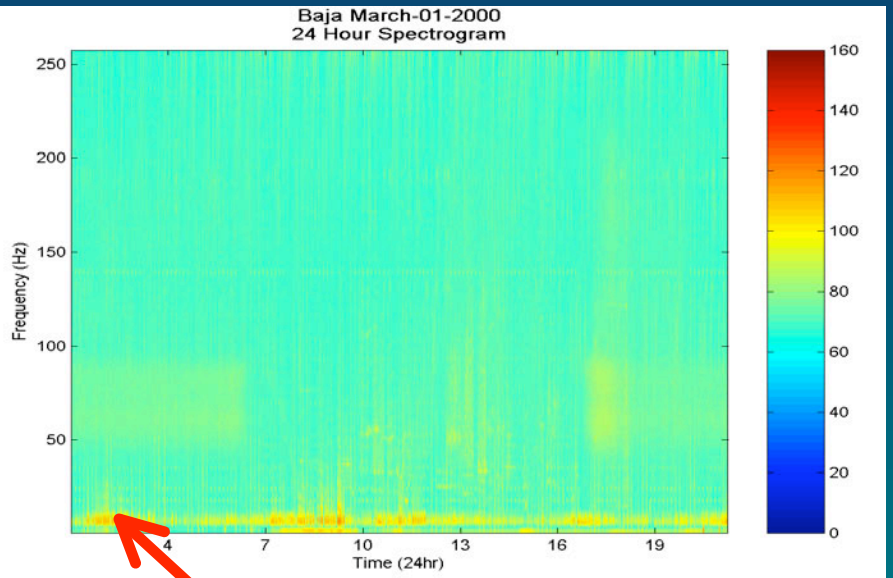
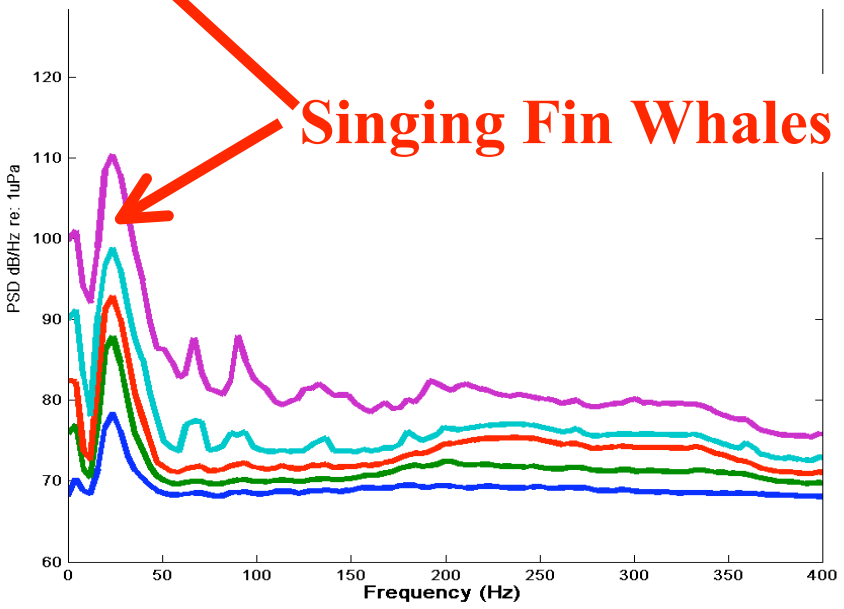
seismic-3

24-Hour Comparison

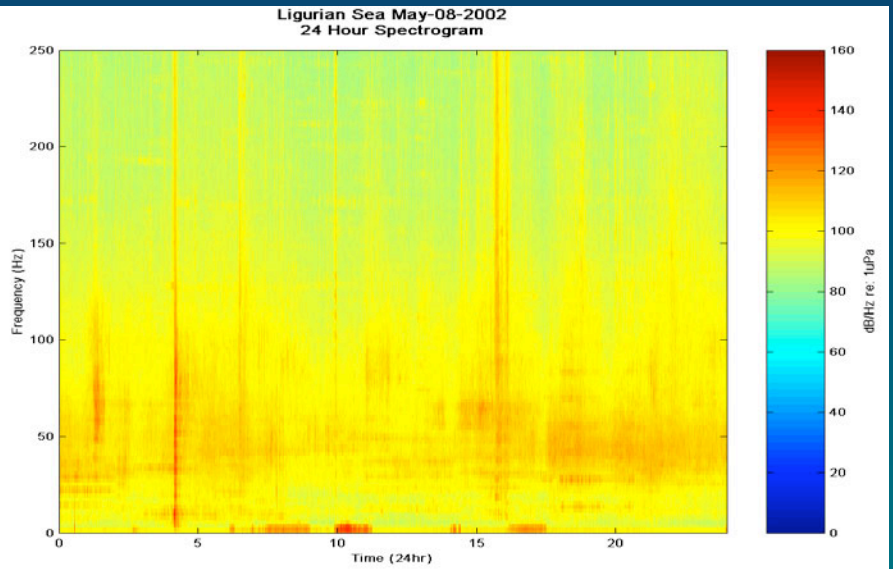
Sea of Cortez, Mex. - Rural

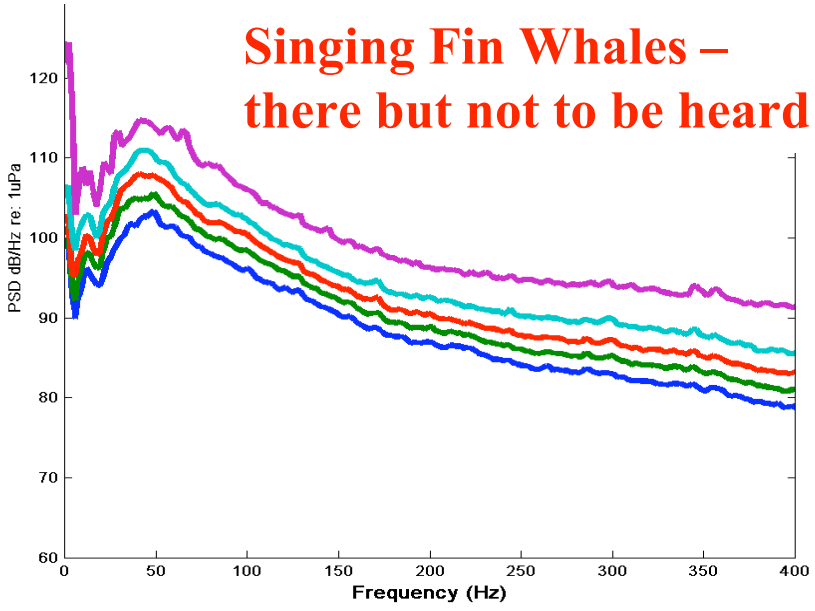




Singing Fin Whales

Ligurian Sea, Med. - Urban





Singing Fin Whales – there but not to be heard

A blue whale's acoustic space - 50 yrs ago

A blue whale's acoustic space - Now

Data, Maps, and Images Courtesy of:

Bob Kenney: Univ. of Rhode Island and the Right Whale Consortium

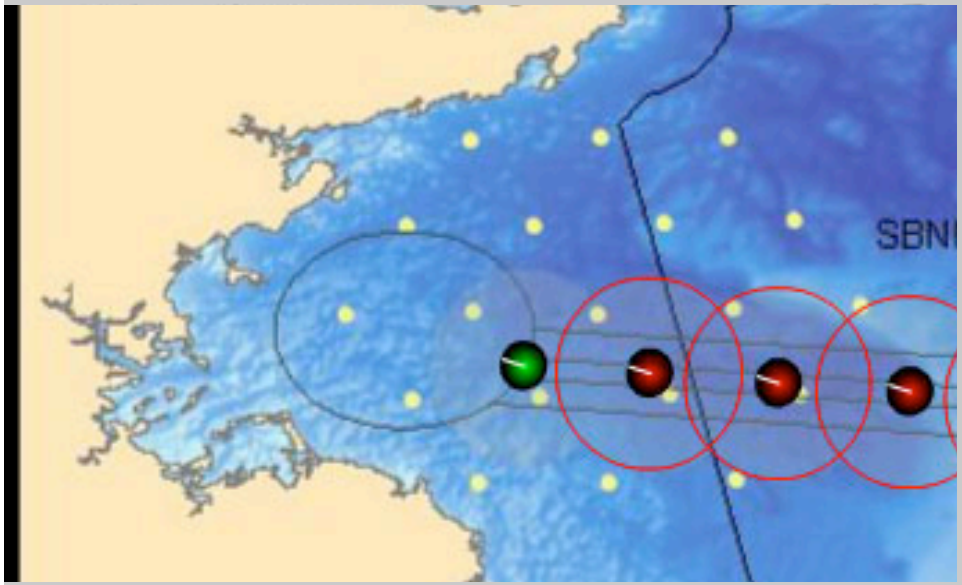
Mark Swingle: VIMS

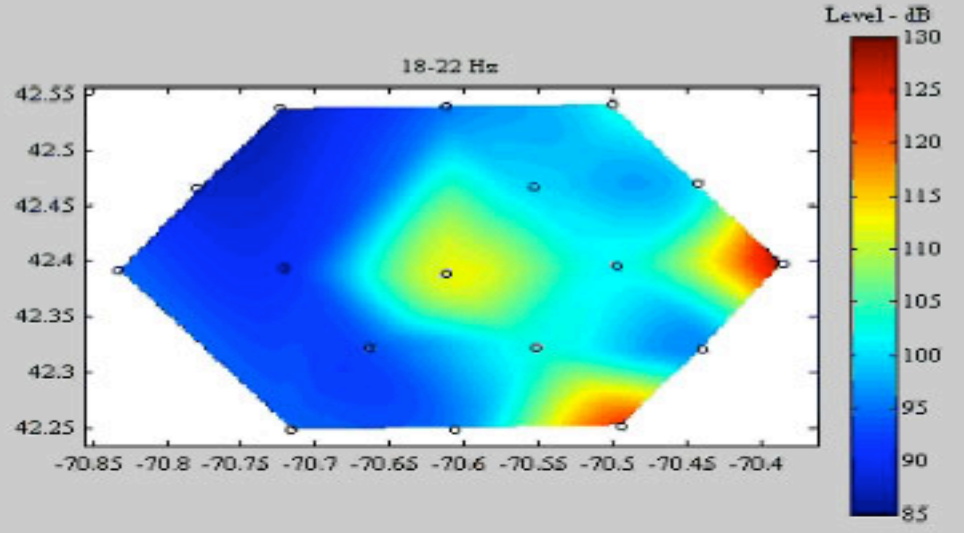
Chris Clark: Cornell University, Lab of Ornithology

Kerry Lagueux, New England Aquarium

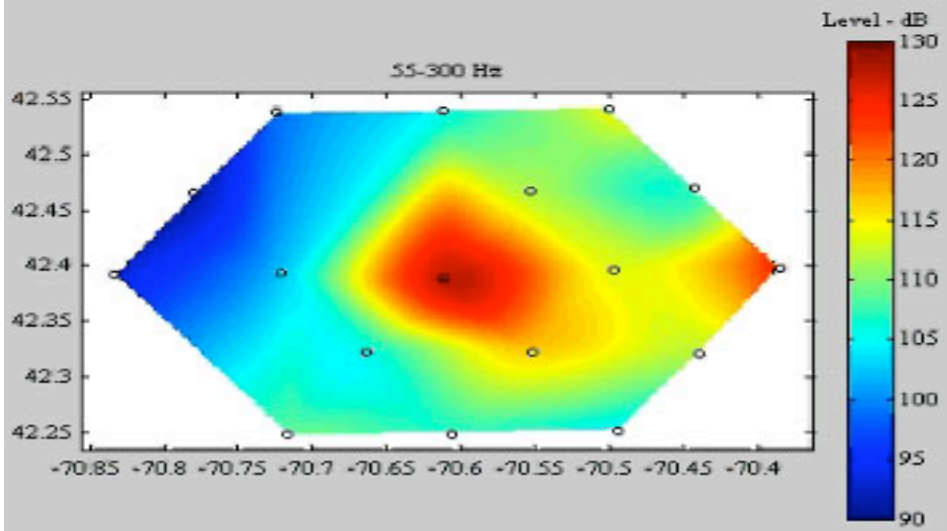
NOAA Fisheries (Alaska)

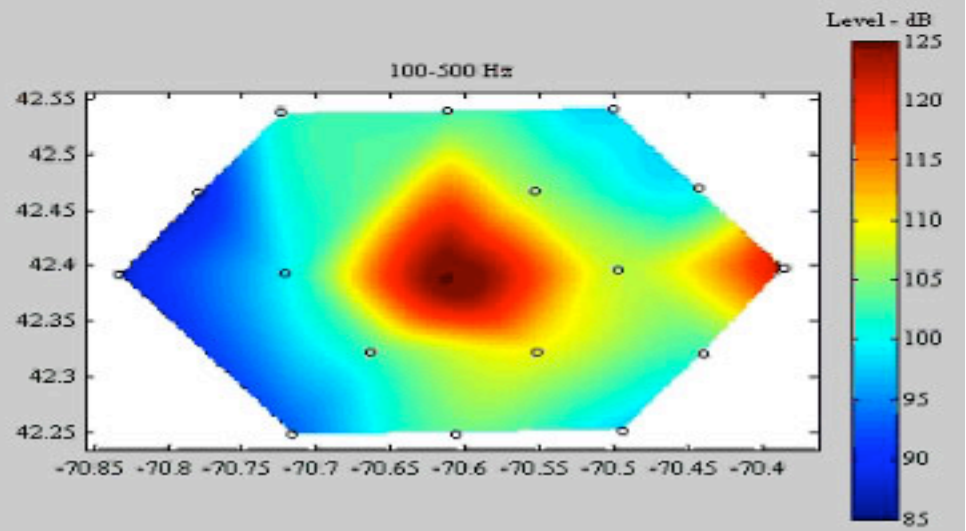
Acoustic Ecology Scenes: lost in the smog of human noise





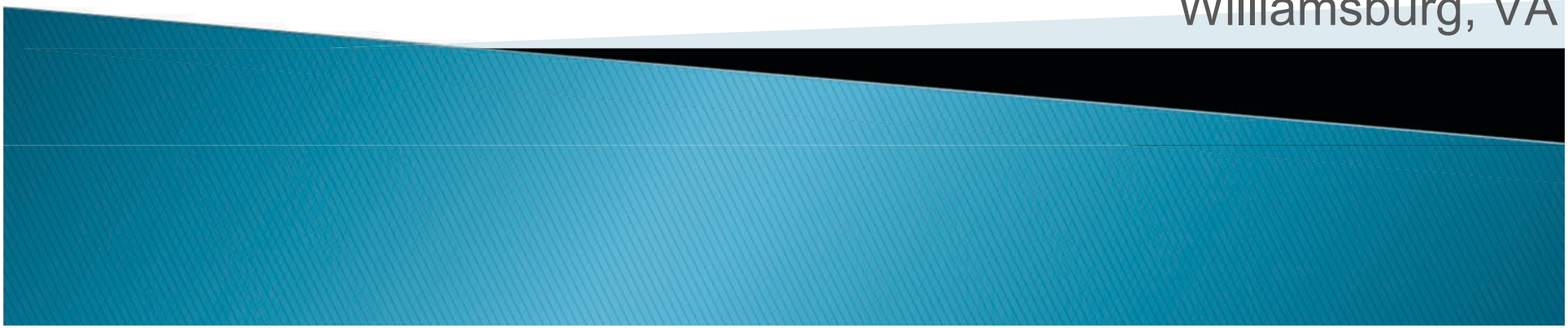
© Chris Clark





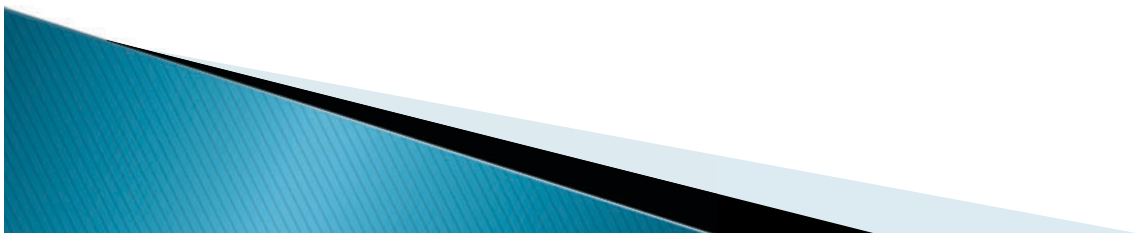
The Economics of Environmental Impacts From Oil & Gas Development Off the Coast of Virginia

Doug Lipton
Department of Agricultural & Resource Economics
University of Maryland College Park
December 3-4, 2008
Williamsburg, VA



OVERVIEW

- ECONOMIC PERSPECTIVE ON:
  - WHAT RESOURCES?
  - HOW ARE THEY VALUED?
  - WHAT'S CHANGED FROM EARLIER STUDIES?



COMMERCIAL FISH LANDINGS

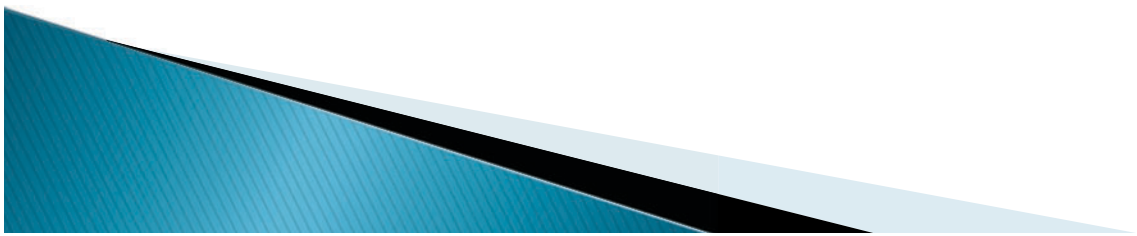
	0-3 MILES	3-200 MILES	TOTAL
POUNDS	497 million	103 million	600 million
DOLLARS	$155 million	$108 million	$264 million

- Menhaden make up 72% of the landings by weight

- Sea Scallops and Blue Crab make up 25% Each, or 50% of the Total Landed Value

WHAT'S CHANGED – COMMERCIAL FISHING

- OLD
  - FISHING DISPLACEMENT MODELS BASED ON ENGINEERED APPROACH
- NEW
  - RANDOM UTILITY MODELS - MODEL FISHING LOCATION CHOICE OF INDIVIDUAL FISHERMEN ON A TRIP BY TRIP BASIS
    - LOG BOOKS
    - VESSEL MONITORING SYSTEMS



AQUACULTURE

- SHELLFISH – PRIVATE PROPERTY
- OFFSHORE CAGES – POTENTIAL
  - U.S. Pilots
    - New England
    - Puerto Rico
    - Hawaii
  - Korea Commercial Scale
    - Highly Profitable rock bream production

FOR HIRE BOAT TRIPS – 2007

	INSHORE	< 3 MILES	> 3 MILES	UNKNOWN	TOTAL
TRIPS	280,452	49,700	284,615	2,793	617,560

- HOW WILL COSTS AND RETURNS FOR FOR HIRE BUSINESSES CHANGE?

- HOW WILL THE NET BENEFITS TO FISHERS ON FOR HIRE TRIPS CHANGE?

PRIVATE BOAT & SHORE FISHING TRIPS – 2007

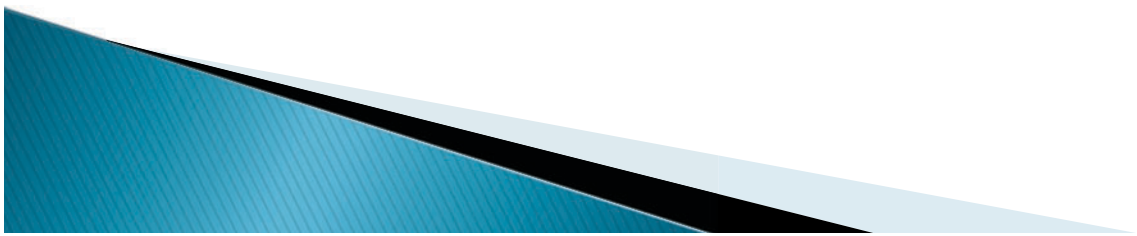
	INSHORE	< 3 MILES	> 3 MILES	TOTAL
TRIPS	7,195,198	5,806,081	807,892	13,809,171

- SPENDING BY INDIVIDUALS FOR 13.8 MILLION TRIPS PER YEAR HAS SIGNIFICANT IMPACT ON REGIONAL ECONOMY. CHANGE?

- HOW WILL NET BENEFITS TO THESE FISHERMEN CHANGE WITH CHANGES IN FISHING OPPORTUNITY AND QUALITY?

WHAT'S CHANGED – RECREATIONAL FISHING

- MODELING
  - RANDOM UTILITY MODELS
  - STATED PREFERENCE SURVEYS
  - REASONABLE TIME SERIES OF DATA
- ABILITY TO VALUE
  - TRIPS
  - CHANGE IN CATCH RATES ON A TRIP
  - LOCATIONS
- BENEFITS TRANSFER



ENDANGERED, THREATENED & CHARISMATIC SPECIES

- NON-CONSUMPTIVE VALUE
  - WHALE-WATCHING
  - BIRD WATCHING
- EXISTENCE VALUE
  - WILLINGNESS-TO-PAY FOR CHANGE IN THE STATUS

WHAT'S CHANGED – EXISTENCE & NON-CONSUMPTIVE VALUE

- STATED PREFERENCE SURVEYS
- CONJOINT ANALYSIS

BEACHES

- U.S. RESIDENTS PARTICIPATING IN VISITS TO BEACHES ADJACENT TO STUDY AREA

9,301,380

- NUMBER OF BEACH DAYS

78,258,000

SOURCE: NATIONAL SURVEY ON RECREATION & THE ENVIRONMENT (2000); LEEWORTHY (2001)

WHAT'S CHANGED – BEACH VALUATION

- RANDOM UTILITY MODELS & SURVEYS IN SOME PLACES – e.g., FLORIDA, CALIFORNIA

- NOT MUCH RESEARCH IN MID-ATLANTIC

WATERFRONT

- TYPES
  - HOMES
  - BUSINESSES
- VIEWSHEDS

WHAT'S CHANGED – WATERFRONT VALUATION

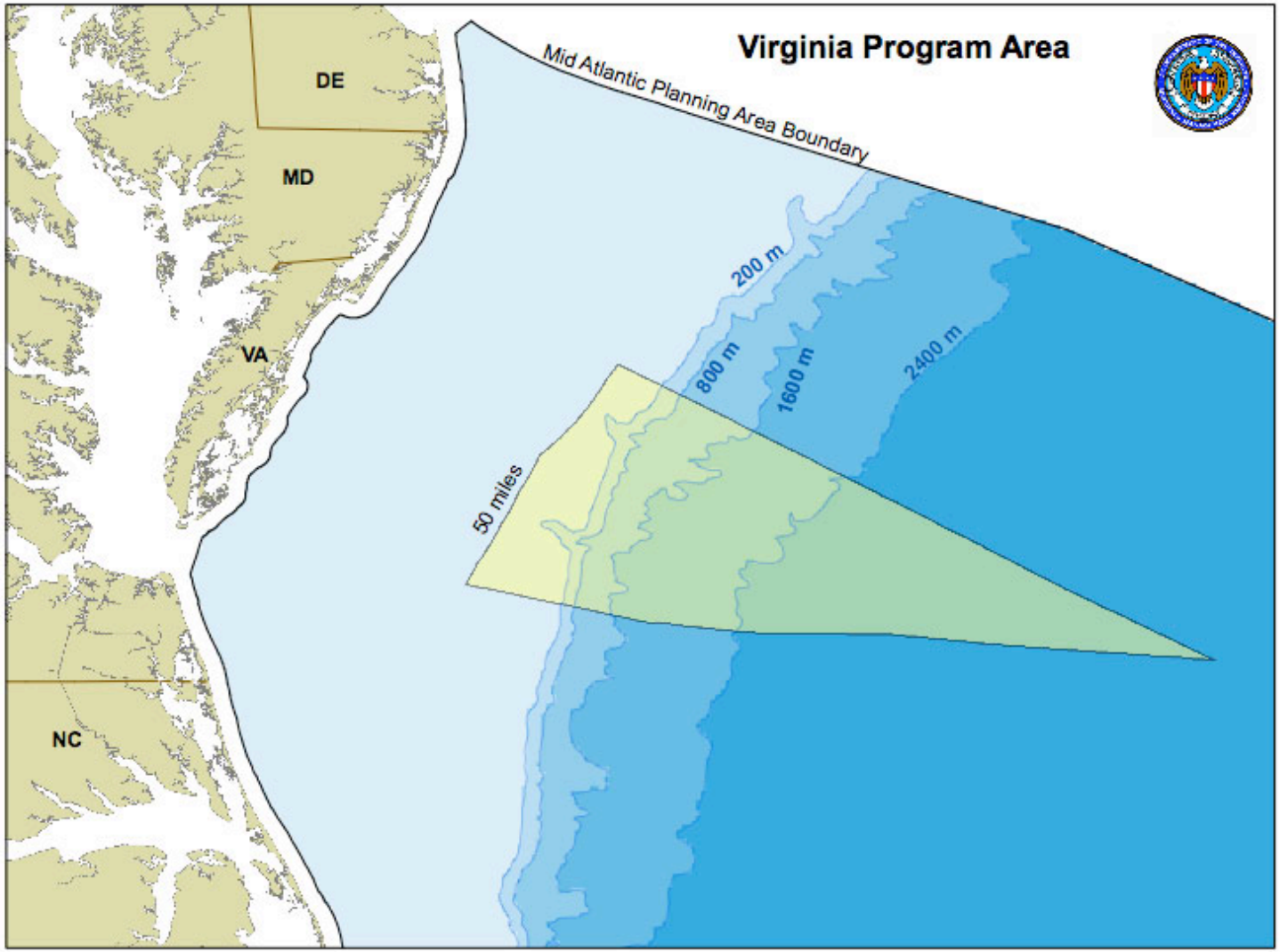
- HEDONIC ANALYSIS
  - WATERFRONT
  - WATERVIEW
  - WATER QUALITY

CONCLUSIONS

- HUGE IMPROVEMENT IN VALUATION METHODOLOGIES OVER THE PAST 20 YEARS
- DATA SPOTTY – GOOD IN SOME PLACES (RECREATIONAL FISHING), POOR IN OTHERS
- FEW EXAMPLES OF REGION-WIDE ECONOMIC ASSESSMENTS

Workshop on Environmental Research Needs in Support of Potential Virginia Offshore Oil and Gas Activities: Social Issues

Diane Austin
Bureau of Applied Research in Anthropology
University of Arizona
December 3, 2008


Virginia Program Area
Mid Atlantic Planning Area Boundary
DE
MD
VA
NC
200 m
800 m
1600 m
2400 m
50 miles

Social Impact Assessment: Historical Context

- Co-occurrence of NEPA, 1970s energy crisis, & expansion of federal OCS leasing program
- National Academy of Science energy-related research plan and BLM-MMS research agenda: examine project technologies & resource demands related to construction, operations, and accidents
- Atlantic Region coastal areas: urbanized, heterogeneous, and complex; OCS development to require new infrastructure and a workforce; goal to characterize the infrastructure and estimate labor demand

BLM/MMS Studies of Mid-Atlantic Region

- A Study of the Socio-Economic Factors Relating to the Outer Continental Shelf of the Mid-Atlantic Coast - 1974
- An Oil Spill Risk Analysis for the Mid-Atlantic Outer Continental Shelf Lease Area - 1976
- Methodology for Assessing Onshore Impacts for Outer Continental Shelf Oil and Gas Development – 1978, 1980
- Design for a Simplified Regional Impact Methodology Using Rims and Seas – 1978
- Assessment of Space and Use Conflicts Between the Fishing and Oil Industries – 1981
- Assessing the Impact of Oil Spills on a Commercial Fishery – 1981
- Impacts of Oil and Gas Exploration, Development, and Production on the Atlantic Continental Shelf - 1991

Sample Findings of Prior Studies

A Study of the Socio-Economic Factors Relating to the OCS of the Mid-Atlantic Coast

University of Delaware, 1974

- As a result of the absence of any offshore activity along the east coast, there is a dearth of direct supportive capability anywhere in the region of study.
- Since the region is a major importer of crude, and the magnitude of a find is unlikely to alter this fact, the impact of offshore crude availability is not expected to differ at the shoreline point of delivery over that associated with [current bulk carrier] operations.
- However, it is possible that a different bulk carrier philosophy could prevail that would substantially alter the net impact (offshore port plus OCS development) on the region

An Oil Spill Risk Analysis for the Mid-Atlantic Outer Continental Shelf Lease Area

Smith, Slack, and Davis - 1976

- In summary, the final product of trajectory model runs consisted of a large number of possible oil spill trajectories or pathways... These trajectories represent only hypothetical pathways for the transport of oil slicks...
- Unless additional refinery capacity is developed to handle increased quantities of crude oil, production from Mid-Atlantic fields would tend to merely replace existing sources currently carried by tankers to Mid-Atlantic terminals. Thus some oil spill risk exists independent of decisions on leasing and development of the area.

Assessment of Space and Use Conflicts Between the Fishing and Oil Industries

Centaur, 1981

- Labor: (1) there may exist direct competition for labor between the OCS oil support vessel (supply boats, crew boats, utility boats, tug boats) and fishing industries and (2) there may exist indirect competition for labor between the onshore OCS oil support and fishing industries
- Port space, and
- Other areas of impacts including fuel and repair facilities, equipment, supplies, and financing

Impacts of Oil and Gas Exploration, Development, and Production on the Atlantic Continental Shelf

A.T. Kearney, 1991

- Develop and demonstrate a model to identify onshore *economic* impacts of offshore activity

- MMS-Defined Coastal MSAs
  - Jaws City County -- York County
  - Chesapeake City -- Hampton City
  - Newport News City -- Norfolk City
  - Portsmouth City -- Suffolk City
  - Virginia Beach City

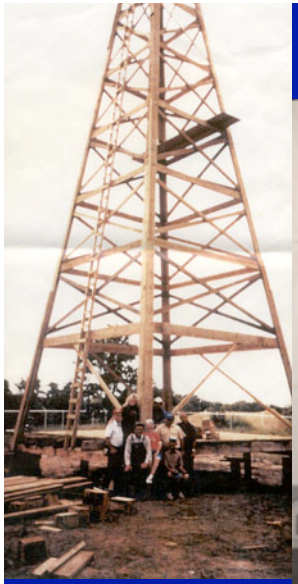
Impacts of Oil and Gas Exploration, Development, and Production on the Atlantic Continental Shelf

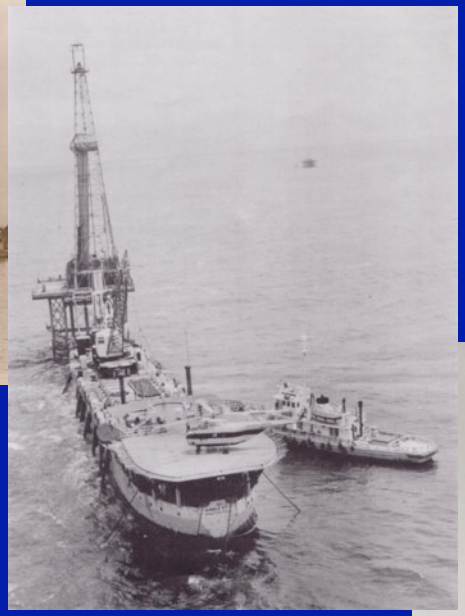
Use of VA ports as supply bases:

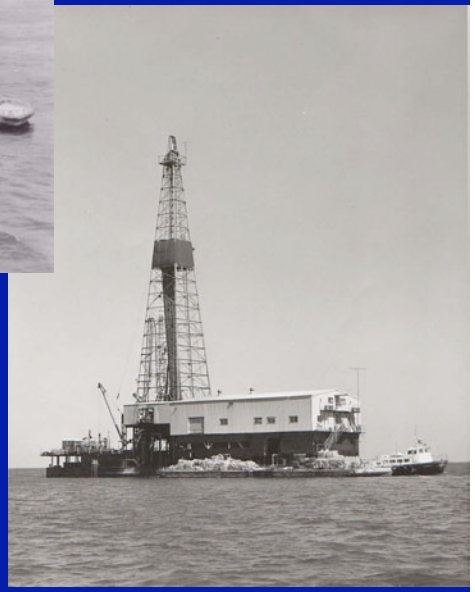
- Hampton Roads - likely
- Norfolk - likely
- Portsmouth - possible
- Chesapeake – possible

Repair Yards

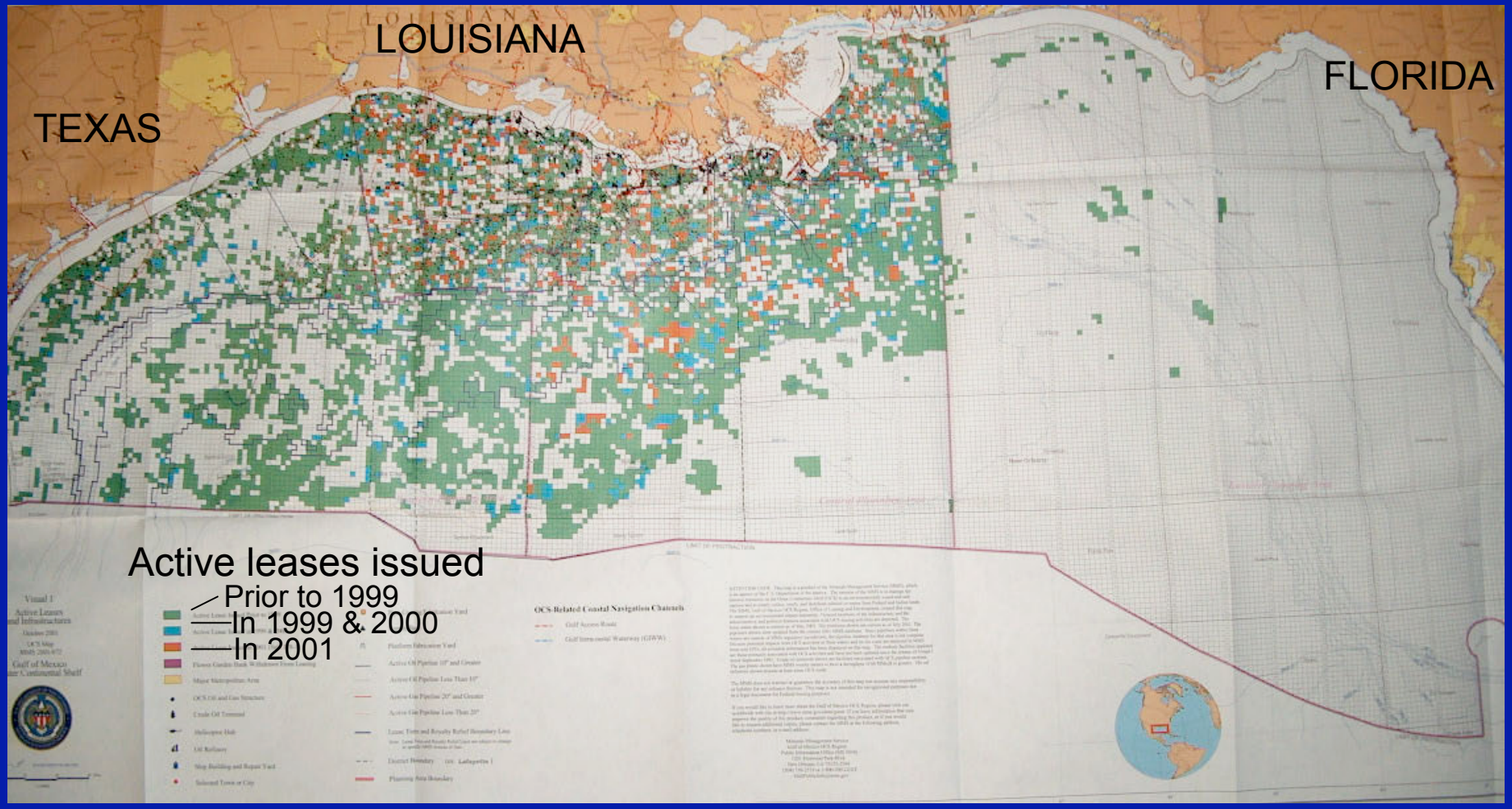
- Limited Repairs
  - Accomack --Northampton
  - York -- James City
  - Surry -- Isle of Wight
  - Hampton -- Virginia Beach
  - Chesapeake -- Suffolk
- Major Repairs
  - Newport News
  - Norfolk
- Repairs Available
  - Portsmouth







Active GOM Leases October 2001

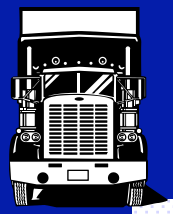


Expanding the Study of Socioeconomic Impacts

- Stakeholders Issues in the Eastern Gulf of Mexico - 1999
- Effect of the Oil and Gas Industry on Commuting and Migration Patterns in Louisiana: 1960-1990 – 2002
- Social and Economic Impacts of OCS Activities on Individuals and Families: Volume 2: Case Studies of Morgan City and New Iberia, Louisiana - 2002
- Environmental Justice Considerations in Lafourche Parish, Louisiana – 2003
- Labor Migration and the Deepwater Oil Industry – 2005
- Examination of the Development of Liquefied Natural Gas on the Gulf of Mexico - 2008

onshore

Fabrication
- foreman
- engineer
- draftsman
- crane operator
- machinist
- welder
- rigger
- fitter
- tacker/helper



Trucking Company
- dispatcher
- owner/operator
- driver

offshore

Offshore Vessel Company
- port captain
- captain
- mate
- engineer
- deckhand

Diving/ Underwater Construction Company
- divers
- ROV//AUV technicians
- diver-tenders
- tenders

Rig
- company man
- toolpusher
- driller
- crane operator
- derrickman
- motorman
- rigger
- roughneck
- roustabout
- shaker

Other Rig Positions
- mud engineer
- wireline operator
- fishing tool operator
- snubber
- completion specialist
- rig mechanic
- electrician
- welder
- galleyhand
- medic
- linen hand
- cook

Platform
- foreman/field supervisor
- lead operator
- second level operator
- first level operator
- roustabout

Other Platform Positions
- electrician
- mechanic
- instrumentation technician
- computer technician

Sources of Impacts on Workers/Families

industry restructuring

societal expectations

work schedules

cycles

OCS

satisfaction

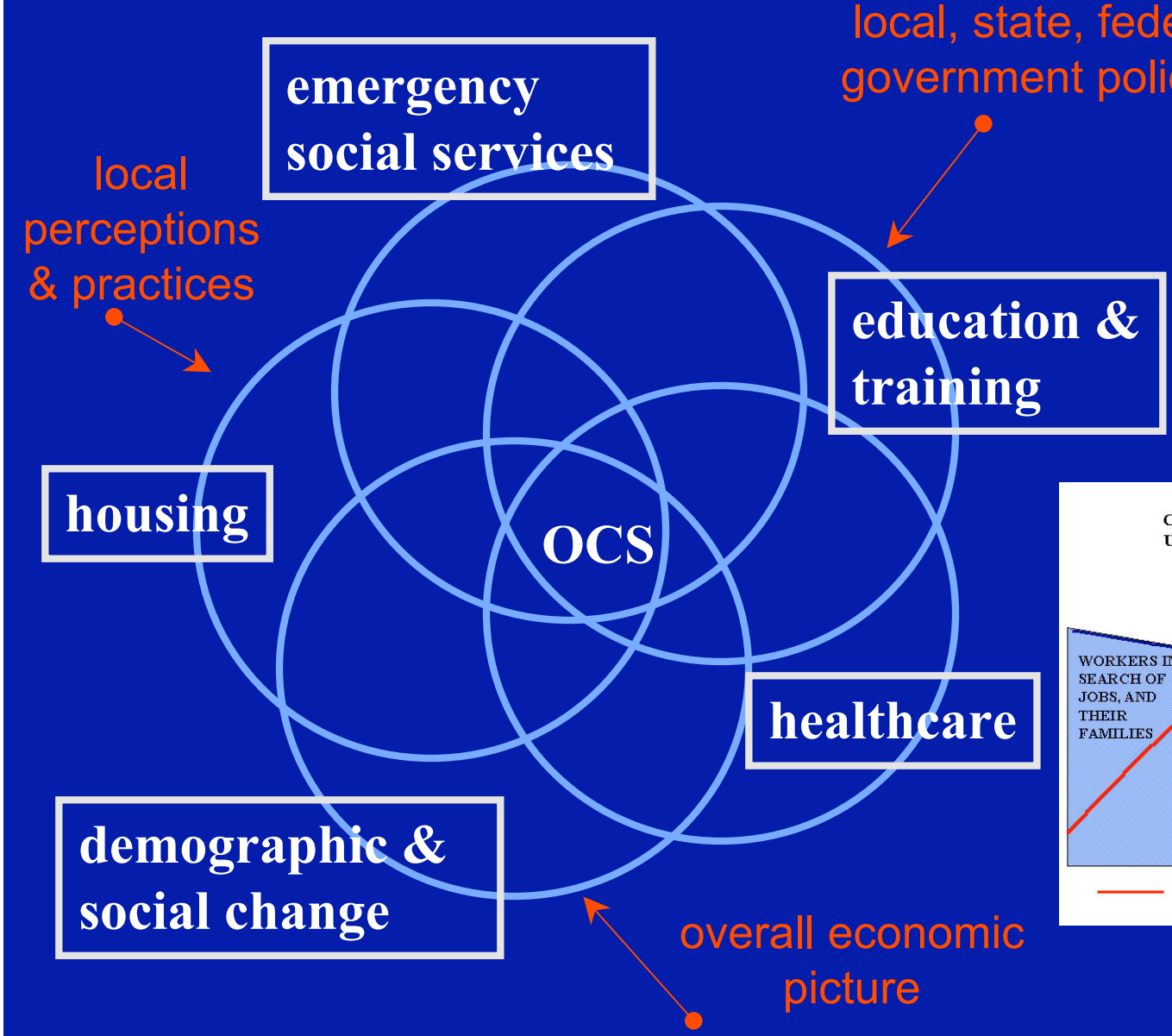
danger

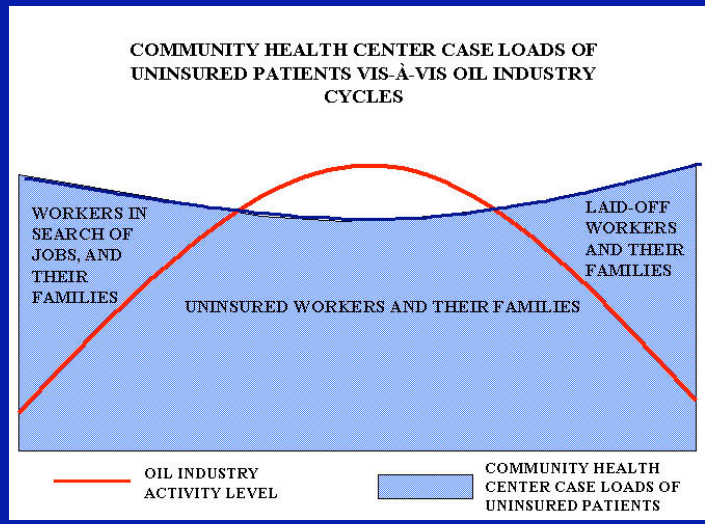
economic rewards

non-OCS opportunities

overall economic picture

Sources of Impacts on Communities





Topics for Possible Consideration

- Perceived Risk
- Composition of Labor Force (local to international) and Labor Migration
- Impacts on Livelihoods
- Environmental Justice
- Cumulative Impacts
- And more…

U.S. Starts Process of Offshore Oil Drilling Near Virginia Coast

by Timothy B. Hurst. 11-17-08. *Red, Green, and Blue: Environmental Politics from Across the Spectrum*

"By opening the public comment period for drafting an environmental impact statement (EIS) on offshore drilling, the Interior Department has now taken the first concrete action in Washington since Bush and Congress lifted certain bans on offshore drilling in the Outer Continental Shelf. …

Needless to say, not everyone is pleased with the late-term move from the Bush administration…"

Social Impacts Occur and Must be Studied at Multiple Levels

- Local
- Regional
- National
- International

Individuals Organize Themselves in Communities

- Geographic
- Virtual
- Professional
- And more…

Working with Communities

- Initial scoping visits to identify issues and interested communities
- Ethnographic study
- Data synthesis and analysis
- Follow up focus group visits
- Final report with copies to communities

Sample Methods for Studying Social Impacts on Communities

- Semi-Structured Interviews
- Focus Groups
- Surveys
- Oral History Interviews
- News/Media Analysis

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 Energy and 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.