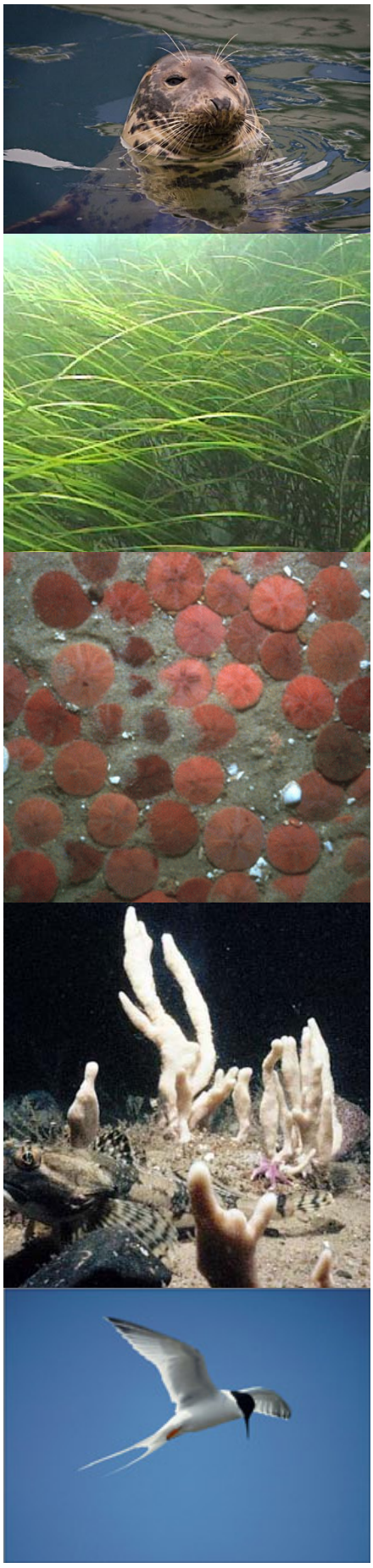

DRAFT

Executive Office of Energy and Environmental Affairs

Ocean Planning

Habitat Work Group Report

November 26, 2008

DRAFT

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Section 1. Work Group membership

Ocean Planning Habitat Work Group

Bruce Carlisle (chair)
Office of Coastal Zone Management

Robert Buchsbaum
Massachusetts Audubon Society

Todd Callaghan
Office of Coastal Zone Management

Emily Chambliss (GIS/Data liaison)
Office of Coastal Zone Management

Phil Colarusso
U.S. Environmental Protection Agency

Kathryn Ford
Division of Marine Fisheries, Department of Fish and Game

Tom French
Division of Fisheries and Wildlife (MassWildlife), Department of Fish and Game

Charles "Stormy" Mayo
Provincetown Center for Coastal Studies

Kate Killerlain-Morrison
The Nature Conservancy, Massachusetts

Dan Sampson (lead GIS/Data liaison)
Office of Coastal Zone Management

Jim Sprague
Department of Environmental Protection

Dave Szczebak (GIS/Data liaison)
Division of Fisheries and Wildlife (MassWildlife), Department of Fish and Game

Megan Tyrrell
Cape Cod National Seashore

Tony Wilbur
Office of Coastal Zone Management

Note: Additional experts provided valuable input and guidance. Those individuals are listed in Sections 2 and 4.

Section 2. Work Group goals and process

The primary charge to the Habitat Work Group is to identify, characterize, and rank areas within the ocean planning area that are priorities (or not) for "important" habitat, irrespective of other ocean uses or resources. Within that broad charge, there are three main goals for the Habitat Work Group, which include:

1. Ensure that appropriate existing data are identified and incorporated;
2. Ensure that data are used appropriately to characterize the topic; and
3. Identify and help prioritize data that are needed for longer term planning and management.

In July 2008—after the signing of the Oceans Act of 2008 and before the seating of the Advisory Commission and Science Council—an internal Habitat Work Group was formed to jump-start the data identification and acquisition process. A preliminary, internal report was developed and submitted to the Executive Office of Energy and Environmental Affairs (EEA) Planning Team on August 13, 2008. In September 2008, the Work Group membership was broadened to include individual expertise outside the state agencies. For a period of three months, nearly every week the Work Group met to discuss different parameters/endpoints, data sources and leads, available data sets, and related issues (Table 1). Individuals with expertise and first-hand knowledge with available data also participated in these meetings (Table 2) and provided extensive consultation and advice on specific data components (Section 4). This draft report represents a first cut of the Work Group's response to its charge and goals. It should be acknowledged as a work in progress, with several issues that need further consideration, advice, and input.

Table 1. Habitat Work Group meeting schedule and topics

Date	Meeting Topic
September 17	Work group overview, marine mammals
September 24	Avifauna
October 1	Abiotic parameters (Geological/chemical/physical)
October 8	Fisheries (with Fisheries Work Group)
October 15	Sea turtles, eelgrass, invasives
October 22	Data integration/synthesis
November 10	Report outline; data integration; prioritization
November 17	Review parameters/datasets; report outline

Table 2. Additional experts consulted by Habitat Work Group

Topic	Additional experts consulted
Marine mammals (whales)	Erin Burke (DMF) and Dan McKiernan (DMF)
Avifauna	Wayne Petersen (Mass Audubon), Simon Perkins (Mass Audubon), and Becky Harris (Mass Audubon)
Abiotic (geological/chemical/physical)	Rich Signell (USGS), Brad Butman (USGS), Walter Barnhardt (USGS), Seth Ackerman (CZM), Mike Mickelson (MWRA), and Changshen Chen (UMass-Dartmouth)
Sea turtles	Robert Prescott (Mass Audubon), Kara Dwyer Dodge (UNH-Durham), and Sara McNulty (NMFS)
Invasives	Judy Pederson (MIT Sea Grant) and Jay Baker (CZM)
Harmful algal blooms	Mike Hickey (DMF) and Dave Whittaker (DMF)

Section 3. Identifying "important" habitat

Massachusetts coastal and marine areas—both inside and outside the ocean planning area—encompass essential and diverse habitats for a wide variety of estuarine and marine species and communities. The process of defining "habitats" can be approached from many angles and determining the overall and/or relative "importance" of particular habitats or species is a particularly tall order, especially in the context of inadequate or non-existent baseline information for the vast majority of marine and estuarine plants and animals.

Given the current conditions and timeframe for the development of the first version of the Commonwealth's Ocean Plan, the Habitat Work Group used the language provided in Section 2 of the Oceans Act as general guidance for the determination of important habitat: "…identify…special, sensitive, or unique estuarine and marine life and habitats". With that as an operative basis, the Work Group focused on three "tracks", with a short term goal of being able to identify priority areas within each component based on available information. The Work Group also agreed that it was critical to adopt a long term goal of acquiring, developing, and synthesizing data and information to revise the short term priority areas over time as necessary based on a more complete and accurate understanding of habitat attributes, species life histories, etc.

The three "tracks" as defined by the Habitat Workgroup were:

1. Mapped areas/resources with special legal protection;
2. Habitat critical to or providing specific life stage support for important species (or group of species, such as guilds or assemblages); and
3. Unique and/or sensitive habitats as indicated by abiotic parameters.

Section 4. Data survey/inventory and utilization

Section 4.1. Mapped areas/resources reference with special legal protection (Track 1)

Track 1 was the most straight-forward and complete as much of the required data is available and current. The primary datasets are discussed below and listed in Table 2. All of the available Track 1 spatial datasets were compiled to create a map entitled: "*Mapped habitat areas/resources with special legal protection*". The map is displayed in Figure 2 in Appendix B. Detailed summaries of the various state and federal legal authorities that most commonly involve marine habitat considerations are included in Appendix E.

Priority Habitats of Rare Species

Priority Habitats are a filing trigger for project proponents, municipalities, and other stakeholders for determining whether or not a proposed project must be reviewed by the Natural Heritage and Endangered Species Program (NHESP) for compliance with the Massachusetts Endangered Species Act (MESA). NHESP maintains a spatial database with the geographic extent of habitat of state-listed rare species in the Commonwealth based on observations documented within the last 25 years. The Priority Habitats were recently updated was recently updated and released in November 2008. The listed species that occur within the ocean planning area are shown in Table 3.

Table 3. MESA-listed species occurring within the ocean planning area

Common Name	Scientific Name	MA ESA status	Federal ESA status
Shortnose Sturgeon	*Acipenser brevirostrum*	E	E
Atlantic Sturgeon	*Acipenser oxyrinchus*	E	None
Loggerhead Seaturtle	*Caretta caretta*	T	T
Green Seaturtle	*Chelonia mydas*	T	T
Hawksbill Seaturtle	*Eretmochelys imbricata*	E	E
Kemp's Ridley Seaturtle	*Lepidochelys kempii*	E	E
Leatherback Seaturtle	*Dermochelys coriacea*	E	E
Leach's Storm-Petrel	*Oceanodroma leucorhoa*	E	none
Roseate Tern	*Sterna dougallii*	E	E
Common Tern	*Sterna hirundo*	SC	none
Arctic Tern	*Sterna paradisaea*	SC	none
Least Tern	*Sterna antillarum*	SC	none
Sperm Whale	*Physeter catodon*	E	E
Fin Whale	*Balaenoptera physalus*	E	E
Sei Whale	*Balaenoptera borealis*	E	E
Blue Whale	*Balaenoptera musculus*	E	E
Humpback Whale	*Megaptera novaeangliae*	E	E
Northern Right Whale	*Eubalaena glacialis*	E	E
Diamondback Terrapin	*Malaclemys terrapin*	T	none
Pied-Billed Grebe	*Podilymbus podiceps*	E	none
Common Loon	*Gavia immer*	SC	none
Bald Eagle	*Haliaeetus leucocephalus*	E	recently delisted
Piping Plover	*Charadrius melodus*	T	T

Ocean Sanctuaries

Recently modified by the Oceans Act of 2008, the Massachusetts Ocean Sanctuaries Act (OSA) prohibits activities that may significantly alter or endanger the ecology or appearance of the ocean, seabed, or subsoil of sanctuaries or the Cape Cod National Seashore. The Act prohibits specific activities and/or uses including (but not limited to): the building of any structure on the seabed or under the subsoil; the construction or operation of offshore or floating electric generating stations, except for appropriate scale renewable energy facilities (as to be defined by the Ocean Management Plan; a specific change made by the Oceans Act of 2008); drilling or removal of sand, gravel (except for the purposes of beach nourishment), other minerals, gases, or oils; and dumping or discharge of commercial, municipal, domestic or industrial wastes. These prohibitions may be waived if a finding of "public necessity and convenience" can be made for the proposed project or activity. Under the OSA changes made by the Oceans Act, the Office of Coastal Zone Management (CZM) administers the OSA. CZM does not issue any licenses or permits but acts through the regulatory process of other agencies, particularly the Chapter 91 Waterways Program.

Areas of Critical Environmental Concern

Areas of Critical Environmental Concern (ACECs) are places in Massachusetts that receive special recognition because of the quality, uniqueness and significance of their natural and cultural resources. An ACEC designation creates a framework for local and regional stewardship of these critical resource areas and ecosystems. ACECs receive higher regulatory protection and require greater environmental review for certain activities. The state's ACEC Program is within the Massachusetts Department of Conservation and Recreation. The ACEC spatial database maintains the digital polygon and line boundaries for areas that have been designated ACECs by the Secretary of Energy and Environmental Affairs.

Eelgrass

Eelgrass areas receive special protection under the Massachusetts Wetlands Protection Act and regulations, Chapter 91 Waterways regulations, and Water Quality Standards. Eelgrass is also designated as a special aquatic site designated under the federal Clean Water Act Section 404.b(1). The Massachusetts Department of Environmental Protection (MassDEP) uses interpreted aerial photography with groundtruth investigations to maintain a spatial database on the mapped extent of eelgrass. The MassDEP eelgrass data, produced from data collected in 2001, is the second statewide mapping of the eelgrass resources along the coast. The data were compiled from similar methodologies as the earlier 1995 dataset. A similar third iteration of this statewide mapping with data from the 2006-07 seasons is expected shortly.

Shellfish Suitability

Shellfish growing areas receive special protection under the state Wetlands Protection Act and regulations, Chapter 91 Waterways regulations, and Water Quality Standards. The Massachusetts Division of Marine Fisheries (DMF) maintains a spatial database called Shellfish Suitability Areas which contains representations of habitats suitable for ten species of shellfish along the coast of Massachusetts. Spatial areas are delineated that are believed to be suitable for shellfish based on the expertise of DMF and local Shellfish Constables, input from commercial fishermen, and information contained in maps and

studies of shellfish in Massachusetts. The areas covered include sites where shellfish have been observed since the mid-1970's, but may not currently support any shellfish. Therefore, these maps represent potential habitat areas. These maps were updated and re-released in Oct. 2008.

National Wildlife Refuges

The National Wildlife Refuge System is administered by the U.S. Department of the Interior for the conservation of fish and wildlife. Federal law and regulations prohibit disturbing, injuring, cutting, burning, removing, destroying, or possessing any real or personal property of the U.S., including natural growth, in any area of the system, or taking or possessing any fish, bird, mammal, or other wild animals within any such area without a permit. The Secretary of Interior may permit areas within the System to be used for hunting, fishing, and public recreation when the Secretary determines such uses are compatible with the major purposes for which such areas were established. Within or proximate to the ocean planning area are four areas that are part of the National Wildlife System: Monomoy, Nantucket, Nomans Land, and Parker River.

Cape Cod National Seashore

Administered by the U.S. Department of the Interior, the National Park Service is charged with promoting and regulating the use of federal areas known as national seashores, parks, monuments, and reservations. Such areas are established by Congress through specific legislation. Among other restrictions, the Cape Cod National Seashore regulations specify that no commercial or industrial uses may be established within the Cape Cod National Seashore.

Section 4.2. Habitat critical to important species (Track 2)

Track 2 is essentially a "biotic" approach, selected to afford a determination of the geographic areas known as critical to—or providing specific life stage support for—"important" species (or group of species, such as guilds or assemblages). To inform a preliminary designation of "important" species, the Work Group used the general criteria contained in the Oceans Act: "special, sensitive, and unique". The data considered by the Work Group for Track 2 is discussed below and in Table 5. Availability of data on given species was a major factor. The Track 2 spatial datasets that were ultimately utilized were transferred to the ocean planning area baseline grid. For a description of the ocean planning area grid system, see Appendix A.

Marine Mammals: Cetaceans

North Atlantic Right whales, Humpback whales, Fin whales, Sei whales, other odontocetes, and other baleen whales were the categories chosen for analysis. Data sources included the North Atlantic Right Whale Consortium , the Provincetown Center for Coastal Studies, the Massachusetts Water Resources Authority, the US Navy, and the College of the Atlantic. Since the North Atlantic Right Whale Consortium data represent a comprehensive, long-term data set and has spatial coverage which covers the planning area, it was selected as the best available for the immediate purposes of the Work Group. As per the data-sharign agreement, it is important to note that: "Raw sighting data from the NARWC database are not effort-corrected and the management documents in which they are used are not peer reviewed. Distributional patterns based on these data are likely to be biased by where, and

when, surveys were conducted." Marine mammal data from the North Atlantic Right Whale Consortium were examined for species distribution and quality assessment by members of the Habitat Work Group with experience examining marine mammal data, and expertise was also provided by Erin Burke and Dan McKiernan (DMF). Four species (North Atlantic Right Whales, Humpback Whales, Fin Whales, and Sei Whales) were selected for inclusion due to their state and federal endangered status as well the importance of Massachusetts waters to providing forage for these species. It was also decided to use all sitings data available from the North Atlantic Right Whale Consortium : both survey data and opportunistic data. Despite potential biases by doing this, it was decided that the quantity of data would outweigh the problems of using non-corrected data. The sitings data were gridded using both inverse distance weighted and kriging interpolations, but this processing resulted in a notable skew, or bias, towards Cape Cod Bay. Therefore, the sitings data were simply gridded at $1m^2$ spacing, yielding an aggregation of the number of sitings per cell. As no other parameter used density or abundance measures, the gridded data used in the maps were simply presence/absence of siting per grid cell. The original dataset could be further analyzed to assess the sitings per unit effort for survey data.

Appendix B contains the map of the North Atlantic Right Whale important habitat in Figure 3, the Humpback Whale important habitat map in Figure 4, the Fin Whale important habitat map in Figure 5, and the Sei Whale important habitat map in Figure 6.

Avifauna

The avifauna data identified by the Work Group included areas of high use by state MESA-listed marine bird species, including three species of tern and Leach's Storm-petrel, as well as concentrations of coastal colonial nesting waterbirds and sea ducks. These data represent the most important coastal and marine areas for birds in Massachusetts. They are based on many years of observations by professional biologists and birders. Three ornithologists from the Massachusetts Audubon Society (Mass Audubon)—Wayne Petersen, Simon Perkins, and Becky Harris—attended the Work Group meeting that was dedicated to avian databases, lent their considerable expertise, and provided the spatial data for Nantucket Sound.

Data for terns are collected annually at nesting, foraging, and staging areas of these species by biologists of the Massachusetts Division of Fisheries and Wildlife (DFW), Mass Audubon, and others. Roseate Terns were mapped separately because of their exceptional rarity, high legal status, and the importance of these areas to their global population. Data for Least, Arctic, and Common Terns and were pooled because of their similar legal status and distribution. Nesting and staging areas are well known for all tern species; foraging areas are used in different densities at different times of year. The mapping of foraging areas does not depict all areas used by terns for foraging but rather areas of higher importance. Terrestrial nesting areas were buffered 0.3 nautical miles to maintain consistency with ocean planning mainland buffer.

Leech's Storm-petrel is a state-listed endangered species. It is a pelagic bird, ranging over wide distances, and breeds at only two locations in Massachusetts. These locations are known from observations by DFW biologists. As with the other terrestrial areas, the locations of storm-petrel nesting colonies were extended 0.3 nautical miles.

Colonial nesting water birds include Double-crested Cormorant, three species of gulls, egrets, herons, Glossy Ibis and Black Skimmer. Comprehensive surveys were more recently conducted by DFW biologists to document the distribution and numbers of colonial nesting waterbirds in 1994-1995 and 2006-2007. Sites with over 100 pairs of

colonial nesting waterbirds were deemed significant, and only these areas were included. Actual nesting areas were then extended 0.3 nautical miles to maintain consistency with ocean planning mainland buffer. The colonial nesting water birds dataset does not contain terns or Leech's Storm-petrel.

Areas important to other avifauna were delineated by biologists of Massachusetts Audubon. These areas were based on the Bird Observer Database which includes field observations from many observers. The Bird Observer Database is a compilation of field observations made from 1980 to the present. These observations form the basis for Important Bird Area designations, which are subjected to review by qualified ornithologists. Additional information related to the Long-tailed Duck and other seabirds in Nantucket Sound was provided by Mass Audubon from aerial surveys conducted in 2002 and 2003. The lack of scientifically designed sampling for most of the coast made our reliance on professional judgment necessary. Future regular monitoring of seabirds with a rigorous sampling design would help refine the mapping.

Appendix B contains the map of the Roseate Tern breeding and staging important habitat in Figure 7; Roseate Tern foraging important habitat in Figure 8; Least, Common, and Arctic Tern breeding and staging important habitat in Figure 9; Least, Common, and Arctic Tern foraging important habitat in Figure 10; Leech's Storm-petrel staging important habitat in Figure 11; colonial nesting water birds important habitat in Figure 12; Long-tailed Duck foraging important habitat in Figure 13; and marine avifauna important habitat in Figure 14.

Sea turtles

The Habitat Work Group sought to acquire and synthesize data on the distribution and abundance of marine turtles, including Loggerhead, Green, Kemp's Ridley, Leatherback and Hawksbill sea turtles. Outside expertise was provided by Robert Prescott, the Sanctuary Director for the Massachusetts Audubon Society's (Mass Audubon), Wellfleet Bay Wildlife Sanctuary, Kara Dwyer Dodge, a graduate student at the University of NH, Durham, and Sara McNulty of the National Marine Fisheries Service, Northeast Region. Three sea turtle data sets were obtained. First, Mass Audubon provided point locations of their sea turtle reports, including floating carcasses, live sightings, and beach strandings from the summer 2008. Second, polygons of sea turtle habitat from NOAA's Environmental Sensitivity Index maps were extracted. These data do not depict widespread distributions of sea turtles—the only sea turtle habitat from this data set that occurred within the ocean planning area was located in Wellfleet Harbor. Third, the U.S. Navy Marine Resource Assessment data set with 10-minute grids of sightings per unit effort for all four sea turtles species was provided by The Nature Conservancy. From this data set, only a few sightings of leatherbacks and loggerheads occurred within the ocean management planning area. All of the sea turtle data sets obtained for the Habitat Work Group had sparse data within the planning area. In recent years, leatherback ecology in the planning area has begun to be studied, however little is known about the distribution and abundance of other sea turtle species. Kara Dwyer Dodge's satellite telemetry data on leatherbacks were also identified as a potential data set, but her data are still being collected and are currently unavailable. A data set with widespread information on the distribution and abundance of sea turtles in the ocean planning area is a remaining data gap.

Marine Mammals: Seals

Several important seal concentration areas are located along the Massachusetts coast. Included among these is the southern-most breeding site within the entire North Atlantic range of the Gray Seal and the largest multi-species haul-out (resting) site for seals on the Atlantic Coast of the United States. The waters immediately adjacent to these areas support high concentrations of seals, particularly Harbor Seals, Gray Seals and Harp Seals. These species are all protected under the federal Marine Mammal Protection Act. Only the terrestrial areas used by seals were mapped. Only the terrestrial areas used by seals are well mapped. These terrestrial areas were buffered by 0.3 nautical miles to maintain consistency with the ocean planning area mainland buffer. These areas were delineated by Massachusetts Division of Fisheries and Wildlife biologists and corroborated by Bob Prescott of Mass Audubon's Wellfleet Bay Wildlife Sanctuary and data for NOAA Fisheries. Data were checked against NOAA Environmental Sensitivity Index maps, which mapped many areas used by seals along the coastline. Seal concentration areas have slight spatial variations from year to year. Yearly observations would be useful to confirm the continued importance of these areas. Appendix B contains the map of the seal haul-out important habitat in Figure 15.

Eelgrass and Kelp

MassDEP maps the distribution of eelgrass in Massachusetts waters. The statewide distribution of eelgrass was mapped twice since 1995 (Table 4). Additional aerial photography was collected since 2002 for select areas (Costello, personal communication). The newer aerial photography and analyses were not available for inclusion in this report. The eelgrass coverage, which includes the two available statewide datasets, that is available through MassGIS was incorporated into the biotic track.

While aerial photography is collected under optimal conditions and the eelgrass distribution coverage represents a valuable source of information on eelgrass, several limitations of the data warrant notice. The minimum mapping unit for the eelgrass mapping project is 20 meters, meaning eelgrass beds smaller than 20 meters are not mapped. Smaller and sporadically dispersed eelgrass beds are found throughout Massachusetts waters and represent valuable nearshore habitat. For example, widely dispersed, low density eelgrass was observed in large areas of Ipswich Bay. The deep water edge of eelgrass is also not always effectively mapped using aerial imagery, and aerial imagery is not collected for offshore shallow water shoal areas that may contain eelgrass, such as shoals found throughout Nantucket Sound. Areas that are mapped as eelgrass are also, in certain areas, other bottom types, such as macroalgae (e.g., *Codium fragile*). Furthermore, eelgrass is a dynamic marine plant, with distribution changing through space and time. The episodic nature of the eelgrass mapping, while valuable, does not comprehensively characterize the variable nature of eelgrass distribution. The eelgrass coverage represents a valuable dataset, but the available data could be complemented by more frequent mapping efforts and more site-specific groundtruthing of eelgrass habitat.

The distribution and abundance of kelp species, which includes sugar kelp (*Laminaria saccharina*), oarweed (*L. digitata*), edible kelp (*Alaria esculenta*), and shotgun kelp (*Agarum clathratum*), is unknown in Massachusetts. There is no known assessment of the presence and absence of kelp in state waters. In general, kelps require clear water and hardbottom for attachment. Groundtruth imagery gathered during the MassDEP eelgrass mapping project and the CZM-USGS seafloor mapping cooperative may identify the location of some kelp, but this dataset would not provide a comprehensive assessment of kelp. Kelp was not considered in prioritizing habitat areas in the ocean planning area.

Appendix B contains the map of the eelgrass important habitat in Figure 16.

Table 4. Location and date aerial photography acquisition.

Project Area	Date of Aerial Imagery Acquisition
1st Statewide Data Coverage	
Nantucket	1993
Martha's Vineyard	1994
Southern Cape Cod	1994
Elizabeth Island	1994
Northern Cape Cod	1995
South Shore	1995
Boston Harbor	1995
North Shore	1995
Buzzards Bay	1996
2nd Statewide Data Coverage	
Nantucket	1999
Martha's Vineyard	1999
Cape Cod	2000
South Shore	2001
Boston Harbor	2001
North Shore	2001
Buzzards Bay	2002

Fisheries (Fish and Shellfish)

The Habitat Work Group made an initial decision to defer issues that directly pertained to managed commercial and recreational fisheries to the parallel Fisheries Work Group. It was anticipated that the two separate workgroups would examine ways to integrate their respective efforts during the next phases of workgroup activity. The two Work Groups held a joint meeting on October 8, where their respective processes and initial results were presented and discussed. There was recognition that while the focus of the Fisheries Work Group was on managed fisheries, the concept of fish and shellfish (collectively: nekton) habitat extends to those species managed by DMF (or subject to federal management plans) and to many that are not, including some that have significant trophic importance (e.g. forage fishes like sand lance which support both predator fish as well as whales, dolphins, porpoises, seals, and seabirds).

On November 13, the Fisheries Work Group made a recommendation to incorporate 13 fisheries species (of more than 200 known to occur in the planning area) into the Habitat Work Group's effort to identify special, unique, and sensitive species and habitats. Cod, lobster, and winter flounder were recommended for inclusion due to their significant role (as measured by commercial and cultural importance) within the Gulf of Maine ecosystem. Alewife, Atlantic halibut, Atlantic sturgeon, Atlantic wolffish, barndoor skate, cusk, rainbow smelt, sand tiger shark, and thorny skate are listed Species of Concern under the federal Endangered Species Act. They were recommended since their presence in the planning area suggests that critical habitat for these rare species may occur within the

planning area. Sand lance were also considered in the habitat assessment as an example of a key forage species for the endangered humpback whales. Sand lance and other forage fishes may serve as habitat indicators for other species groups.

The actual integration of these datasets proved more challenging than anticipated, and it was decided that more discussion was warranted regarding how to represent widely disparate species groups in a habitat compilation. Revised drafts of the Habitat and Fisheries Work Groups can be developed to reflect these deliberations.

Data for location of anadromous fish runs exist in MassGIS, and more up-to-date information is available directly from the Division of Marine Fisheries. Horseshoe crab beach locations are also available directly from DMF. The runs and beaches are outside of the planning area, but were considered for incorporation since these organisms use the planning area. Our best understanding of where they might be in the planning area is adjacent to the known land-side locations. As such, we considered buffering the locations by 0.3 km to represent the use of the planning area by these species, as was done for seals and avifauna. But since some species hug the coast for several miles before entering a river to spawn, DMF biologists thought that a simple buffer was too inaccurate a method to define those species distributions.

Combining all of these datasets is notoriously difficult, and warrants considerably more work, particularly in the realm of examining community relationships and trophic structure.

Invasive Species

Judy Pederson (MIT Sea Grant) and Jay Baker (CZM and MA Aquatic Invasive Species Working Group) shared their expertise on the status of available data for invasive species in the estuarine and marine environments. The Marine Invader Monitoring Information Collaborative (MIMIC) database contains data and information collected by a network of community groups and citizens using a standardized monitoring protocol in a single shared system that is maintained by MIT Sea Grant. It was decided that since all the data in the MIMIC database are shore-based and consequently outside the planning area, the data are not included in this Habitat Work Group report. Similar to other parameters/assemblages, there is some research and directed studies which are examining the extent and effects of marine invasives including the recent discovery of the fast-growing sea squirt, *Didemnum*, on Georges Bank. However, long-term, systematic datasets covering the spatial extent of the planning area were not identified. It was determined that assessment and monitoring of invasive species in the ocean planning area is an important data gap and should be addressed in future versions.

Primary/secondary productivity

The Habitat Work Group briefly discussed the acquisition of primary and secondary productivity data. Aside from some research and directed studies (e.g., MWRA outfall monitoring; Massachusetts Bays studies by URI and WHOI, Cape Cod Bay studies by Center for Coastal Studies; WHOI monitoring on ferries in Nantucket Sound), long-term, systematic datasets covering the spatial extent of the planning area were not identified. Satellite data from NASA's sea-viewing wide field of view sensor (SeaWiFS) does provide complete and routine coverage of ocean color, which in the visible light region (wavelengths of 400-700 nm) varies with the concentration of chlorophyll and other plant pigments present in the water. SeaWiFS data only represents color conditions at the ocean surface, and clouds and fog can obscure both visible (ocean color) and infrared (temperature)

information. Because of the transitory nature of free-floating primary and secondary productivity (i.e., phytoplankton and zooplankton) and their dependence upon oceanographic characteristics, other abiotic oceanographic parameters could be quantified as a proxy for important water column productivity areas (see more on this below). Attached primary productivity was addressed via eelgrass maps. No data was identified on the distribution or abundance of attached or unattached macroalgae in the planning area.

Table 5. Summary of biotic data considered/utilized by Work Group (Track 2)

Habitat Parameter	Source	Summary	Status / Comments	Final Usage / Ranking
Diadromous fish runs	MA Division of Marine Fisheries	The MA Dept. of Fish and Game, working in conjunction with biologists from the MA Div. of Marine Fisheries and MA Dept. of Fish and Wildlife, compiled and automated a point coverage of anadromous fish data. The data include all known coastal anadromous fish runs spawning habitat and runs for three major inland rivers - the Nashua, the Concord and the Shawsheen. Note, this data layer should not be considered definitive in determining the presence or absence of fish runs, spawning habitat, barriers or fishways. It is the best current representation of these features.	Occurs outside planning area. Experts mixed on need to capture diadromous passage through ocean planning area (to/from spawning areas). DMF is working on updating the data; expected completion is summer of 2009.	No
Colonial coastal waterbirds	MA Dept. of Fish and Wildlife	Surveys were conducted to document the populations of colonial nesting waterbirds. Sites represent areas where colonial nesting waterbirds have been observed during surveys. Only sites where >100 pairs of waterbirds were observed have been included. Waterbird species observed at these sites may include Common Terns, Least Terns, Roseate Terns, Arctic Terns, Leach's Storm-petrels, Double-crested Cormorants, Herring Gulls, Great Black-backed Gulls, Laughing Gulls, Black Skimmers, Great Egrets, Snowy Egrets, Cattle Egrets, Little Blue Herons, Black-crowned Night Herons, and Glossy Ibis. Survey points were extended 0.3 nautical miles to maintain consistency with the Ocean Planning mainland buffer.	Colonial coastal waterbirds are an important and conspicuous component of Massachusetts coastal ecosystems. Colonial nesting birds are often concentrated in small areas and are therefore vulnerable to disturbance, predation, habitat destruction, and other events that could eliminate a large number of birds at one time.	Yes Rank= 2

Habitat Parameter	Source	Summary	Status / Comments	Final Usage / Ranking
Eelgrass and Widgeon Grass (SAV)	MA Department of Environmental Protection	Eelgrass areas receive special protection under the state Wetlands Protection Act regulations, Chapter 91Waterways regulations, and Water Quality Standards. The MassDEP Eelgrass layer, produced from data collected in 2001, is the second statewide mapping of the eelgrass resources along the coast. The data were compiled from similar methodologies as the earlier 1995 dataset. A similar third iteration of this statewide mapping with data from the 2006-07 seasons is currently being created by MA Dept. of Environmental Protection.	Data include both eelgrass and Widgeon Grass.	Yes Rank = 2
Horseshoe Crabs	MA Division of Marine Fisheries	Horseshoe crabs are managed by Division of Marine Fisheries under interstate management agreements. The beaches are surveyed and mapped annually during the spring spawning season when horseshoe crabs move up onto the beaches to lay eggs. This is a proprietary dataset but available for planning purposes.	Occurs outside planning area. Experts mixed on need to capture horseshoe crab usage of the ocean planning area (to/from spawning areas).	No
Invasives	Marine Invader Monitoring Information Collaborative	Information on invasives exists landward of the planning area. Didemnum is thought to occur in the planning area and may have important ecological impact but no spatial distribution information is available.	Insufficient data identified in the ocean planning area.	No
Leach's Storm Petrel Nesting	MA Dept. of Fish and Wildlife	Leach's Storm-petrel is a state-listed Endangered species.	Areas delineated are documented breeding areas. Nesting areas were extended 0.3 nautical miles to maintain consistency with the Ocean Planning mainland buffer.	Yes Rank= 3
Long-tailed Ducks	Mass Audubon	Regionally significant populations of Long-tailed Ducks winter in MA state waters.	Long-tailed Ducks were extracted from the Mass Audubon Critical Avian Habitat data. Future inventory, especially in the marine areas, would help refine the mapping.	Yes Rank = 1

Habitat Parameter	Source	Summary	Status / Comments	Final Usage / Ranking
Marine avifauna critical habitat (excluding all terns and Long- tailed Ducks)	Mass Audubon	This dataset was compiled by the Massachusetts Audubon Society for the Ocean Management Plan. These data represent the most important coastal and marine avian areas in Massachusetts based on actual observations by scientists and birders. Much of the information is from the Bird Observer Database, which is a compilation of multiple observations by many different birders. Mass Audubon ornithologists used their professional judgment and knowledge of this database to determine priority areas for sea ducks and pelagic species.	CZM separated the dataset into the following categories: Long-tailed Duck, terns (to be removed from data as tern data has been included separately), and all other species. Future inventory, especially in the marine areas, would help refine the mapping.	Yes Rank = 1
Mass Audubon tern and winter waterfowl data	Mass Audubon	The Nantucket Sound dataset was based on aerial surveys along transects. Two observers sat in an airplane flying at approximately 500' altitude and made observations out of the window. Their observations were called out and then recorded by an observer. Aerial surveys for terns were carried out beginning in August 2002 and were carried out in spring, summer and fall through 2004. Winter waterfowl surveys were carried out from 2003-2006.		No
Migration routes: shorebirds, raptors, bats	Work Group unable to find adequate data		Work Group unable to find adequate data	No
Primary Productivity	National Aeronautics and Space Administration	Primary production is the production of organic compounds from atmospheric or aquatic carbon dioxide, principally through the process of photosynthesis, with chemosynthesis being much less important. Algae, the predominant organisms responsible for primary production, form the base of the food chain.	Data exist but have not been harvested as no specific use for these data have been identified. Data can be collected from the NASA SeaWIFS satellite sensor. No rationale and/or methodology was established by the workgroup to include primary productivity in subsequent analysis.	No

Habitat Parameter	Source	Summary	Status / Comments	Final Usage / Ranking
Resource Assessment Trawl Survey Data	MA Division of Marine Fisheries	Dataset includes fisheries data from MA Div. of Marine Fisheries Resource Assessment Trawl Survey. Two categories of species are included: 1) Species of concern (quantitative data are provided for species that meet a minimum threshold of occurrence in the survey; species include Thorny skate, Alewife, Rainbow smelt, Atlantic and wolffish. Presence/absence data are provided for species that do not meet the minimum threshold of occurrence; species include Sand tiger shark, Barndoor skate, Cusk, Atlantic halibut, and Atlantic sturgeon); 2) Species that are often considered when proposed activities might impact their habitat (species include American lobster, Atlantic cod, and Winter flounder). In addition, sand lance data were also provided.	Further discussion needed on how to represent fisheries/nekton in a habitat compilation	No
Restoration / Mitigation Areas	MA Division of Marine Fisheries	Areas that have been subject to habitat enhancement or restoration.	Sites for artificial reefs, eelgrass, and shellfish were identified by DMF and are available as a point coverage. Further discussion needed on how to represent in a habitat compilation	No
Roseate tern breeding and staging	MA Dept. of Fish and Wildlife	The Roseate Tern is both a state and federally-listed Endangered species. Areas delineated are Roseate tern breeding and staging sites.	Breeding and staging sites were extended 0.3 nautical miles to maintain consistency with Ocean Planning mainland buffer.	Yes Rank = 3
Roseate tern foraging	MA Dept. of Fish and Wildlife	The Roseate Tern is both a state and federally-listed Endangered species. Areas delineated are documented Roseate tern foraging areas. While tern foraging will extend greater distances, these represent the most important foraging areas.		Yes Rank = 2
Seals	MA Division of Marine Fisheries	These data show important areas utilized by gray seals primarily and harbor seals incidentally for resting and congregating. These areas include some of the largest concentrations of seals on the east coast.	Primarily Gray seals in moderate to high concentrations are included in this dataset. The data were buffered 0.3km to maintain consistency with the Ocean Planning mainland buffer.	Yes Rank = 1

Habitat Parameter	Source	Summary	Status / Comments	Final Usage / Ranking
Seals	National Oceanographic and Atmospheric Administration	This dataset comprises the seal data from the Environmental Sensitivity Index (ESI) maps for the shoreline of Massachusetts. ESI data characterize marine and estuarine environments and wildlife by their sensitivity to spilled oil. For seals major haul-out sites for harbor seals and pupping and haul-out sites for gray seals are depicted. Though only haul-out and pupping sites are mapped, seals can occur throughout the nearshore waters of Massachusetts.	Contains Gray and Harbor seal sites and concentrations binned as high, medium, and low. These data were used to confirm the Division of Marine Fisheries seal haul-out data.	No
	Provincetown Center for Coastal Studies / National Marine Fisheries Service	Data set includes coordinates of 20 seal survey locations in southern Massachusetts	A limited point dataset showing survey locations not haul-outs themselves; does not include any information on the species being surveyed. Data not deemed robust enough for use.	No
Sea turtles	Mass Audubon	Data represent point locations of Mass Audubon's sea turtle reports, including floating carcasses, live sightings, and beach strandings from the summer 2008.	Data are very limited in spatial extent. Since experts note that sea turtles occur throughout the planning area, the data were deemed not robust enough for inclusion.	No
	United States Navy Marine Assessment (provided by The Nature Conservancy)	The U.S. Navy Marine Assessment data represent seasonal sightings of sea turtles per 1,000 km of search effort for 10-minute grids in the North Atlantic. The species included in this dataset include Loggerheads and Leatherbacks.	Only four data points fell within the Ocean Planning area. Since experts note that sea turtles occur throughout the planning area, the data were deemed not robust enough for inclusion.	No
	Kara Dwyer Dodge, graduate student, University of New Hampshire	Satellite telemetry data of Leatherbacks.	Data is still being collected and is currently unavailable.	No

Habitat Parameter	Source	Summary	Status / Comments	Final Usage / Ranking
Sea turtles	National Oceanographic and Atmospheric Administration	This dataset comprises the sea turtle data from the Environmental Sensitivity Index (ESI) maps for the shoreline of Massachusetts. ESI data characterize marine and estuarine environments and wildlife by their sensitivity to spilled oil. Sea turtles are only mapped in a few locations where in-water concentrations were reported by data providers (sea turtles do not nest in Massachusetts). The more widespread or dispersed distributions of sea turtles in the study area are not depicted in the data. In general, sea turtles can be found in the major coastal embayments and in nearshore and offshore waters of the study area. In particular, loggerhead, Kemp's Ridley, and Green Turtles can be found in Cape Cod Bay, and Leatherback turtles can occur sporadically throughout nearshore and offshore waters, especially from July-September.	Data are minimal with only one polygon for Loggerheads, Kemp's Ridleys, and Greens that occurs off Wellfleet. Since experts note that sea turtles occur throughout the planning area, the data were deemed not robust enough for inclusion.	No
Shellfish suitability	MA Division of Marine Fisheries	Shellfish growing areas receive special protection under the state Wetlands Protection Act regulations, Chapter 91 Waterways regulations, and Water Quality Standards. The polygons delineate areas that are believed to be suitable for shellfish based on the expertise of the MA Div. of Marine Fisheries and local Shellfish Constables, input from commercial fishermen, and information contained in maps and studies of shellfish in Massachusetts. The areas covered include sites where shellfish have been observed since the mid-1970's, but may not currently support any shellfish.	Further discussion needed on how to represent fisheries/nekton in a habitat compilation	No
Special concern tern breeding and staging	MA Dept. of Fish and Wildlife	Areas delineated are important breeding and staging areas for terns state-listed as species of Special Concern (Common, Least, and Arctic Terns).	Tern breeding and staging areas were extended 0.3 nautical miles to maintain consistency with Ocean Planning mainland buffer.	Yes Rank = 2

Habitat Parameter	Source	Summary	Status / Comments	Final Usage / Ranking
Special concern tern foraging	MA Dept. of Fish and Wildlife	Areas delineated are important foraging areas for terns state-listed as species of Special Concern (Common, Least, and Arctic Terns). Areas delineated are documented tern foraging areas. While tern foraging will extend greater distances, these represent the most important foraging areas.		Yes Rank = 1
Ventless Lobster Trap Survey Data	MA Division of Marine Fisheries	DMF's Ventless Lobster Trap Survey was specifically designed to describe the distribution and relative abundance of lobster in Massachusetts coastal waters. The Ventless Trap Survey also samples lobster in areas inaccessible to the trawl survey.	Further discussion needed on how to represent fisheries/nekton in a habitat compilation	No
Waterfowl focus areas	MA Dept. of Fish and Wildlife	Waterfowl Focus Areas identify areas critical to the conservation of waterfowl and other wetland species. These data were developed by the Waterfowl Technical Committee. Major updates were made in February 2005 and minor updates were made in June 2005.	These data were supplanted by the Mass Audubon Critical Avian Habitats dataset.	No
Whales	North Atlantic Right Whale Consortium	The number of **Right** whale sitings per 1 km2 grid were mapped by season. Dataset also includes grids made for data quality.	The number of sitings for other baleen species (Sperm and Minke whales) and odontocetes (Killer Whales, white-sided dolphins, Belugas, Bottlenose Dolphins, Common Dolphins, False Killer Whales, Harbor Porpoises, Pilot Whales, Pygmy/Dwarf Sperm Whales, Risso's Dolphins, White-beaked Dolphins, and Striped Dolphins) were also grouped and mapped. Dataset also includes grids made for data quality.	Yes Rank = 3

Habitat Parameter	Source	Summary	Status / Comments	Final Usage / Ranking
Whales	North Atlantic Right Whale Consortium	The number of **Humpback** whale sitings per 1 km2 grid were mapped by season. Dataset also includes grids made for data quality.	The number of sitings for other baleen species (Sperm and Minke whales) and odontocetes (Killer Whales, white-sided dolphins, Belugas, Bottlenose Dolphins, Common Dolphins, False Killer Whales, Harbor Porpoises, Pilot Whales, Pygmy/Dwarf Sperm Whales, Risso's Dolphins, White-beaked Dolphins, and Striped Dolphins) were also grouped and mapped. Dataset also includes grids made for data quality.	Yes Rank = 2
	North Atlantic Right Whale Consortium	The number of **Fin** whale sitings per 1 km2 grid were mapped by season. Dataset also includes grids made for data quality.	The number of sitings for other baleen species (Sperm and Minke whales) and odontocetes (Killer Whales, white-sided dolphins, Belugas, Bottlenose Dolphins, Common Dolphins, False Killer Whales, Harbor Porpoises, Pilot Whales, Pygmy/Dwarf Sperm Whales, Risso's Dolphins, White-beaked Dolphins, and Striped Dolphins) were also grouped and mapped. Dataset also includes grids made for data quality.	Yes Rank = 2
	North Atlantic Right Whale Consortium	The number of **Sei** whale sitings per 1 km2 grid were mapped by season. Dataset also includes grids made for data quality.	The number of sitings for other baleen species (Sperm and Minke whales) and odontocetes (Killer Whales, white-sided dolphins, Belugas, Bottlenose Dolphins, Common Dolphins, False Killer Whales, Harbor Porpoises, Pilot Whales, Pygmy/Dwarf Sperm Whales, Risso's Dolphins, White-beaked Dolphins, and Striped Dolphins) were also grouped and mapped. Dataset also includes grids made for data quality.	Yes Rank = 2

Habitat Parameter	Source	Summary	Status / Comments	Final Usage / Ranking
Whales	United States Navy Marine Assessment (provided by The Nature Conservancy)	The U.S. Navy Marine Assessment data represent seasonal sightings of marine mammals per 1,000 km of search effort for 10-minute grids in the North Atlantic. The species included in this dataset include Atlantic White-sided Dolphins, Bottlenose Dolphins, Fin Whales, Harbor Porpoises, Humpback Whales, Minke Whales, North Atlantic Right Whales, Sei Whales, Sperm Whales, and Striped Dolphins.	Data is based on 10 minute by 10 minute grid cells and consequently were considered too coarse for inclusion.	No
	MWRA	Downloaded PDFs of summaries of marine mammal observations from 1997 - 2007 from the MWRA Environmental Quality Department Technical Reports website. PDFs include tables with the location and species of marine mammal sited during water quality surveys.	Data were not used because they were purely opportunistic sitings that were recorded when a marine mammal was sited during water quality surveys.	No
	Provincetown Center for Coastal Studies	Right whale data are included in the North Atlantic Right Whale Consortium dataset. CCS collects data on other cetacean species as well but these data are not included in the Consortium database.	Right data already in Consortium database; other data need to be sorted and collated by CCS data keeper who was unavailable during the time period during which the data were being reviewed and analyzed.	No
	College of the Atlantic	COA, in collaboration with two other research partners, collects ceatacean data during research cruises. The available data were collected from 1990 to 2007.	All data occurred outside of the planning area and were consequently not used.	No

Section 4.3. Track 2 datalayer integration

Two techniques were utilized to integrate the suite of datalayers into a single map. Within every gridded datalayer, each individual grid cell is assigned a value. In the first technique, grid cell values were either "1" or "0" for each datalayer—a "1" indicates that for the datalayer parameter (e.g., North Atlantic Right Whale or eelgrass) the grid cell in questions serves as "important" habitat, and a "0" indicates it is not. All of the utilized datalayers were combined and the values for each grid cell were aggregated (totaled). The grid cell values then ranged from 0 to 6. Table 6 shows how the aggregated values were reclassified using quartiles of the frequency distribution to generate "classes" of "low", "medium", "high" and "critical". Using these classes, a map entitled "*Important biotic habitat (integrated by binary occurrence)"* was generated. The map is displayed in Figure 17 in Appendix B.

Table 6. Biotic data integration: non-ranked aggregated values reclassification by quartiles

Grid Cell Aggregated Raw Value	Quartile Reclassification Class
0-1	Low
2	Medium
3	High
4-6	Critical

In the second technique, grid cell values for every datalayer were ranked with the Work Group's professional judgment using the criteria in Table 7. For every datalayer, each grid was assigned either a "3", "2", or "1" based on its ranking score, and a "0" was used for grid cells that were absent (no data). All of the utilized datalayers were then combined and the ranked values for each grid cell were aggregated (totaled). The grid cell values then ranged from 0 to 16. Table 8 shows how the aggregated ranked values were reclassified using quartiles of the frequency distribution to generate "classes" of "low", "medium", "high" and "critical". Using these classes, a map entitled "*Important biotic habitat (integrated by ranked occurrence)"* was generated. The map is displayed in Figure 18 in Appendix B.

Table 7. Criteria utilized for datalayer ranking

Standard / Condition	Score
Rare, unique, and/or sensitive habitat. Identified as critical habitat for endangered or threatened species (e.g., nesting, staging) where there are no or very few other areas exist that provide similar structure or function.	3
Exceptional and somewhat unique habitat and/or habitat with high vulnerability. These are habitat areas where few others exist providing similar structure or function.	2
Important habitat and/or habitat or resources susceptible to adverse impacts. Identified as areas that support endangered, threatened, or special concern species or other important species, but where use is general or occurs over large geographic areas. These could be general or transient habitats or areas where some others exist providing similar structure or function.	1

Table 8. Biotic data integration: ranked aggregated values reclassification by quartiles

Grid Cell Aggregated Raw Value	Quartile Reclassification Class
0-1	Low
2-3	Medium
4-5	High
6-16	Critical

Section 4.4. Unique and/or sensitive habitats as indicated by abiotic parameters (Track 3)

While Track 2 focuses on known biota, Track 3 focuses on the determination of important (special, unique, sensitive) habitats as indicated by an assessment of a suite of abiotic parameters. Certain configurations and relationships of physical, geological, and chemical conditions may have limited occurrences in the planning area or may be particularly susceptible to perturbation or degradation. Synthesis and analysis of these abiotic parameters can also be performed to derive habitat classes, determine unique areas that can be linked to habitat requirements for specific species, and develop habitat suitability models.

Over the past several months, through meetings, the examination of available datasets, and the assessment of work in other countries, the various components and outputs of a marine habitat map have been considered. There is general agreement on a strategy to marine habitat mapping in

Massachusetts that synthesizes a suite of important parameters and uses classification and modeling approaches to support characterization and management of the planning area. The habitat modeling work being conducted by Canada's Department of Fisheries and Oceans and by the United Kingdom's Joint Nature Conservation Committee (UKSeaMap project) have many of the same underlying parameters. Using these studies as a guideline and with input from Work Group members, the suite of parameters that are proposed as the foundational elements of a marine habitat mapping effort are listed in Table 9. The data considered by the Work Group for Track 3 is discussed below and in Table 10. The Track 3 spatial datasets that were ultimately utilized were transferred to the ocean planning area baseline grid.

Table 9. Foundational parameters of Massachusetts marine habitat mapping

Parameter	Spatial component	Possible data source
Depth/bathymetry	Sea surface to seafloor	CZM/USGS Seafloor Mapping Cooperative
Seafloor topography	Seafloor	CZM/USGS Seafloor Mapping Cooperative
Sediment grain size	Seafloor	CZM/USGS Seafloor Mapping Cooperative
Temperature	Water column	UMass-Dartmouth/WHOI Northeast Coastal Ocean Forecast System
Salinity	Water column	UMass-Dartmouth/WHOI Northeast Coastal Ocean Forecast System
Water column stratification	Water column	UMass-Dartmouth/WHOI Northeast Coastal Ocean Forecast System
Wave base	Sea surface/water column	UMass-Dartmouth/WHOI Northeast Coastal Ocean Forecast System
Near bed sheer stress	Seafloor/water column	CZM/USGS Seafloor Mapping Cooperative and UMass-Dartmouth/WHOI Northeast Coastal Ocean Forecast System
Light attenuation	Water column	UMass-Dartmouth/WHOI Northeast Coastal Ocean Forecast System
Productivity	Water column/sea surface	NASA SeaWIFS, NCOFS, PCCS
Frontal probability	Water column/sea surface	NOAA AVHRR, NCOFS

Depth, Bathymetry and Topography (Rugosity and Slope)

In 2003 the CZM-USGS Seafloor Mapping Cooperative was initiated to comprehensively map the topography and geology of the seafloor in Massachusetts. Acoustic data from the Seafloor Mapping Cooperative are used to produce high-resolution bathymetric, backscatter intensity, and geologic interpretative maps of offshore coastal Massachusetts. To date, nearly 1450 km2 of the seafloor environment is mapped from the New Hampshire border to northern Cape Cod Bay, with plans to start mapping Buzzards Bay and Vineyard Sound in 2009. The datasets from this systematic mapping effort do not yet cover the full spatial extent of the planning area and are not incorporated in this report.

A composite bathymetric data set with a nominal horizontal resolution of 30m was created for the waters off the coast of Massachusetts by mosaicking the most accurate and up to date federal bathymetric data. Data sources included: USGS Open File Reports, NOAA Estuarine Bathymetry, and the NOAA Coastal Relief Model. Since these sources vary in spatial resolution from 2m to 90m, 30m was selected to represent a median spatial resolution for mosaicking. The mosaicked data were checked for bad values (errant soundings) and "ledges" between adjacent data sets representing potential datum conflicts. The data appear to be free from bad values and edgematch well. Bathymetry, the fundamental measure of seafloor topography, was used in all subsequent analysis of abiotic habitat.

The NOAA Benthic Terrain Modeler (BTM) tool (http://www.csc.noaa.gov/products/btm/) was utilized to quantitatively map major seafloor terrain features in the planning area. Using this model, bathymetric position and slope were derived from the 30m resolution bathymetric data. The bathymetric position index was created at a broad scale by comparing a pixel's relative depth to nearby cells that occur within an annulus with an inner radius of 600 m and an outer radius of 3 km. Within certain parameters that were defined for bathymetric position and slope, five seafloor features were mapped: crests, depressions, flats, sloping plains (2 -5 degrees), and steeply sloping plains (greater than 5 degrees). Appendix B contains a map (Figure 19) of the BTM output.

A seafloor rugosity data set was also derived from the bathymetric data. Rugosity is a measure of terrain roughness, and in seafloor habitats, provides valuable information about potential species occurrences, diversity, and abundance. A seafloor with a high rugosity (or habitat complexity) has more crevices available to epibenthic organisms (e.g., stalked tunicates, mussels, sponges with upright growth) and other nekton than a seafloor with low rugosity and is typically composed of hard substrate such as cobble, boulders, or rock outcrops. Also, the expectation is that highly rugose habitats, especially those that are composed of boulders and cobble, are going to be less resilient than less rugose habitats (e.g., sands or muds). Assuming that the disturbance regime is slow enough to allow epibenthic communities to develop (e.g., sponge or mussel "reefs" on boulders), a boulder field community is going to be much slower to regain its previous composition and abundance than a benthic community associated with a sand plain. A measure of rugosity provides a preliminary assessment of seafloor complexity, which is important in understanding potential species associations (e.g., fish habitat) with the seafloor. Rugosity is computed from bathymetry by any of a number of similar algorithms. For this work, rugosity was calculated from the 30m bathymetry data using the Vector Ruggedness Measure (VRM) developed by Sappington et al., 2005. The VRM incorporates the heterogeneity of both slope and aspect, resulting in a measurement of vector dispersion in three dimensions. Using the VRM tool in ArcGIS, rugosity was calculated for the ocean planning area. While rugosity may range from 0 (flat) to 1 (complete terrain variation), the ruggedness of the ocean planning area ranged from 0.00 to 0.05. These roughness values were defined as low, medium, and high using the standard deviation classification method in ArcGIS. Appendix B contains a map (Figure 20) of the rugosity output.

Sediment Grain Size

The Habitat Work Group held several discussions with USGS Woods Hole geologists and seafloor mapping specialists regarding how to describe and analyze grain size data for the ocean planning area. A preliminary map was generated using a very simplified version of the Folk classification (Folk, 1959) resulting in the following categories: mud, fine sediment, and coarse sediment. Source data on grain size was from the usSEABED dataset (Reid et al., 2006). All silt combinations are mud, all sand combinations are fine sediment, and all gravel combinations are coarse sediment. Anything with a grain size higher than gravel was labeled hard bottom. This is the same classification of sediment types that was utilized in the Irish Sea Pilot Project of the UK SeaMap program. More details regarding the usSEABED dataset (including a data quality assessment) and the process utilized to analyze the dataset will be available via a technical report in the coming months. The resulting point dataset that showed the distribution of sediment type was interpolated using an inverse distance weighting approach. Due to the variability of some parts of the Massachusetts seafloor as well as the paucity of data in some areas, this approach may oversimplify the

seafloor sediment composition. There are many datasets that remain to be integrated into a full assessment of grain size, including DMF lobster habitat data, DMF trawl hang data, dredged material management sediment profile imagery, benthic monitoring data (e.g., Massachusetts Water Resources Authority outfall monitoring), and datasets generated by construction and dredging projects. It is anticipated that these datasets will be incorporated over the next several months.

More importantly, acoustic seafloor mapping datasets from the CZM-USGS Seafloor Mapping Cooperative have not yet been incorporated (see Appendix C). The level of detail and spatial accuracy of these new data are better than the various existing and historic seafloor datasets (e.g., usSEABED). These acoustic mapping datasets provide significantly higher resolution, and can in some cases change previous interpretations of the seafloor made from the usSEABED dataset. Although the usSEABED database has significant state-wide coverage, there are important limitations that should be noted with using these data to create a continuous seafloor sediment type map (see Appendix D):

1. Many of the samples from the usSEABED database were collected prior to modern GPS navigation, which may present substantial error in geographic position of samples. Pre-loran data was removed for this derivative use.
2. A relatively small percentage of the usSEABED records are sediment samples that have been laboratory analyzed, which means most samples are observational and are crudely classified from written descriptions.
3. Many areas in Massachusetts are not sampled, so interpolation between points may incorrectly represent bottom types. The recently collected acoustic data are contiguous coverages.

Classifying the seafloor environment into discrete geologic and habitat units is an ongoing effort in Massachusetts. CZM, DMF, USGS, and other partners are actively examining the next steps in moving acoustic seafloor mapping data, in combination with detailed examination (e.g., benthic grabs and underwater observation) of the ecology of the seafloor, toward an integrated seafloor habitat classification. Among the many tasks required to appropriately classify the physiographic nature of the seafloor is the development of a rigorous approach to combine the multiple backscatter datasets that are collected through the Seafloor Mapping Cooperative. These discrete datasets need to be combined to create a state-wide dataset, including a state-wide dataset of sediment types. An approach to classify and map the seafloor environment, including the combination of disparate backscatter data, could be applied to areas that currently have acoustic data, with sufficient groundtruth data, and then to the whole planning area once acoustic coverage is completed.

Sediment Depth

Seismic data are collected as part of the Seafloor Mapping Cooperative. These data exist for most of the state waters that were mapped using acoustic technologies. The datasets from this systematic mapping effort do not yet cover the spatial extent of the planning area and are not incorporated in this report. There are also a variety of sediment cores located throughout the planning area that may help characterize depths of particular sediment types in specific areas.

Temperature, Salinity, Currents, Waves, Wind Stress and Bottom Stress

The Habitat Work Group enlisted the help of two oceanographers from the U.S. Geological Survey (Brad Butman and Rich Signell) who have experience monitoring and modeling physical parameters within Massachusetts waters. Butman and Signell provided

the workgroup with a list of 11 variables that should be quantified to adequately describe the physical aspects of the ocean planning area waters. These variables are: sea surface and bottom temperature, surface and bottom salinity, stratification (density of surface – density at bottom), surface and bottom current velocity, sea surface height, wind stress, significant wave height, and bottom stress.

Given that these variables are not measured consistently in time or space across the ocean planning area, it was determined that calibrated and verified modeled outputs could be used as robust surrogates for empirical data. The Work Group enlisted the help of Chengshen Chen (UMass-Dartmouth) who is working with other collaborators, including Bob Beardsley (WHOI), on the linked Northeast Coastal Ocean Forecast System (NCOFS) which utilizes a series of complex models, including:

1. A mesoscale atmospheric model (MM5);
2. The Weather Research and Forecast (WRF) model;
3. The unstructured grid Finite-Volume Coastal Ocean Circulation Model (FVCOM-GOM);
4. The unstructured grid surface wave model (FVCOM-SWAVE); and
5. A 3-D suspended sediment transport model.

Chen's lab provided an 11-year dataset (1995-2005) of outputs from the FVCOM. Data outputs from the model will be compared to actual monitoring data recorded at USGS, NOAA, and GOMOOS buoys, tide gauges, and MWRA hydrographic stations. An additional data need (beyond the requests suggested by Butman and Signell) is the degree of oxygen saturation of the water column. These data likely are an output from the Chen model. With the mean and standard deviation values for the parameters, by month, for the 11-year period, the Habitat Work Group will need to determine the appropriate aggregation of monthly data into oceanographic seasons. The Work Group should also examine the frequency of occurrence and geographical extent of the FVCOM derived parameters to determine if certain configurations and/or relationships may have limited occurrences in the planning area or may be particularly susceptible to perturbation or degradation. Expert advice from the Science Advisory Council and others would be helpful.

The Habitat Work Group also obtained frontal probability data that was compiled and synthesized by Dave Ullman (URI) and made available in the NetCFD format by Rich Signell. Frontal probability is an indication of where water masses of two different densities (either due to salinity, temperature, or both) meet. Frontal probability can be an indicator of primary and/or secondary productivity and may also indicate areas of concentration of forage and predatory species. The data are 15-year averages (1985-2000) by month for the northwestern Atlantic ocean. There has been no further analysis to date of these data and the Work Group has not considered them in depth. Expert advice from the Science Advisory Council and others would be helpful.

Nearbed stress is the shearing force exerted on the seafloor by water movements above the seabed. It is a useful parameter in determining the seabed disturbance arising from tidal or residual currents. Bed stress varies with water depth and substratum type; the bed stress value could be the same in two areas, even though the current speed in the water column above may be very different. The degree of bed stress has an influence on both seabed substratum type and the associated biological communities, particularly the epibiota (surface-dwelling community).

Table 10. Summary of abiotic data considered/utilized by Work Group (Track 3)

Habitat Parameter	Source	Summary	Status / Comments	Final Usage
Benthic Terrain Modeler Data	MA Office of Coastal Zone Management	The Benthic Terrain Modeler (www.csc.noaa.gov/ products/btm/) is an ArcGIS-based tool used with bathymetric data sets to quantitatively classify the benthic environment into terrain features (such as depressions, flats, and slopes) at both broad and fine scales.	MA Coastal Zone Management classified the seafloor into the following categories: flats, sloping plains, steeply sloping plains, crests, and depressions. Input data are 30m bathymetry. BTM results have been combined with rugosity and sediment types to produce a seafloor map of unique abiotic potential habitat types.	Yes
Current (surface and bottom)	Chen et al. (UMass Dartmouth)	Current regime data are necessary to model maximum-near bed stress, a shearing force per unit area exerted on the seabed by water movements above the seabed. Currents have a strong influence on both the character of the water column (temperature, frontal probability, and salinity) and the seabed (sediment type, formation of surface features such as sand waves and ripples) and the biological communities it supports.	Derived data received Nov. 21; needs assessment and synthesis	No
Depth	Various National Oceanographic and Atmospheric Administration, compiled by the MA Office of Coastal Zone Management	Increasing depth brings greater stability (in terms of temperature, salinity, and wave action) and greater pressure, both parameters to which biological communities respond.	Complete. 30m based on both higher and lower resolution data. Derived products will be used for abiotic seafloor habitat analysis.	Yes
Frontal Probability	United States Geologic Survey	Fronts are an important zone of rapid change in hydrographic and biological character. The frontal probability density function can be defined as the number of days the horizontal temperature difference between neighboring modeled locations exceeds 0.5ºC, divided by the number of days in this season over the 15-year run. CZM has 12 grids which show the monthly averages of the SST frontal probability (percent) for 1985-2000.	Draft provided by Rich Signell, used for visualization purposes. No rationale and/or methodology was established by the workgroup to include frontal probability in subsequent analysis.	No

Habitat Parameter	Source	Summary	Status / Comments	Final Usage
Maximum near-bed stress	Chen et al. (UMass Dartmouth)	Near-bed stress (i.e. bottom current) is modeled from bottom current and waves and has a strong influence on both the character of the seabed (sediment type, formation of surface features such as sand waves and ripples) and the biological communities it supports.	Derived data received Nov. 21; needs assessment and synthesis	No
Photic Depth	Insufficient data identified in the ocean planning area.	Photic depth determines the depth to which macroalgae (e.g. kelp) can grow. It is widely cited in the scientific literature that the lower limit of the infralittoral zone is broadly correlated with the depth at which available light is 1% of surface irradiance.	Can be derived from bathymetry.	No
Rugosity index	MA Office of Coastal Zone Management	Rugosity is a measure of seafloor complexity and is indicative of the amount of habitat available for colonization by epibenthic organisms and shelter and foraging area for mobile organisms. CZM calculated rugosity with an algorithm developed by Sappington et al. 2005 that measures vector dispersion in three dimensions.	Complete. Input data are 30m bathymetry. Rugosity data have been combined with BTM results and sediment types to produce a seafloor map of unique abiotic potential habitat types.	Yes
Salinity (surface to bottom)	Chen et al. (UMass Dartmouth)	The salinity regime, which varies from brackish and estuarine through to fully marine in Massachusetts waters, has a marked influence on the character of the pelagic biological communities.	Derived data received Nov. 21; needs assessment and synthesis	No
Sea surface height	Chen et al. (UMass Dartmouth)	Identifies large areas of surface fluctuations (primarily tides).	Derived data received Nov. 21; needs assessment and synthesis	No
Secondary productivity	Insufficient data identified in the ocean planning area.	Secondary productivity is generally defined as the planktonic animals that consume primary productivity.	Insufficient data identified in the ocean planning area.	No
Sediment Depth	U.S. Geologic Survey	Sediment depth data shows the total thickness of sediment that overlies bedrock. Sediment depth has important implications for benthic infaunal communities.	Available from approximately MA-NH line to northern Cape Cod Bay in Open File reports. The dataset was not used as it was not synoptic and no methodology was established by the workgroup to include sediment depth in subsequent analysis.	No

Habitat Parameter	Source	Summary	Status / Comments	Final Usage
Sediment Type	MA Office of Coastal Zone Management - MA Division of Marine Fisheries	Seabed sediments have important implications for benthic biological communities many of which have substratum preferences.	CZM and DMF have developed an interpolated seabed sediment map from USGS usSEABED grab sample data. Sediment types are based on a "linearized" Folk diagram in which all sediment is classed as mud, fine sediment, coarse sediment, and hard bottom. Sediment type results have been combined with BTM results and rugosity to produce a seafloor map of unique abiotic potential habitat types.	Yes
Stratification	Chen et al. (UMass Dartmouth)	A coupling of temperature (surface to bottom) and salinity (surface to bottom). Both salinity and temperature have major impacts on the abundance and distribution of species.	Derived data received Nov. 21; needs assessment and synthesis	No
Temperature (surface and bottom)	Chen et al. (UMass Dartmouth)	Surface to seabed temperature difference data can be used to distinguish classes which reflect the degree of stability in the water column.	Derived data received Nov. 21; needs assessment and synthesis	No
Wave base (Height and Period)	Chen et al. (UMass Dartmouth)	Wave height is used to calculate wave base, defined as the maximum depth to which the passage of a wave causes motion in the water column (equal to half the wave length). Below the wave base the water remains stationary as the wave passes. The wave base therefore distinguishes between shallower disturbed waters and deeper undisturbed waters. The maximum wave base, as measured over a period of years, can therefore be used to define a shallower zone of periodically-disturbed seabed and a deeper zone of undisturbed seabed.	Derived data received Nov. 21; needs assessment and synthesis	No
Wind stress	Chen et al. (UMass Dartmouth)	Wind stress data are needed to model waves and bottom stress.	Derived data received Nov. 21; needs assessment and synthesis	No

Section 4.5. Track 3 datalayer integration

Seafloor terrain, rugosity, and seafloor sediments (interpolated from usSEABED) datalayers were combined, creating 56 unique combinations of seafloor habitat classes within the planning area. Appendix B contains a map (Figure 21) of all of the derived seafloor classes. A heterogeneity index was then calculated based on the number of unique abiotic habitat classes that occurred within each 250 m^2 grid block of the planning area. The grid cell values of the heterogeneity index ranged from

0 to 19 and were reclassified into quartiles to define areas of no, low, medium, and high habitat class variety (Table 11). Figure 22 in Appendix B shows the reclassified data as a map: "*Important abiotic habitat: seafloor heterogeneity*".

Table 11. Abiotic data integration: seafloor habitat classes reclassification by quartiles

Grid Cell Raw Seafloor Classes	Quartile Reclassification Class
1	Low
2	Medium
3-4	High
5-19	Critical

Section 4.6. Track 2 and 3 datalayer integration

The reclassified (quartile) values from the unranked datalayer integration from Tack 2 (Important Biotic Habitat; Figure 17) and from the reclassified seafloor classes (Seafloor habitat heterogeneity; Figure 22) were combined. There were four grid cell values from each data layer (0 [low], 1 [medium], 2 [high], and 3 [critical]). The resulting range of grid cell values was 1 to 6, and the resulting datalayer was reclassified into quartiles (Table 12). The final integrated map was generated: "*Combined Track 2(Biotic) and Track 3 (Abiotic) Important Habitat*" which is displayed in Figure 23 in Appendix B.

Table 12. Biotic and abiotic datalayer integration: combined value reclassification by quartiles

Grid Cell Combined Values	Quartile Reclassification Class
0	Low
1-2	Medium
3	High
4-6	Critical

Section 5. Ongoing matters and questions

Data limitations

Because of the limitations inherent to certain datasets, the ability to utilize many important parameters in ocean management and planning is restricted, and certain datasets were not utilized in the assessment included in this draft report. A good example of this is sea turtle data. Five state and federally endangered and threatened sea turtle species utilize areas within the Massachusetts ocean planning area as critical habitat for their life history requirements (Loggerhead Sea Turtle, Green Sea Turtle, Hawksbill Sea Turtle, Kemp's Ridley Sea Turtle, and Leatherback Sea Turtle). The data that the Work Group was able to identify either was extremely limited in spatial extent, limited in temporal duration, or was part of research or monitoring that is currently underway. The issue of using partially complete or in-progress data is discussed further below in "potential" habitat.

The issue of data quality came up repeatedly in discussions of habitat mapping. Datasets with different spatial coverage and data collection methods were utilized to establish the "best available data" layers for the habitat analyses. In all cases, there are easily identified gaps. For both the whale sitings data and the sediment composition data, data quality assessments were conducted. These assessments have yet to be integrated into a consideration of the reliability of the resulting grids.

Habitat outside planning area

As with other Work Groups, there was considerable concern and discussion about the difficulties and limitations that the planning area boundary presents for addressing important habitat outside its boundary. Examples include: MESA-listed species habitats (e.g., nest and staging areas for listed terns that includes shorelines which are very close to, but excluded from, the planning area and other islands that do occur in the planning area), diadromous fish species runs, and significant eelgrass areas, all of which are located landward of the nearshore planning boundary. Similarly, on the seaward side, significant state uses and resources are closely tied to marine habitat structure and function in federal waters.

"Potential" habitat

The issue of "potential" habitat came up many times in the Work Group process. It was discussed in three ways:

1. Using incomplete data (partial spatial coverage; studies in progress);
2. Applying surrogate parameters (mostly abiotic) to "model" suitable habitat areas for specific biota by applying knowledge about likely species/habitat associations; and
3. Non-stationary habitat: includes areas where conditions currently exist to support specific biota but they are not found or data does not exist to document utilization, or habitat areas that could exist in the foreseeable future due to intervention of management action (e.g., improved water quality or curtailed physical disturbance).

The Work Group agreed that inclusion of "potential" habitat into the ocean planning dialogue could help to designate where critical habitats occur today and also to illustrate where they are likely to occur in the future, either naturally, in response to climate change, or as the result of proactive or mitigation restoration efforts.

Certain data sets, such as those documenting the range of sea turtles using satellite telemetry methods, were extremely difficult to use in developing habitat maps of the entire planning area since

the data was not collected systematically and is not comprehensive in nature. As the Commonwealth will not be able to have comprehensive and robust data sets for all marine species and habitats, discussion is warranted as to how partial information can be used as a starting place in the absence of other information. For example, sea turtle telemetry data can be used to map locations of prey availability, so that we can better understand trophic relationships between species and the habitats which they frequent.

Some marine habitats are ephemeral and move over time. While documenting where existing habitats are today is critical for management, of equal importance is ensuring there is enough available space for habitats to shift over time, especially in consideration of long-term climate change impacts. Parameters to support habitat suitability indices should be mapped, so that areas of suitable bottom substrate, water quality and depth (using eelgrass as an example) can be taken into consideration when assessing compatible uses. Suitability models can also be used to designate prime restoration sites, which are important in restoration and in project-specific mitigation discussions.

In the habitat mapping field, there is a growing body of literature worldwide on likely species/habitat associations, where researchers have documented benthic/pelagic coupling to support a more ecosystem-based approach to management (e.g., west coast rockfish). In the absence of long-term empirical data, it is useful to consider what types of physical, chemical and geological factors certain important species need for various life stages. As a national leader in seafloor mapping, the Commonwealth has a great opportunity to leverage available information about the benthic environment by continuing discussions about species that depend on it.

Section 6. Recommendations

1. Priority data needs

"Pending" data

While the Work Group was able to identify, acquire, and assess a considerable amount of data and information, there are some that were not available at the time of report submittal which could be brought into the ocean planning process. For example (as described above), derived data from the Northeast Coastal Ocean Forecast System (NCOFS) were just recently made available by Dr. Chen and associates at UMass-Dartmouth and WHOI. More time is needed to synthesize these data and discuss how they are incorporated. Further analysis could also be brought to bear on the Mass Audubon Bird Observer Database, and it may be possible to acquire or generate some derived spatial coverage for sea turtle species based on a combination of observations, strandings, and known habitat.

Habitat mapping, classification, and modeling

As described above and in Appendix C, there has been considerable progress through the CZM/USGS Seafloor Mapping Cooperative to use acoustic and other high-resolution technologies to characterize the seafloor. Following models from such efforts as the UKSeaMap project, the opportunity exists to couple the seafloor mapping work with other water column, seafloor, and seasurface parameters to develop a robust habitat classification system for Massachusetts waters (and beyond). From the physical habitat "maps", it is then possible to derive habitat classes, determine unique areas that can be linked to habitat requirements for specific species, and ultimately develop habitat suitability models. While such efforts will not be fully developed and available for the initial version of the comprehensive Ocean Plan, if given attention and resources, they could generate such a framework to inform future versions.

2. Compatibility analysis or determination

In the deliberations surrounding the determination of "important" habitat, the Habitat Work Group clearly recognized that the decision was certainly influenced by the possible impacts or adverse effects on the habitat by different "uses" in and outside of the ocean planning area. The Work Group understands that there are already efforts underway on compatibility determinations and acknowledges that it will be an important part of the planning process. The Work Group is available to help further develop such an analysis by providing expertise on habitat "interactions" with other uses or operations.

3. Establishment of an ocean monitoring and assessment network

Another element of the initial comprehensive Ocean Plan will be the development of a series of indicators (ecological, social, economic, etc.) to allow for a measure or assessment of plan implementation. Key habitat components must be included as part of this ocean monitoring and assessment network and, again, the Habitat Work Group is available to provide expertise.

4. Maintain a "standing" habitat work group for continued assistance

Considering that further work will be needed on outstanding issues such as resolving the issue regarding the incorporation of fisheries (nekton) data into the "important" habitat framework

and continuing to pursue the development of a robust ocean habitat mapping, classification, and modeling approach, the Habitat Work Group is available to continue its work either as an "ad-hoc" group or as specifically directed by EEA.

Appendix A:
Ocean planning area grid system

Appendix A: Ocean planning area grid system

To allow for consistent evaluation and comparison of a variety of datasets (within and between Work Groups) with distinct spatial resolutions, accuracies, and other characteristics, the ocean planning area was partitioned into two grid systems—a 250 m^2 grid and 1 km^2 grid (Figure 1). The 250 m^2 grid was designed for more detailed data, while the 1 km^2 grid was created for coarser data. To make these grids, the Create Raster Dataset tool was used in ArcGIS to create a raster with a 250 m^2 cell size. This raster was then trimmed to the ocean planning area. A 1 km2 grid was also created in ArcGIS using the same tool and snapping it to the 250 m^2 raster to ensure alignment between cells.

The Feature to Raster tool was used in ArcGIS to convert polygons to a grid. If a polygon occurred in the center of a cell, the raster cell received a value of 1; otherwise, the raster cell received a value of 0. It should be noted that one downside to using a standardized grid system, is that for some high-resolution datasets, by using the grid, you actually lose resolutions (accuracy).

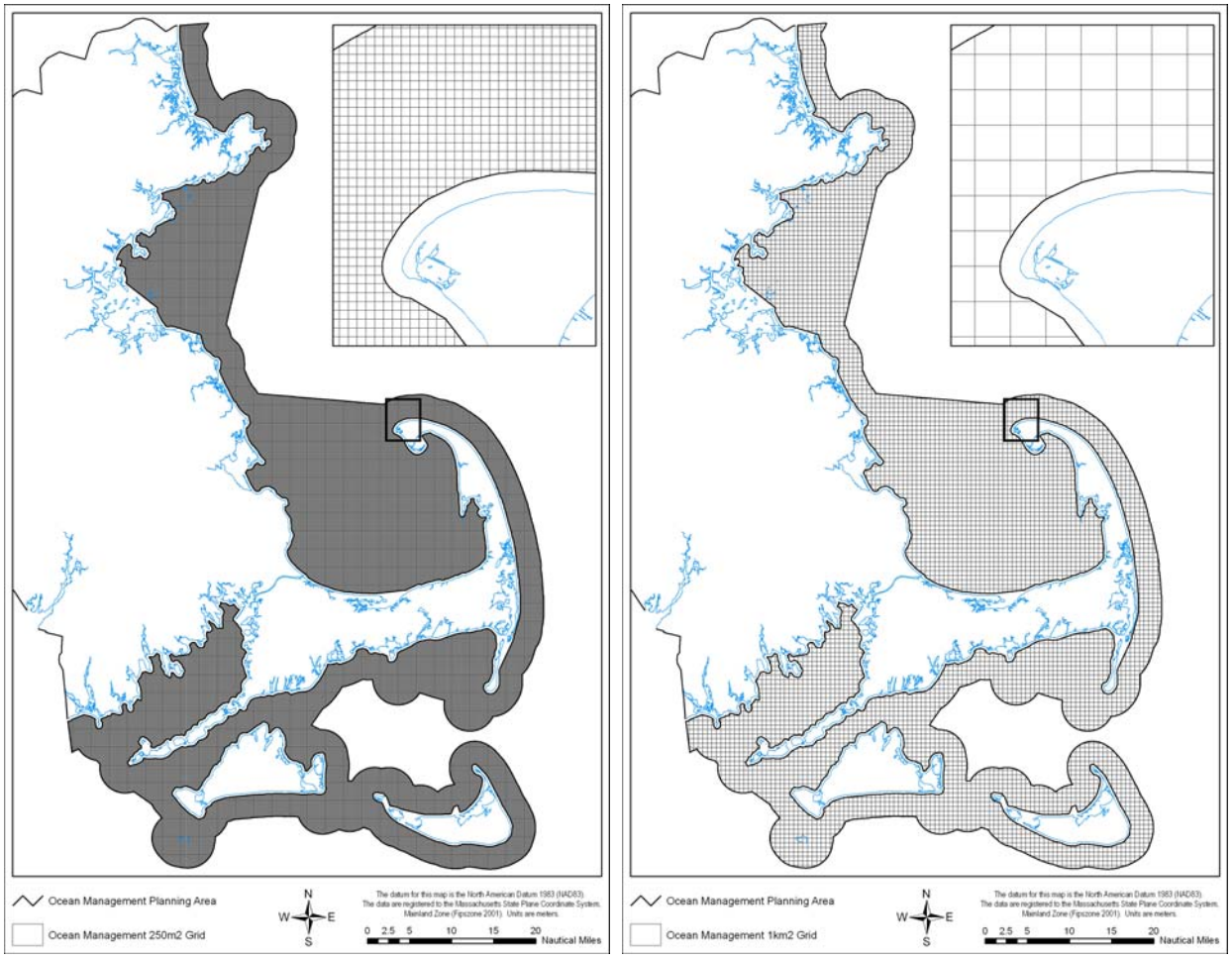

Figure 1. Grid system for ocean planning area: 250 m2 (left) and 1km2 (right)

Appendix B:
Report Figures (Maps)

Appendix B: Report Figures (Maps)

All of the maps referenced in the body of the report are contained here as figures in Appendix B. The following Table is an at-a-glance summary of these maps/figures. Shaded rows indicate integrated maps synthesizing selected datasets.

Figure	Description
Figure 2	Mapped areas/resources reference with special legal protection
Figure 3	North Atlantic Right Whale sitings distribution
Figure 4	Humpback Whale sitings distribution
Figure 5	Fin Whale sitings distribution
Figure 6	Sei Whale sitings distribution
Figure 7	Roseate Tern important habitat: breeding / staging
Figure 8	Roseate Tern important habitat: foraging
Figure 9	Least, Arctic, Common Tern important habitat: breeding / staging
Figure 10	Least, Arctic, and Common Tern important habitat: foraging
Figure 11	Leech's Storm Petrel important habitat: staging
Figure 12	Colonial nesting water bird important habitat
Figure 13	Long-tailed duck important habitat
Figure 14	Marine avifauna important habitat
Figure 15	Seal haul-out important habitat
Figure 16	Mapped eelgrass areas important habitat
Figure 17	Important biotic habitat (integrated by binary occurrence)
Figure 18	Important biotic habitat (integrated by ranked occurrence)
Figure 19	Benthic Terrain Modeler output
Figure 20	Rugosity output
Figure 21	Seafloor terrain, rugosity, and seafloor sediments: seafloor habitat classes
Figure 22	Important abiotic habitat: seafloor heterogeneity
Figure 23	Combined Track 2 (Biotic) and Track 3 (Abiotic) important habitat

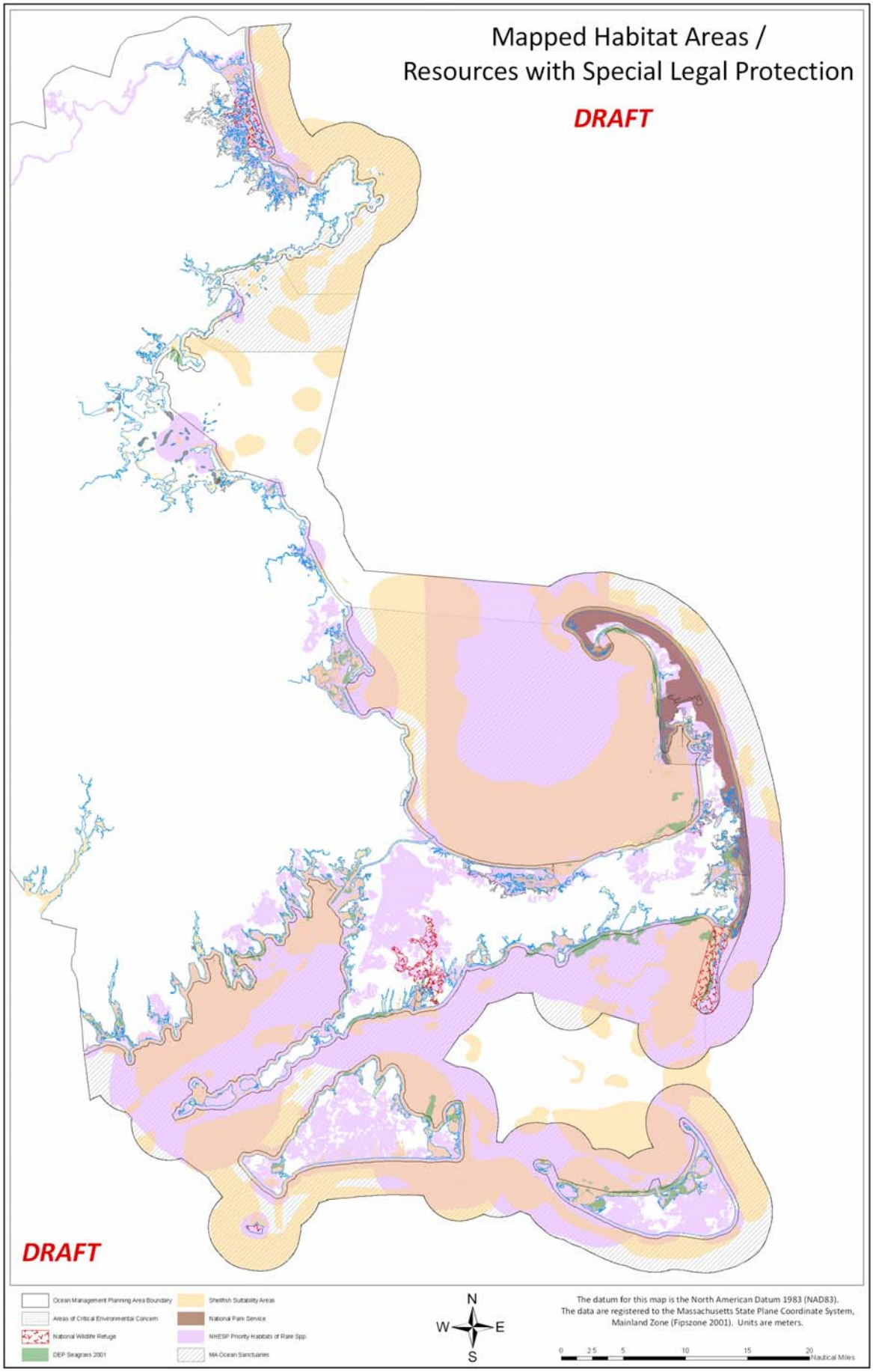

Figure 2. Mapped habitat areas / resources with special legal protection

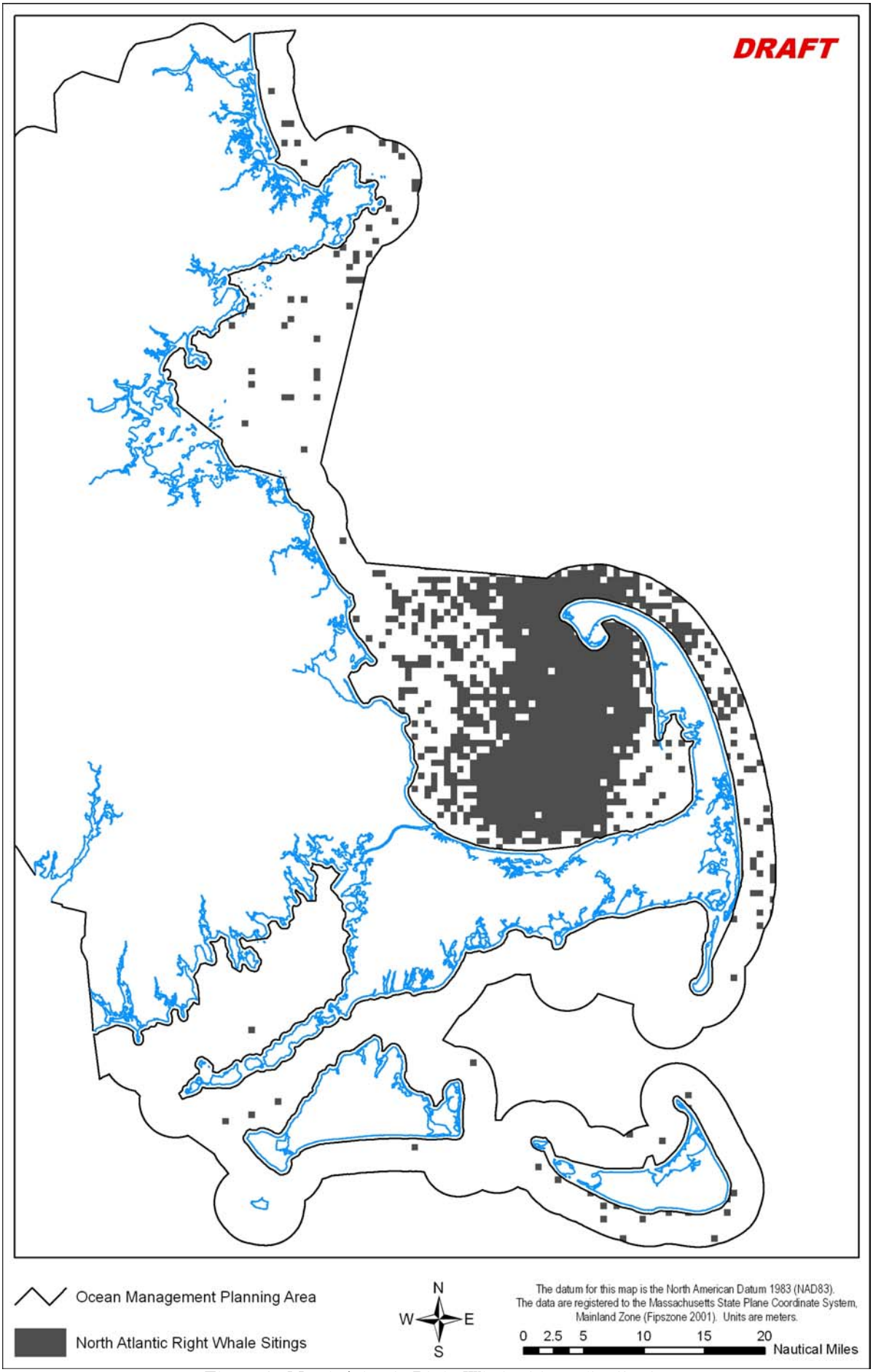

Figure 3. North Atlantic Right Whale sitings distribution

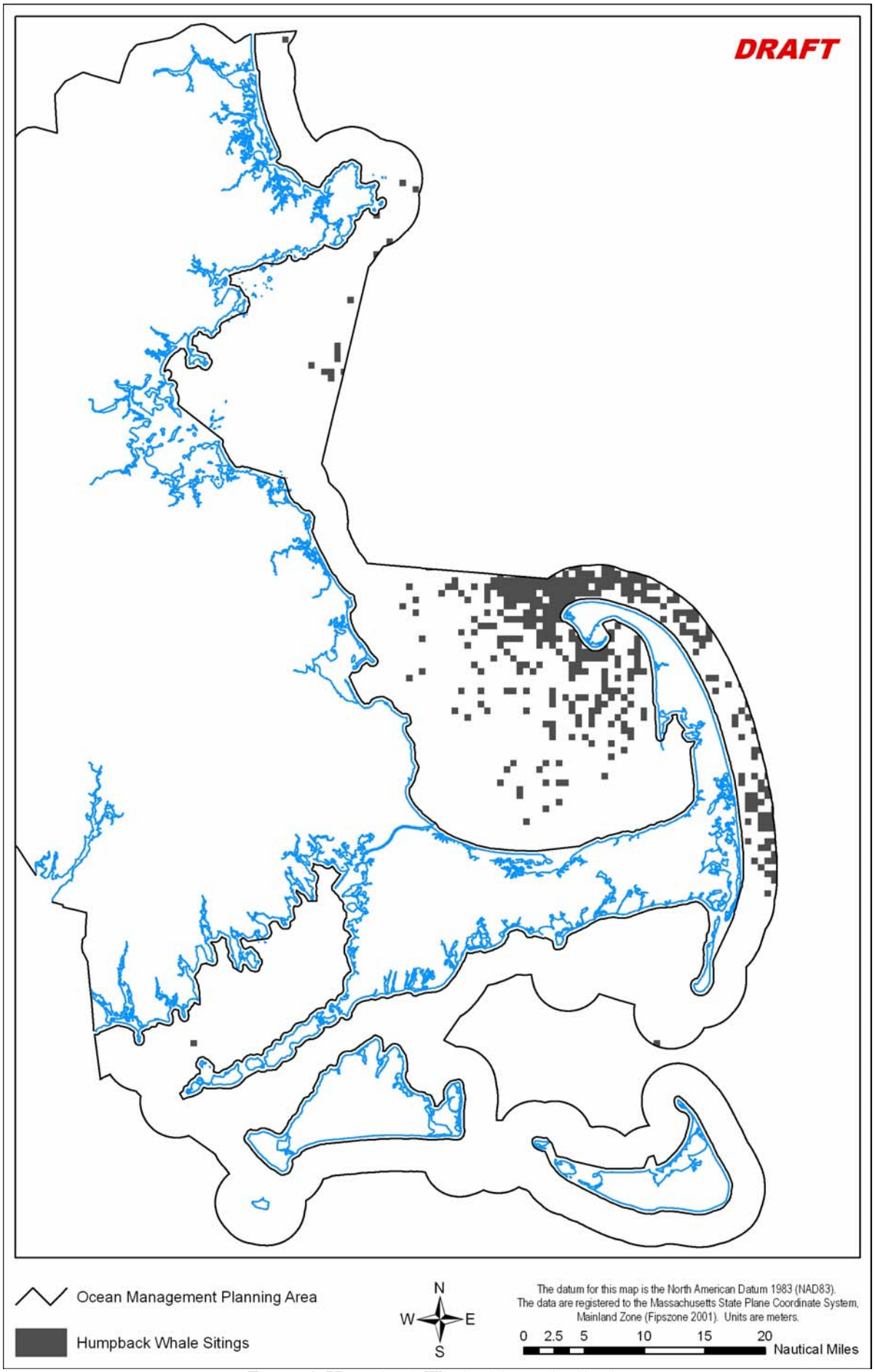

Figure 4. Humpback Whale sitings distribution

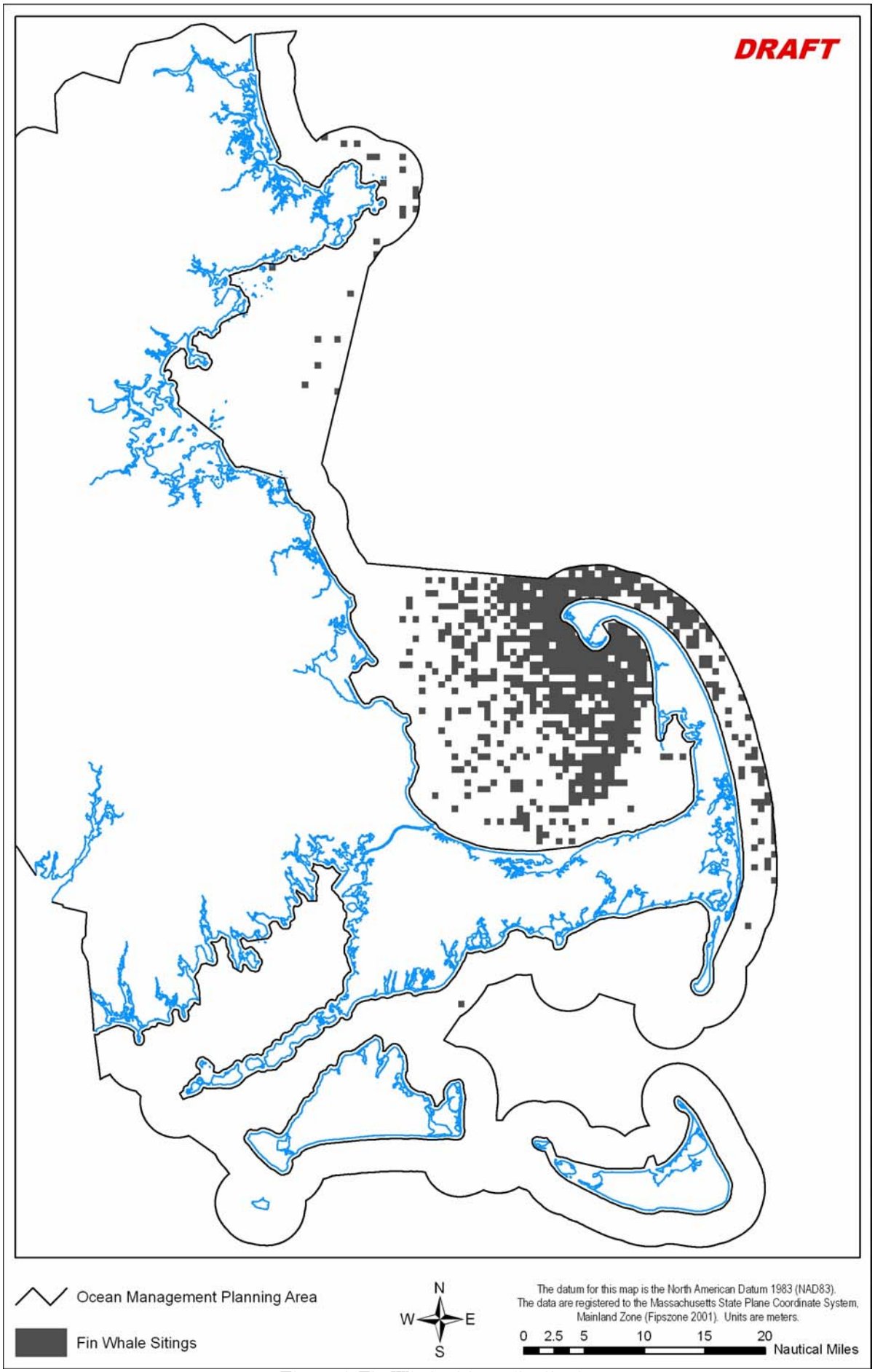

Figure 5. Fin Whale sitings distribution

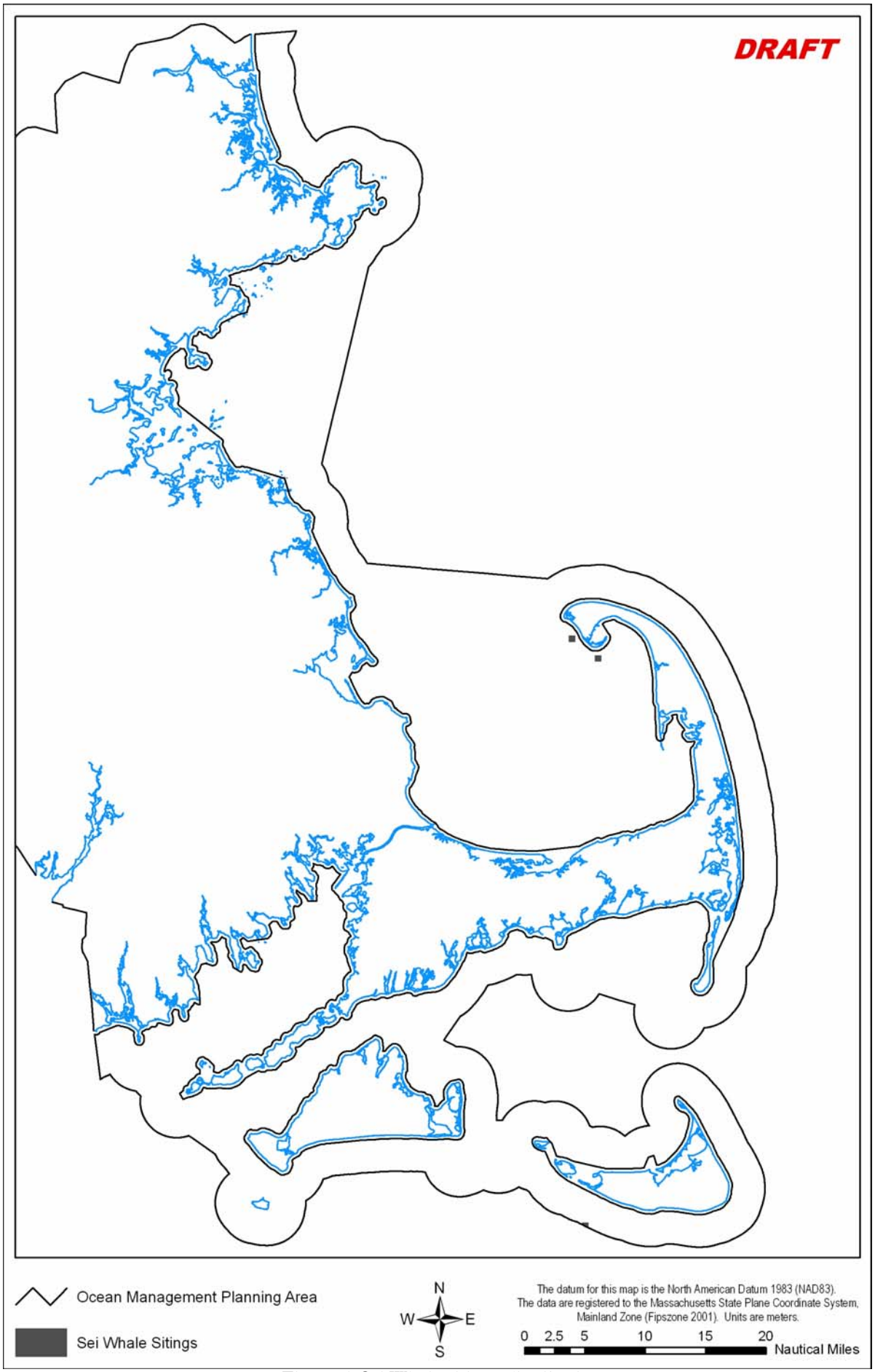

Figure 6. Sei Whale sitings distribution

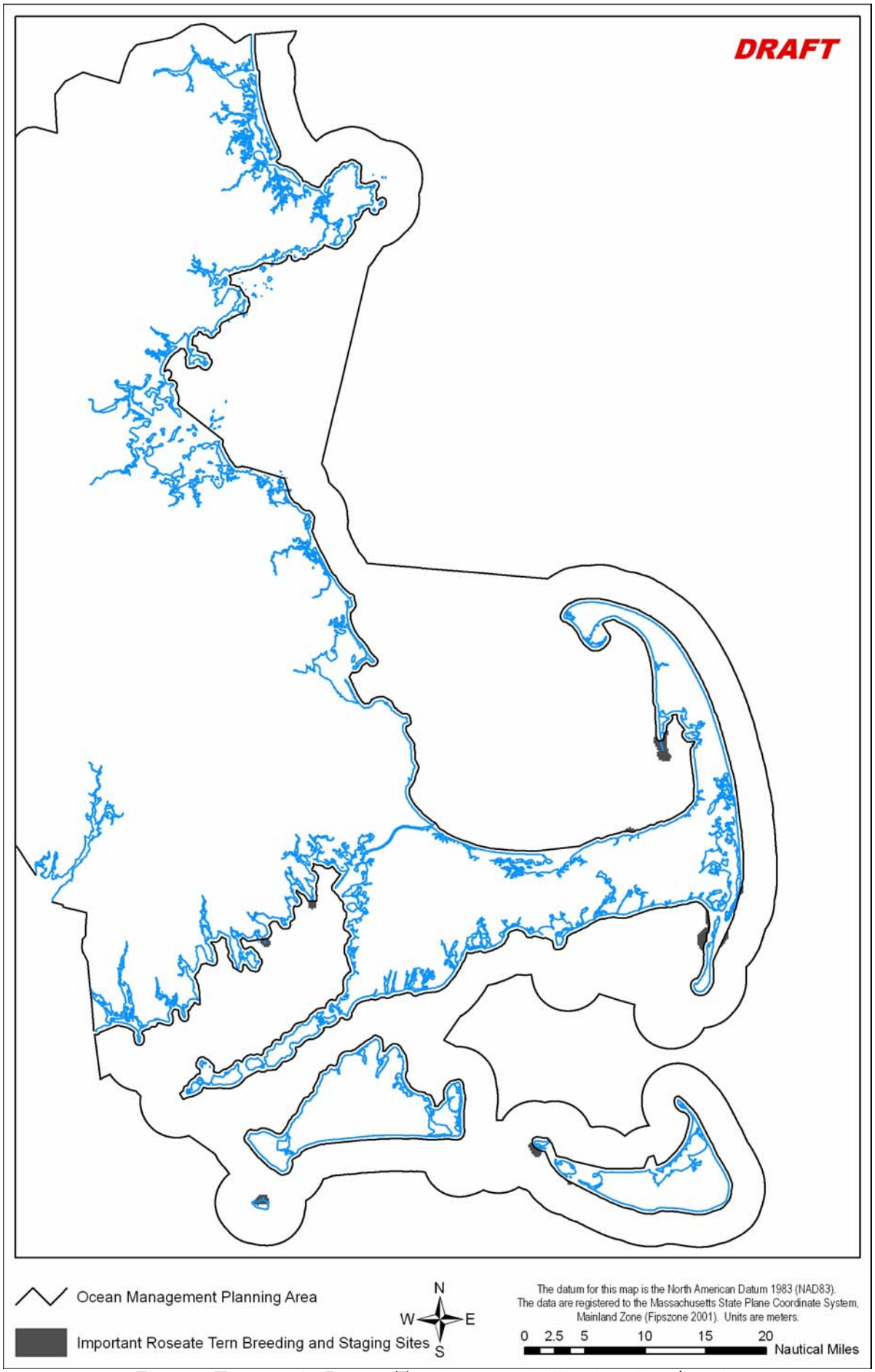

Figure 7. Key areas for Roseate Tern important habitat: breeding / staging

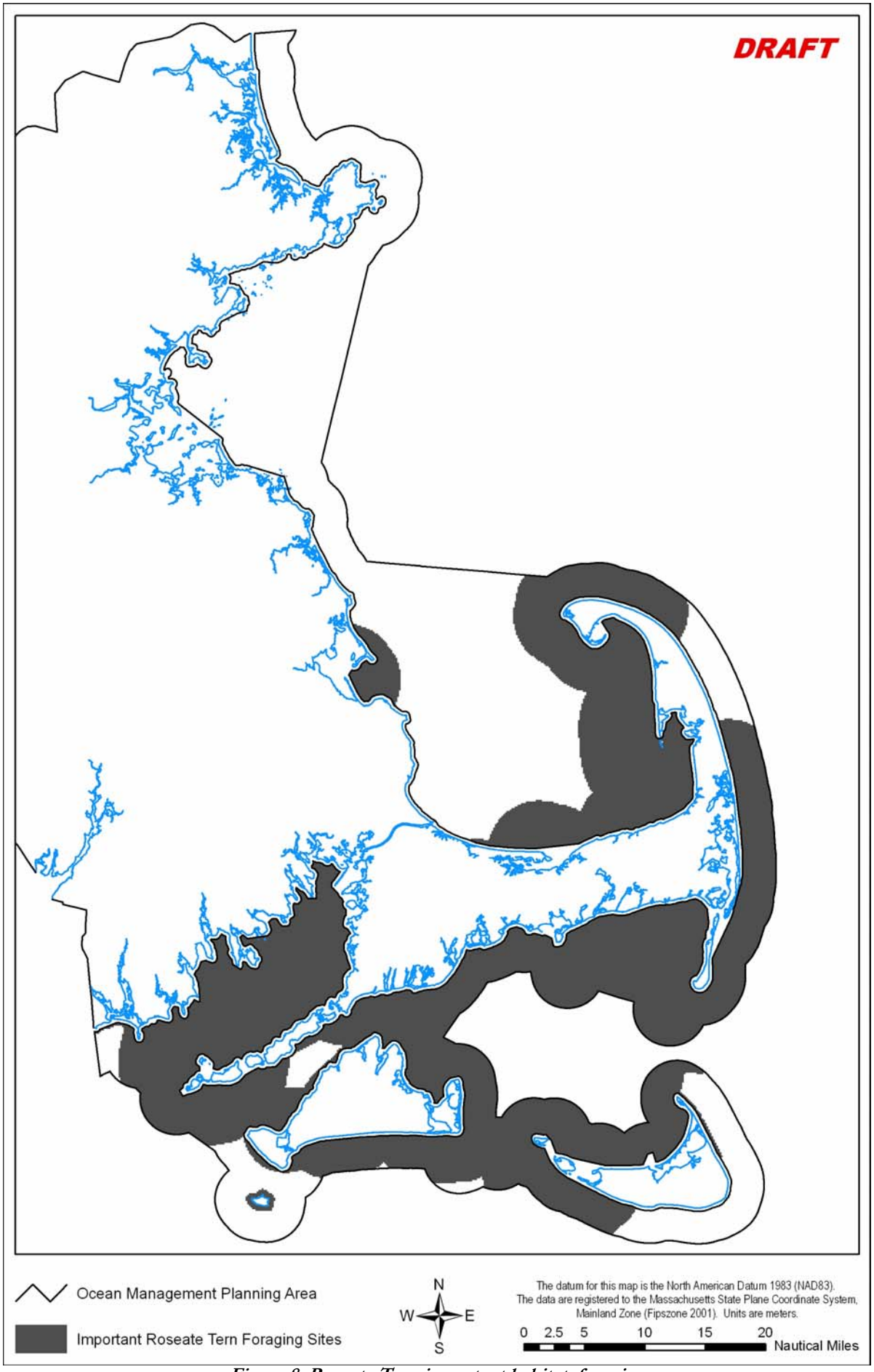

Figure 8. Roseate Tern important habitat: foraging

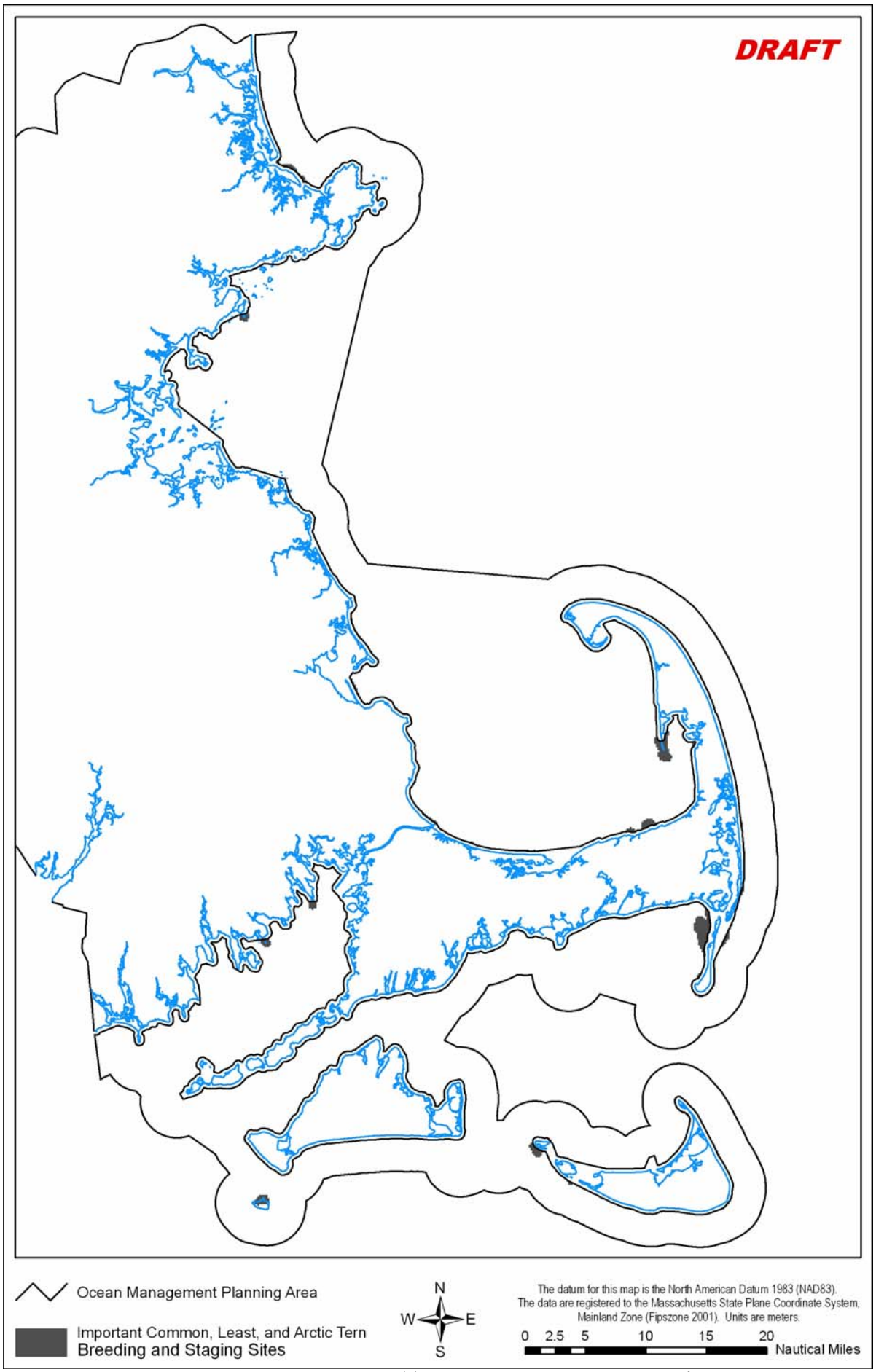

Figure 9. Least, Arctic, Common Tern important habitat: breeding / staging

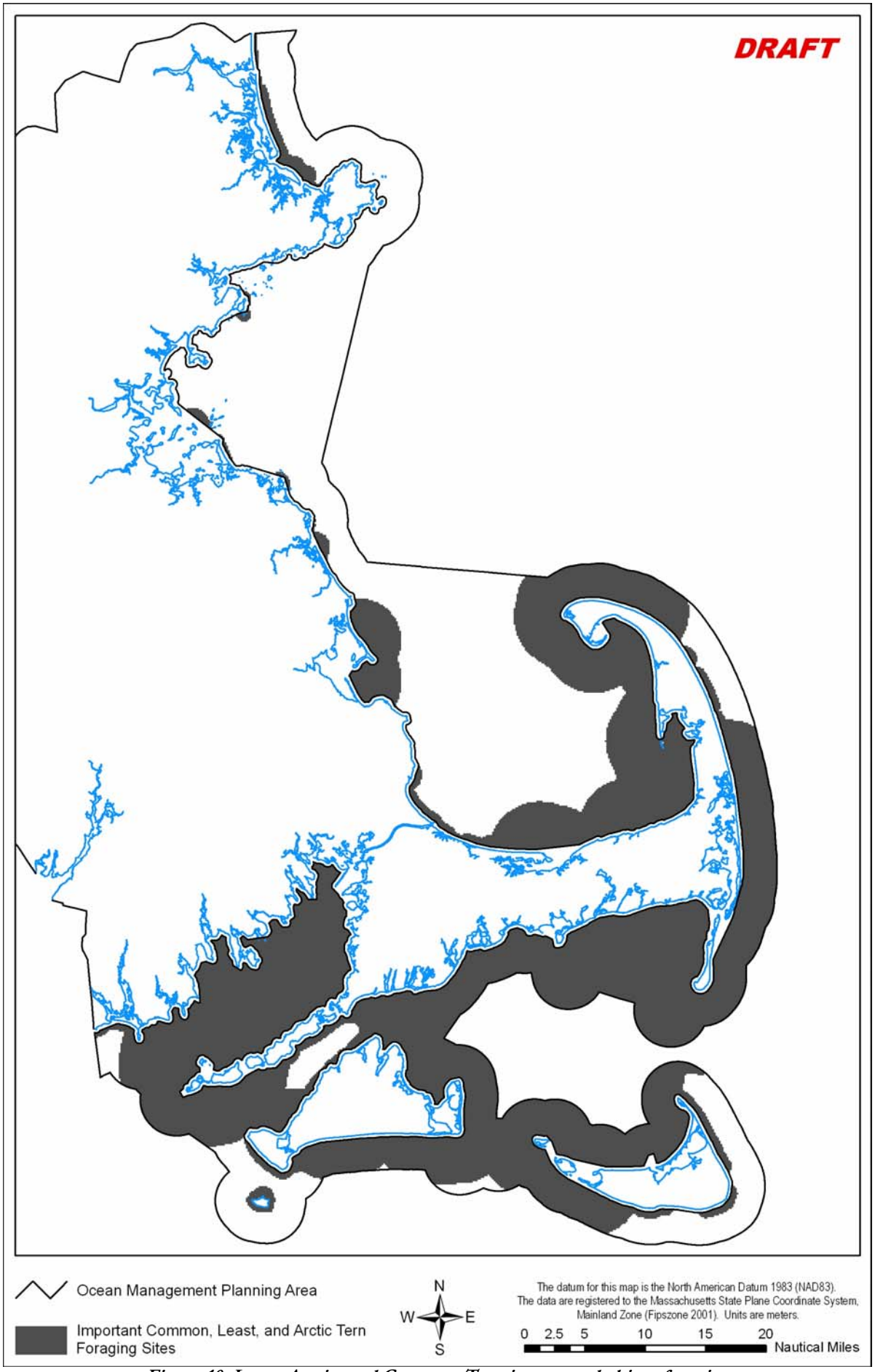

Figure 10. Least, Arctic, and Common Tern important habitat: foraging

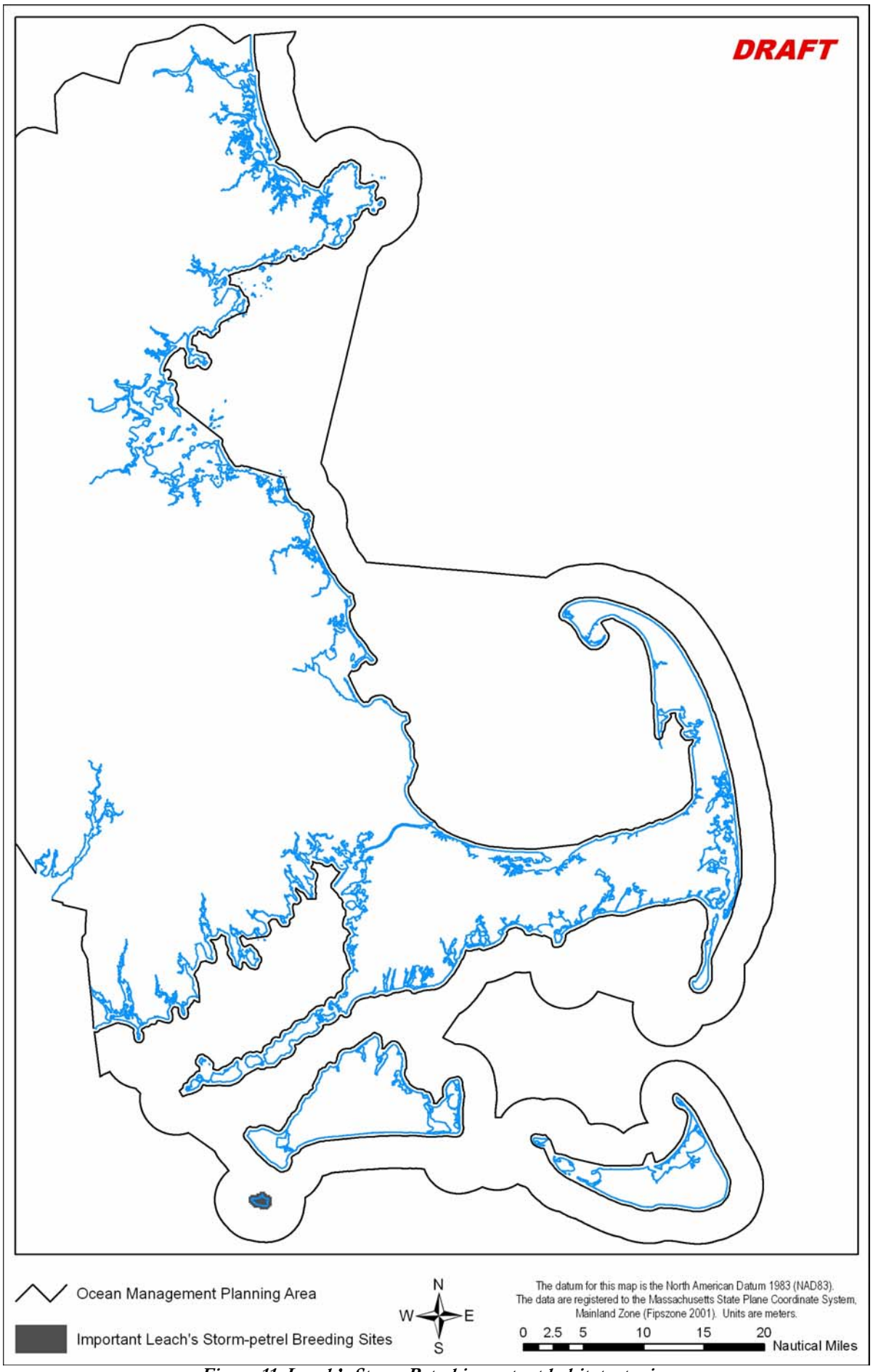

Figure 11. Leech's Storm Petrel important habitat: staging

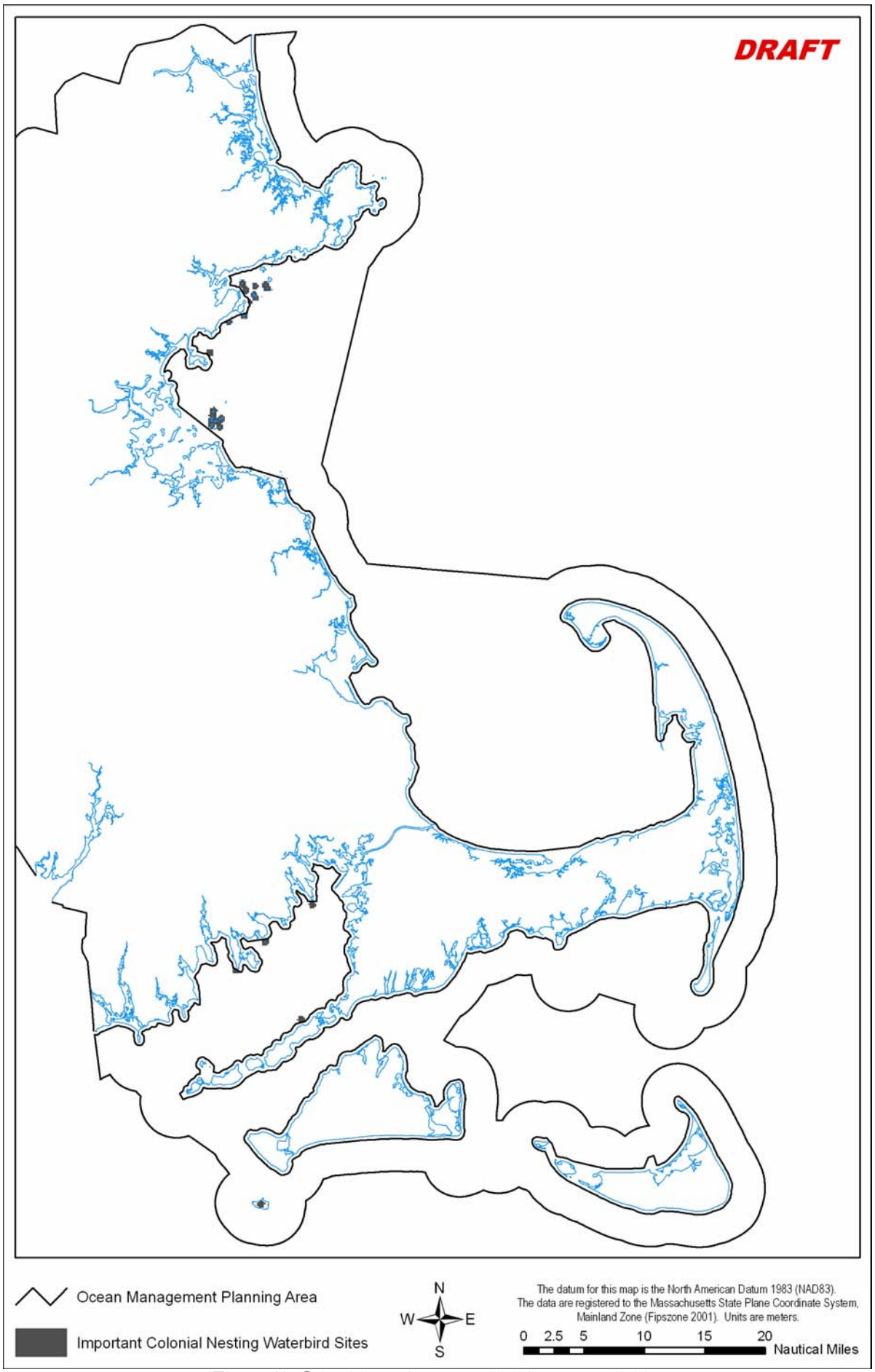

Figure 12. Colonial nesting water bird important habitat

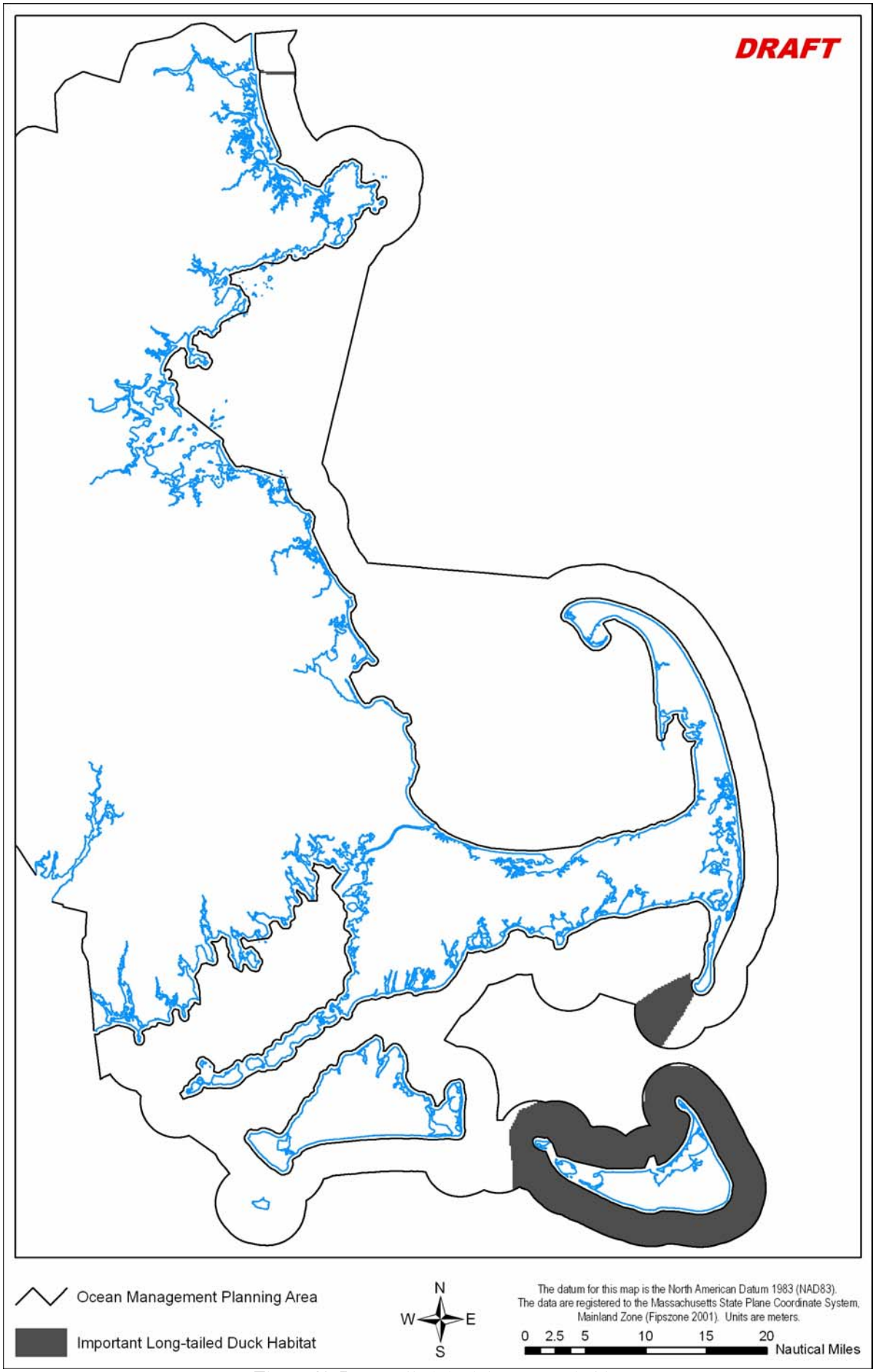

Figure 13. Long-tailed duck important habitat

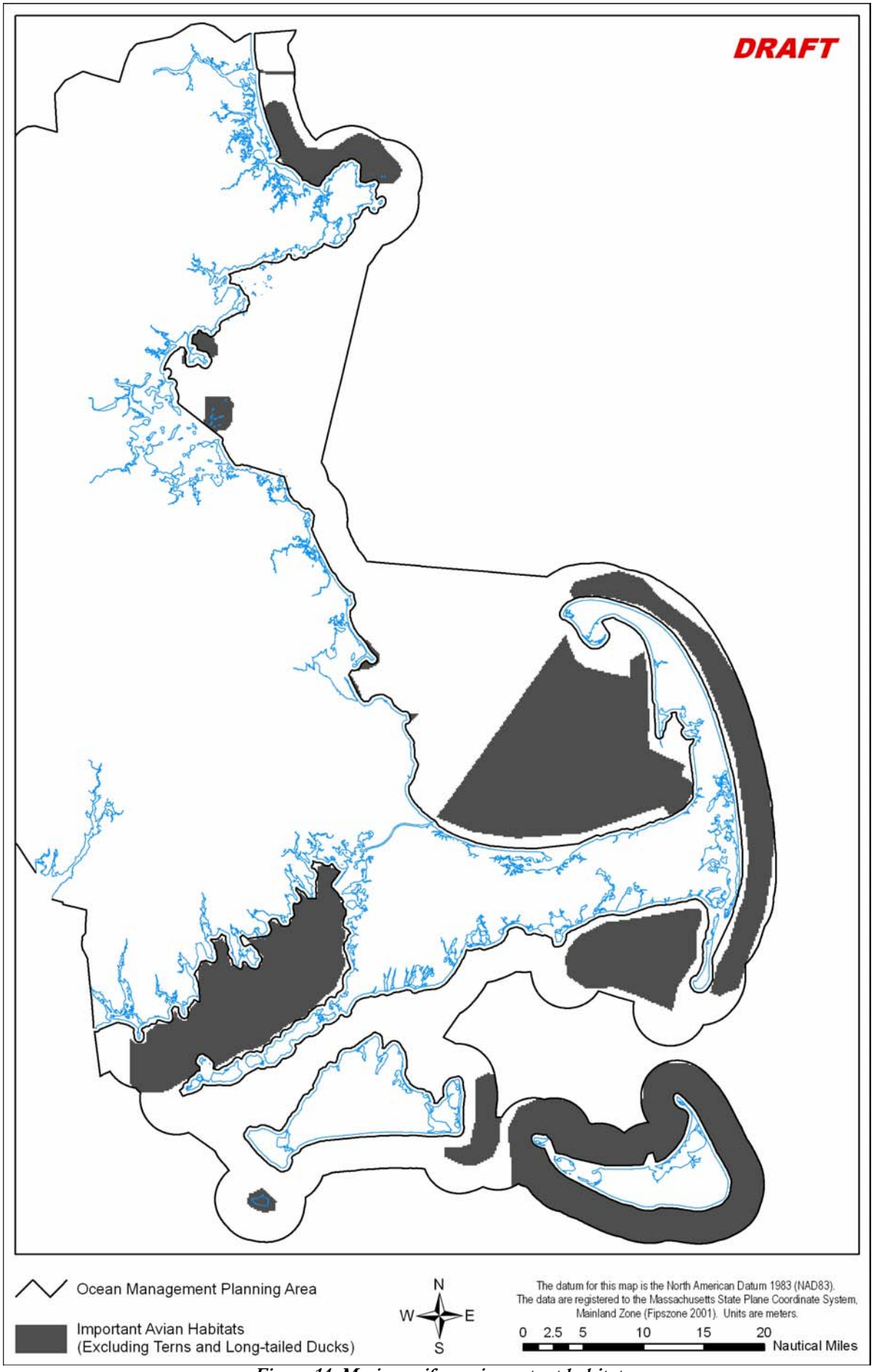

Figure 14. Marine avifauna important habitat

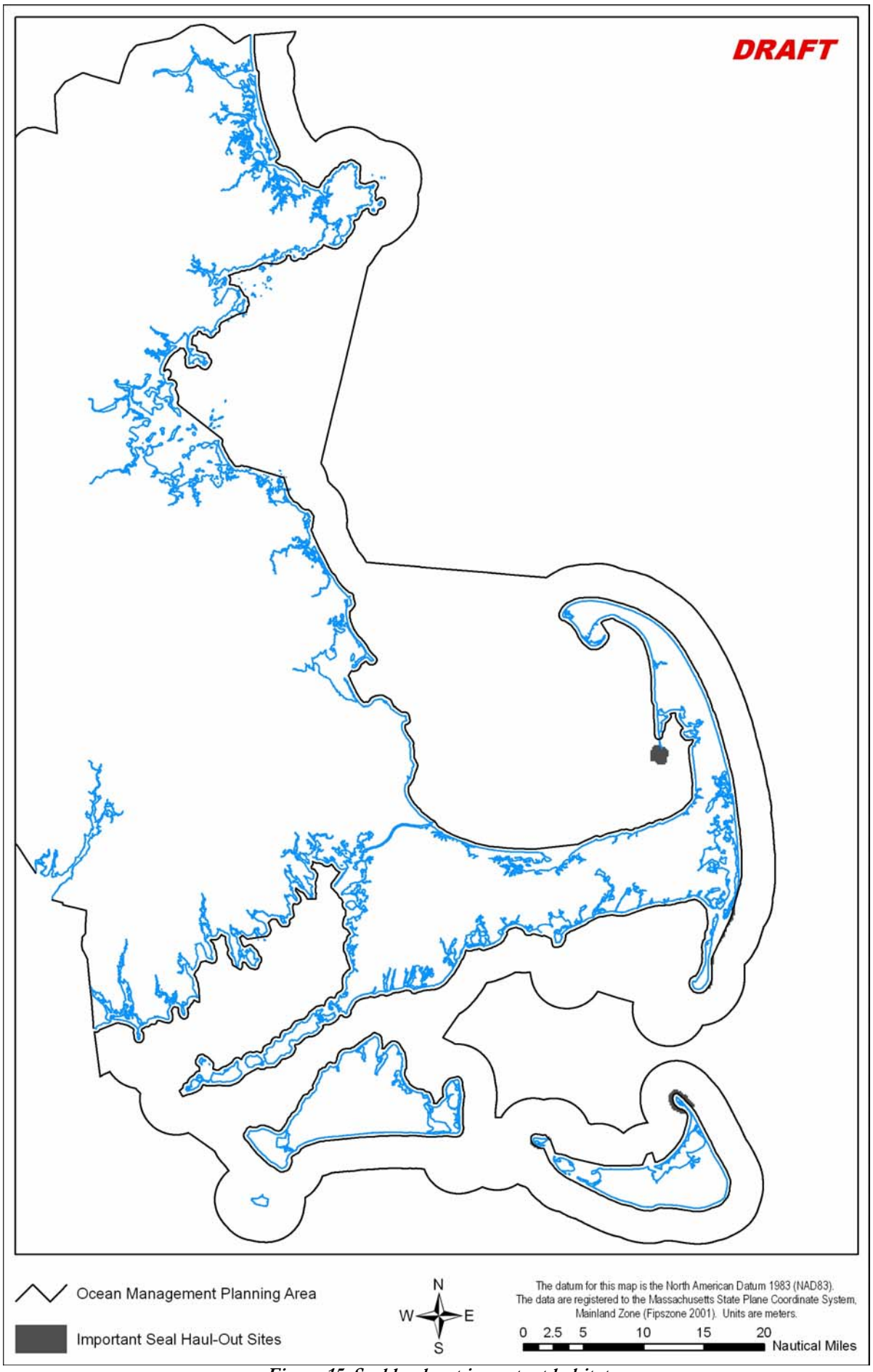

Figure 15. Seal haul-out important habitat

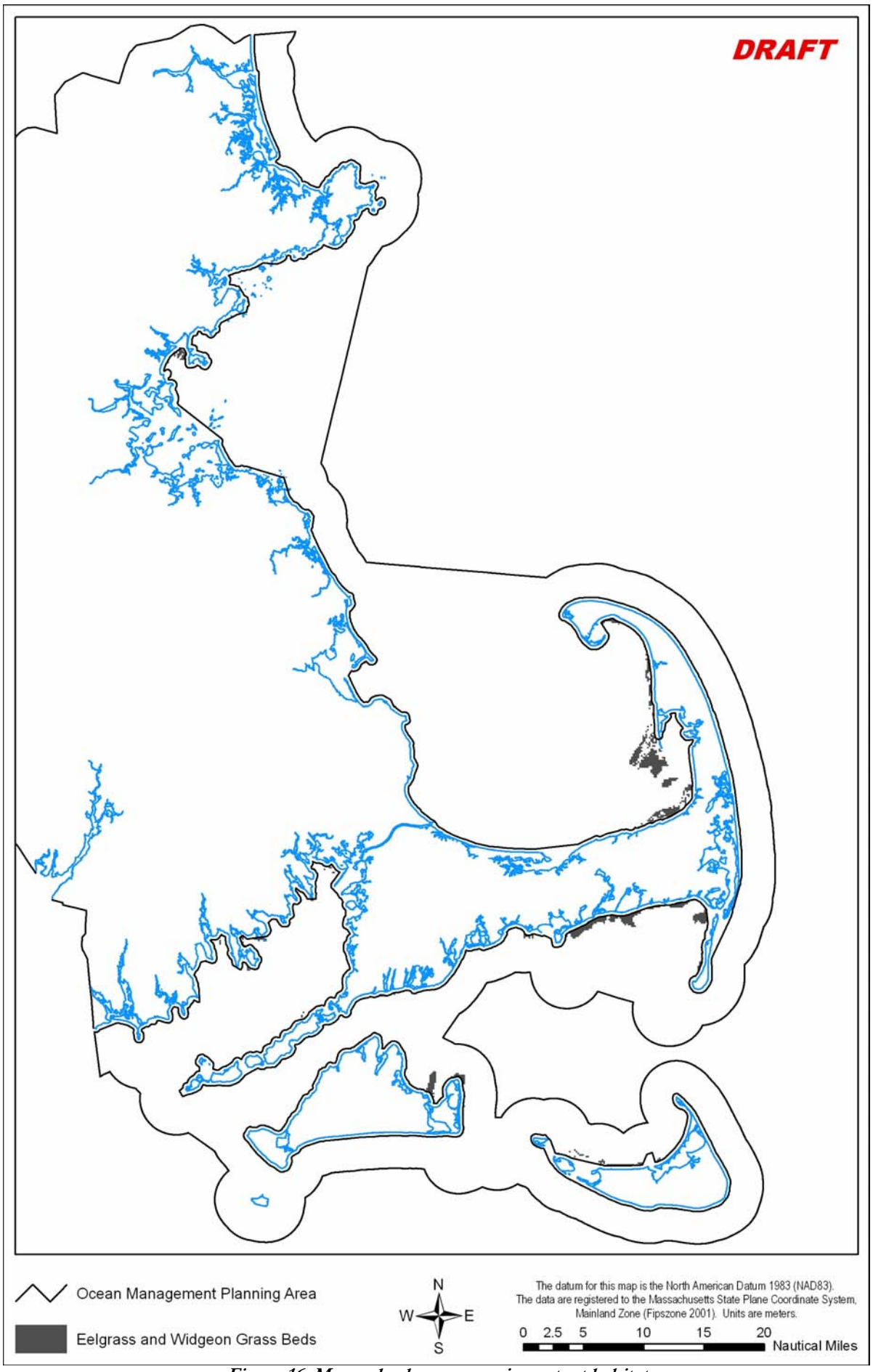

Figure 16. Mapped eelgrass areas important habitat

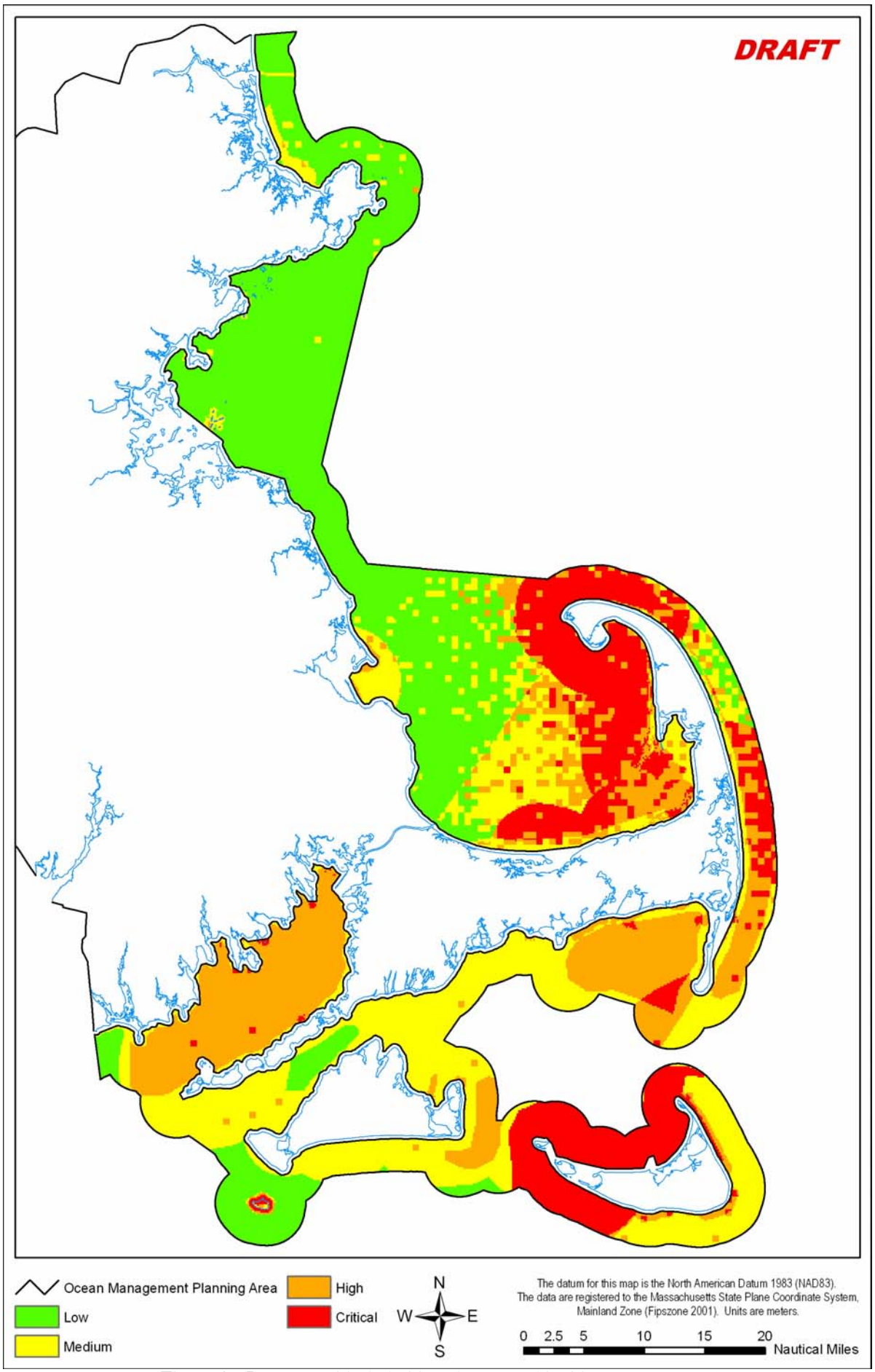

Figure 17. Important biotic habitat (integrated by binary occurrence)

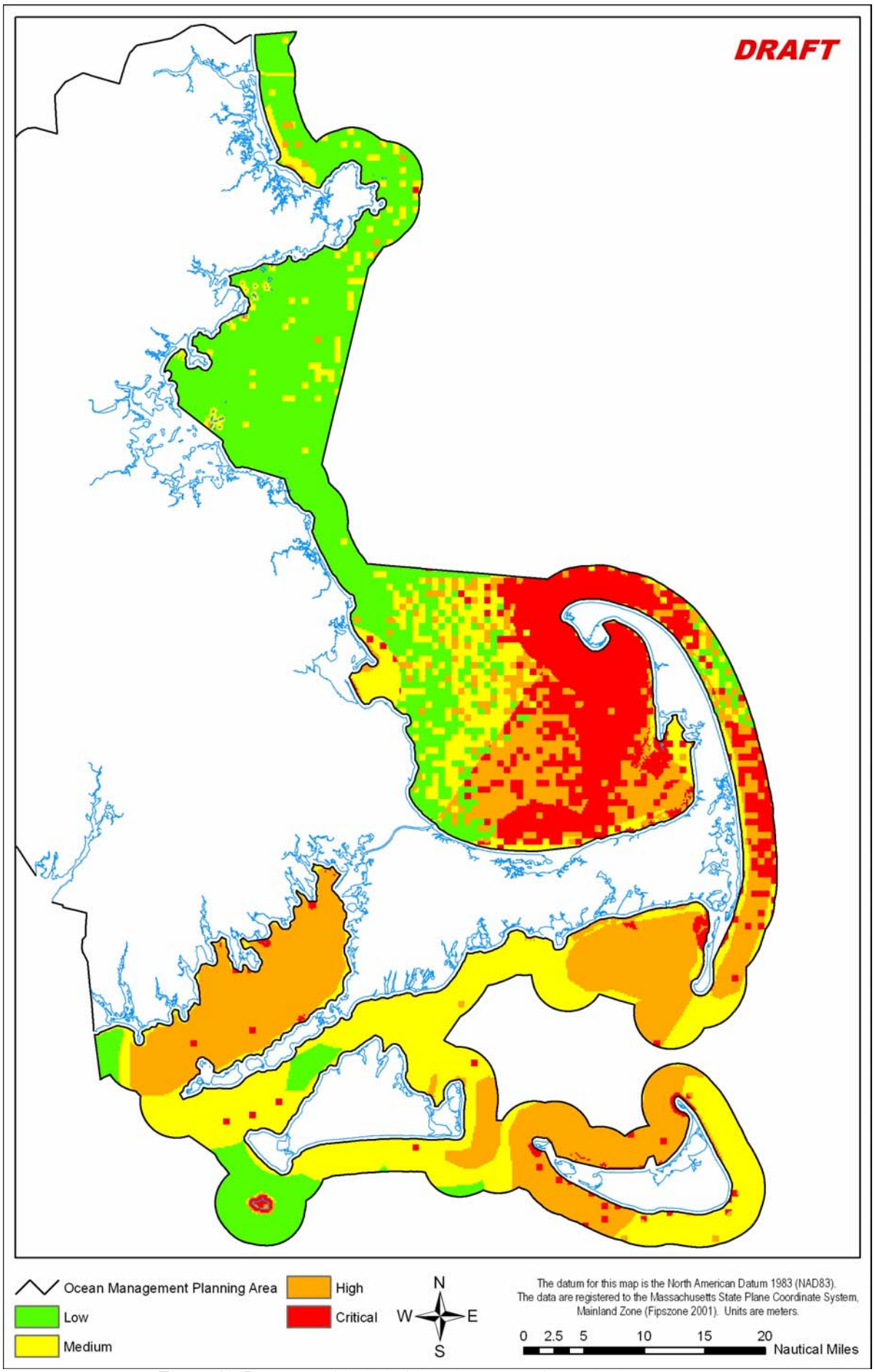

Figure 18. Important biotic habitat (integrated by ranked occurrence)

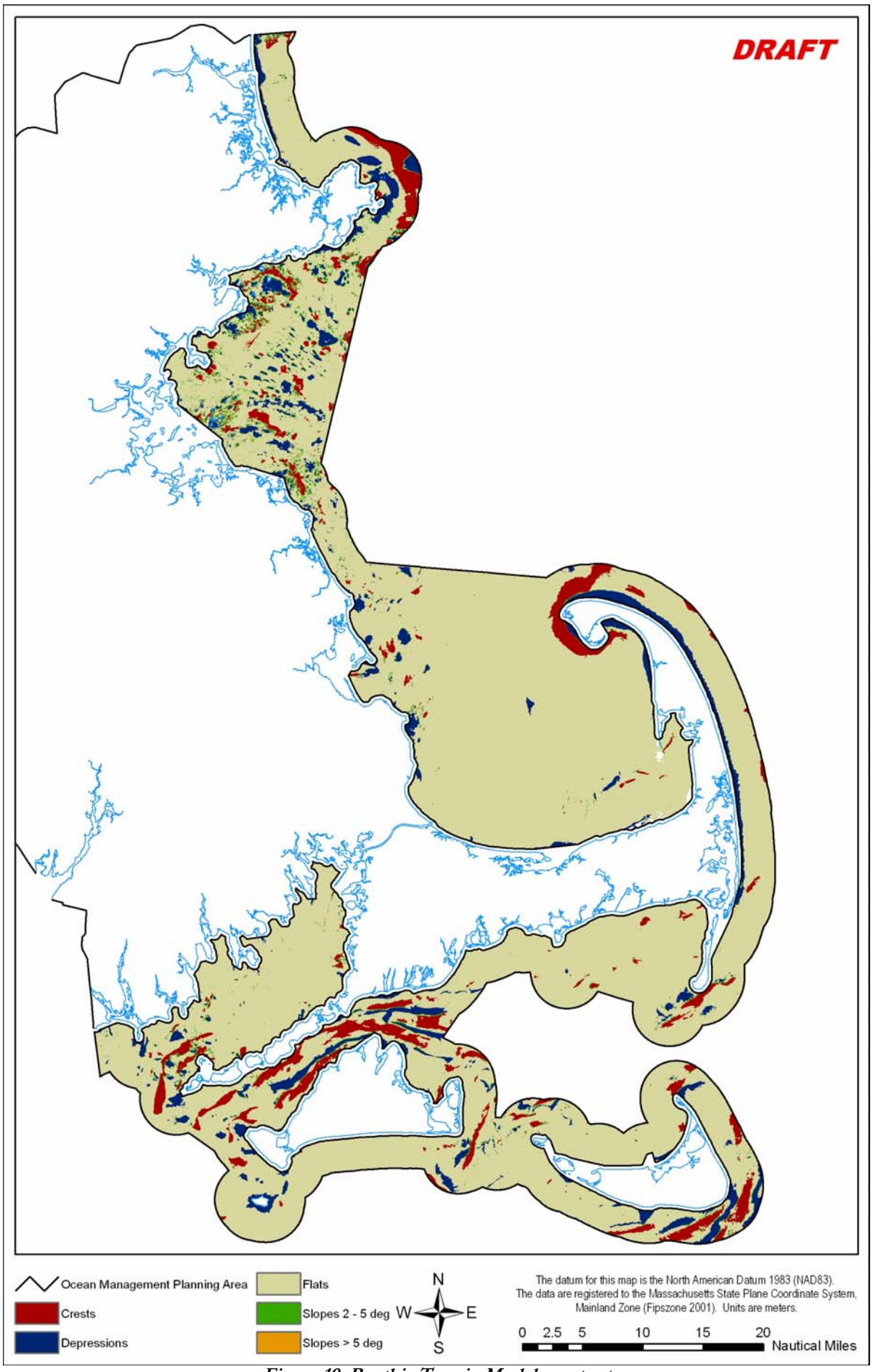

Figure 19. Benthic Terrain Modeler output

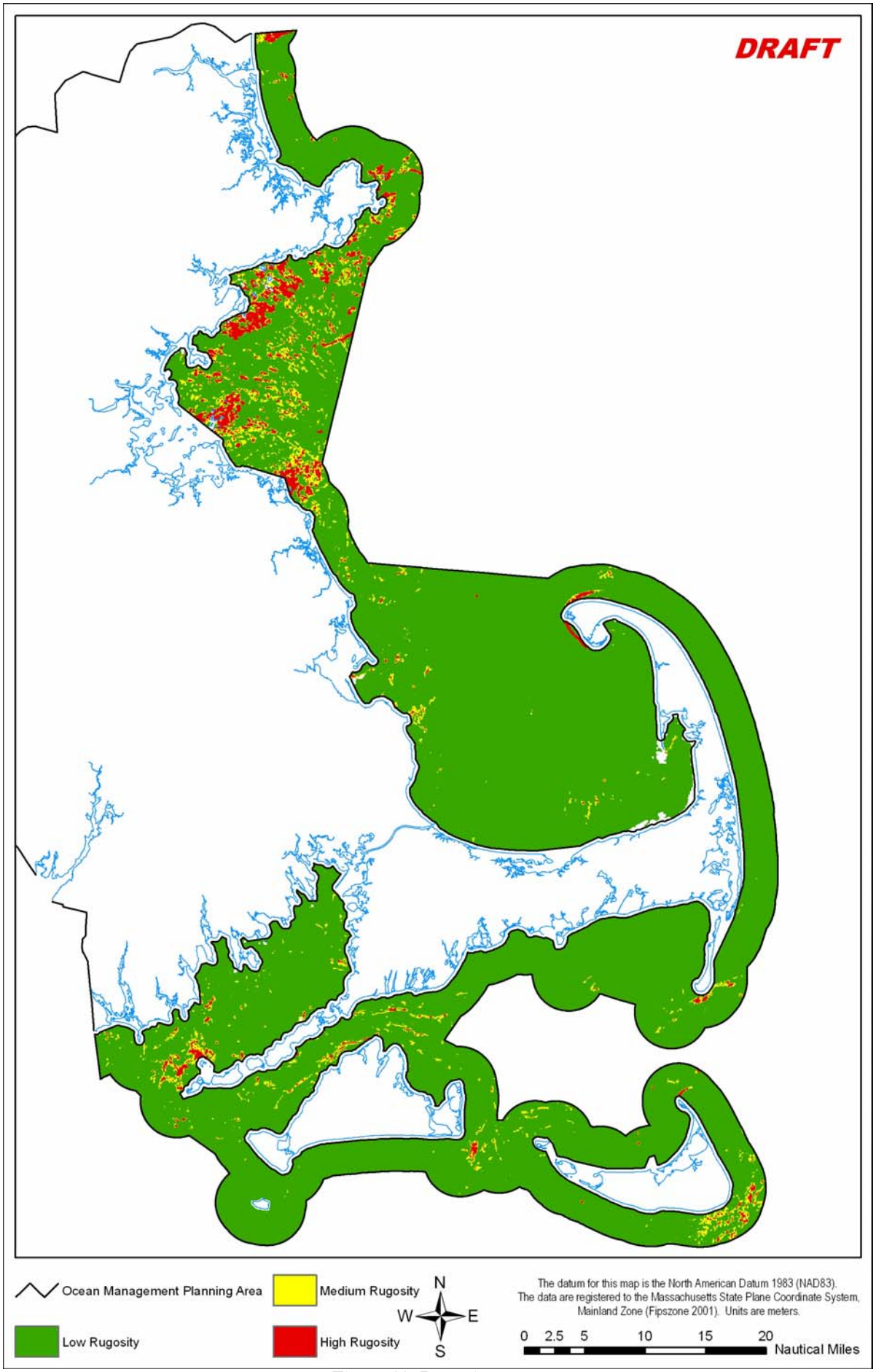

Figure 20. Rugosity output

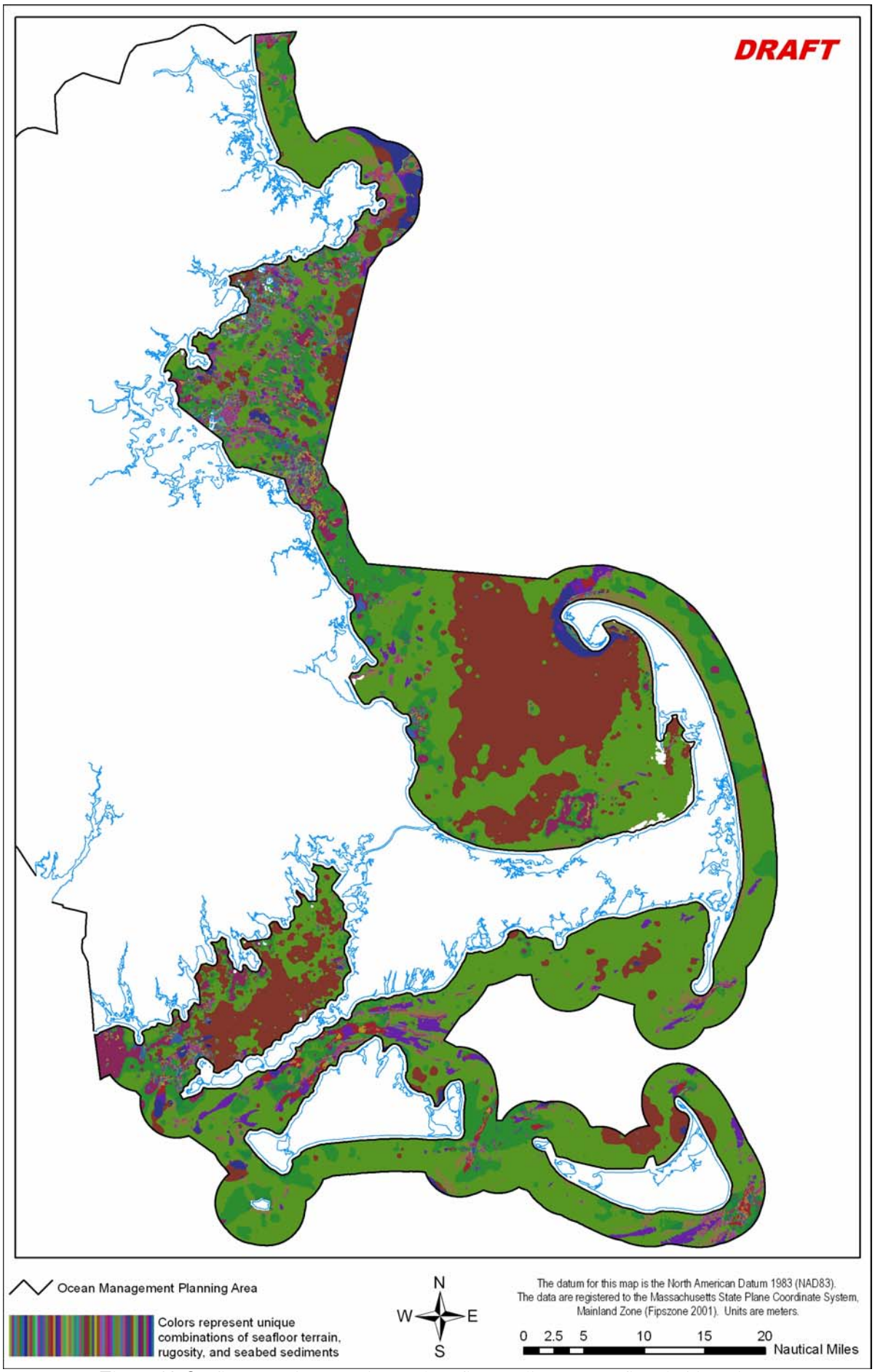

Figure 21. Seafloor terrain, rugosity, and seafloor sediments: seafloor habitat classes

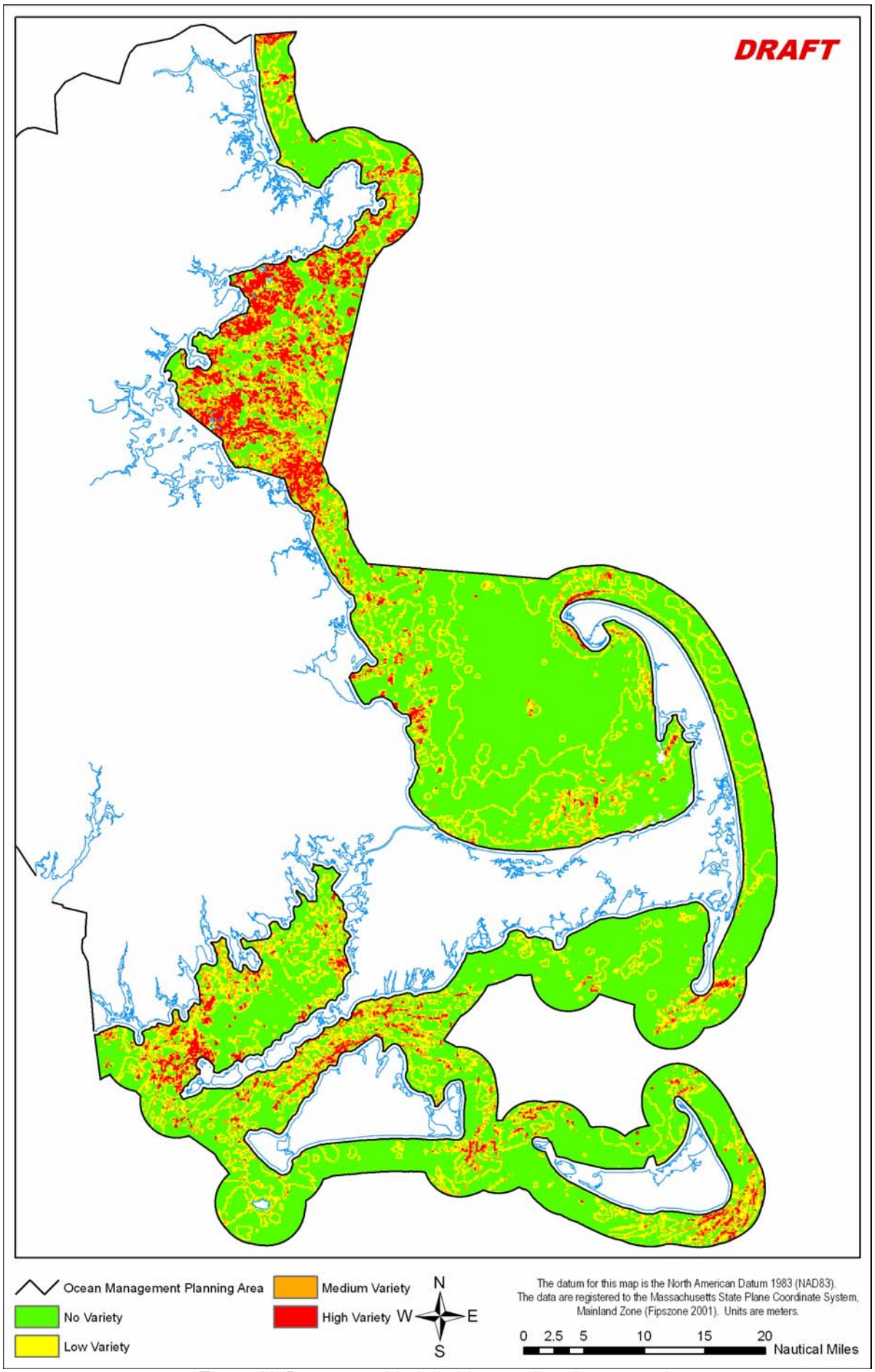

Figure 22. Important abiotic habitat: seafloor heterogeneity

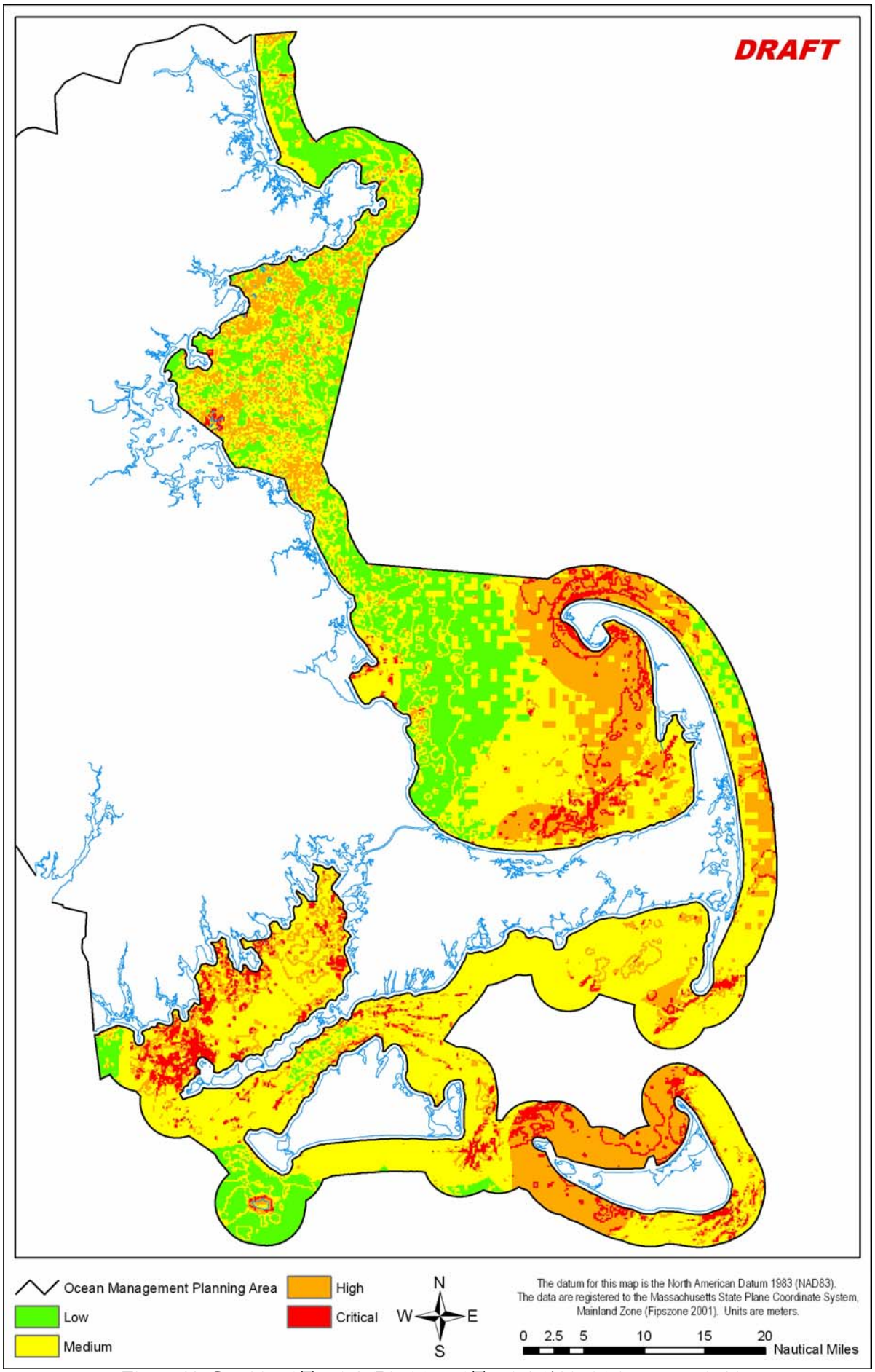

Figure 23. Combined Track 2 (Biotic) and Track 3 (Abiotic) important habitat

Appendix C:
CZM-USGS Seafloor Mapping Cooperative

Appendix C: CZM—USGS Seafloor Mapping Cooperative

CZM and USGS partnered in a Seafloor Mapping Cooperative to comprehensively map the seafloor environment in Massachusetts. Acoustic data from the CZM-USGS Massachusetts Seafloor Mapping Cooperative are used to produce high-resolution bathymetric, backscatter intensity, and geologic interpretative maps of offshore coastal Massachusetts. The level of detail and spatial accuracy of these new data are better than the various existing and historic seafloor datasets (e.g., usSEABED). To date, nearly 1450 sq km of the seafloor is mapped from the New Hampshire border to northern Cape Cod Bay, with plans to start mapping Buzzards Bay and Vineyard Sound in 2009 (Figure 24). When combined with recent seafloor mapping projects in western Massachusetts Bay (Butman et al. 2004), approximately 1770 sq km is mapped with swath sonar systems in state waters.

Acoustic datasets offer unparalleled views of the varied topography, seabed character, and sub-surface structure of the seafloor environment. The CZM-USGS Seafloor Mapping Cooperative acquires the following three acoustic datasets, as well as sediment samples, bottom photos, videos, and cores to groundtruth acoustic signatures:

Swath bathymetry provides high accuracy depth measurements over large areas of the seafloor, which are used to create detailed bathymetric maps and give a sense of the varied or subtle nature of the seafloor landscape (e.g. highly rugged relief, broad flat plains).

Backscatter intensity provides information about the distribution and characteristics of the surficial sediment and bedrock on the seafloor. The intensity of acoustic backscatter indicates the relative hardness and roughness of the seabed (e.g., high-backscatter intensity is produced by a strong acoustic return and generally signifies a coarse and/or rough surface, while a low-backscatter intensity is produced by a weak return of energy and generally signifies finer sediments and/or a smoother surface). Natural and man-made features, such as boulders, shipwrecks, pipelines, can often be identified by abrupt changes in the local backscatter intensity.

Seismic reflection (or subbottom) profiles provide insight into geologic structure and stratigraphy beneath the surficial seafloor. The subbottom structure helps drive the surficial expression of the seafloor. Imaging the sub-surface reveals the distribution and extent of sediment bodies or bedrock hard-bottom. These data are especially useful to determine whether or not an area is suitable for offshore construction and development, where the surficial seafloor datasets (e.g., backscatter intensity, sediment samples, and underwater video) may disguise the true seafloor character (e.g. a relatively thin veneer of sediment over hard-bottom). These data also allow us to measure the thickness and volume of sediment deposits that might, for example, be suitable as beach-nourishment material or construction aggregate. Seismic reflection data are the primary data source for sediment depth (see next section; 'Sediment Depth').

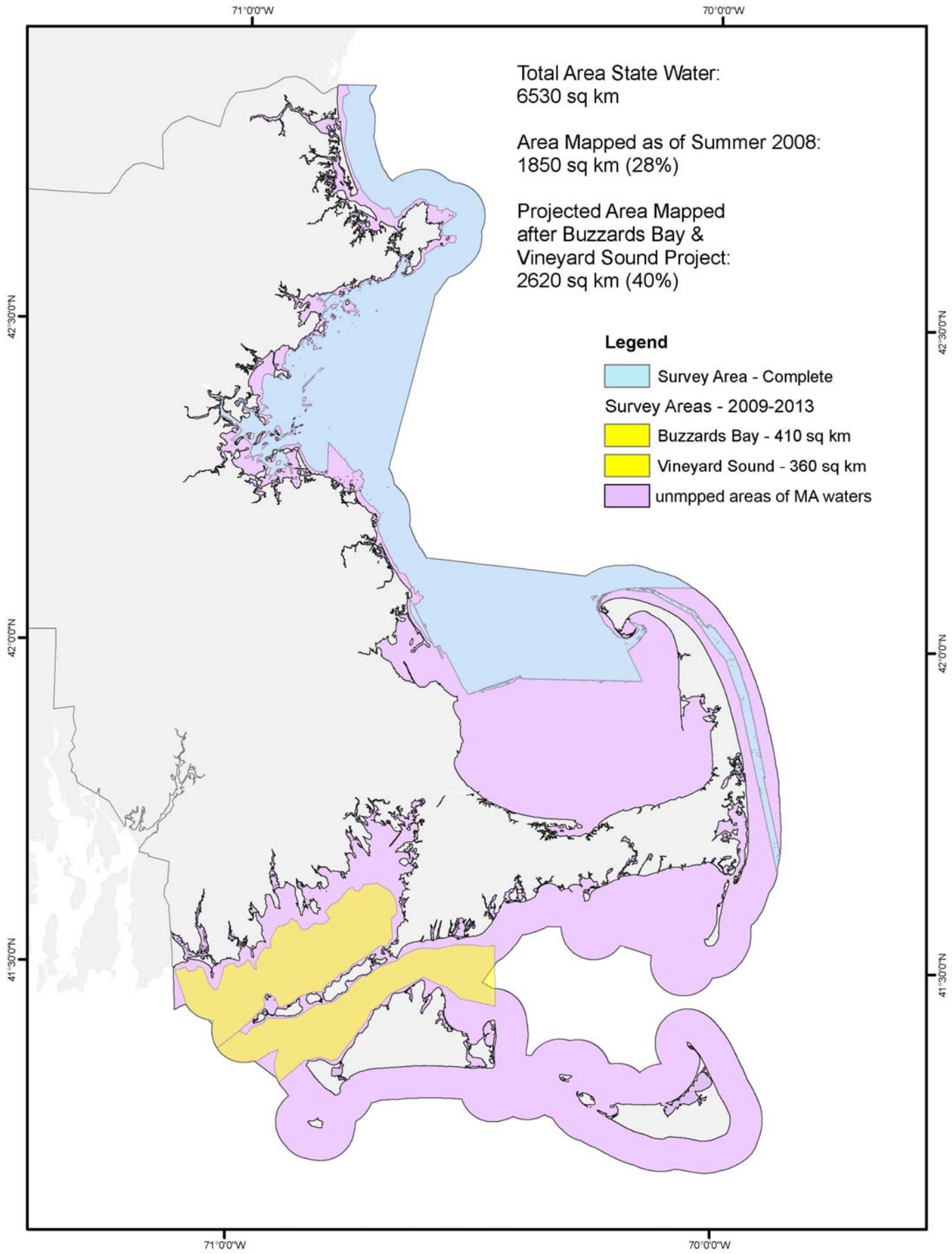

Figure 24. Extent of high-resolution seafloor mapping data.
Buzzards Bay mapping will begin in summer 2009. Vineyard Sound mapping will begin in summer 2010.

Appendix D:
Comparison of interpolated usSEABED data with CZM—USGS Seafloor Mapping Cooperative data

Appendix D: Comparison of interpolated usSEABED data with CZM—USGS Seafloor Mapping Cooperative data

Although the usSEABED database has significant state-wide coverage, limitations that should be noted with using these data to create a continuous seafloor sediment type map:
(1) Many of the samples from the usSEABED database were collected prior to modern GPS navigation, which may present substantial error in geographic position of samples.
(2) A relatively small percentage of the usSEABED records are sediment samples that have been laboratory analyzed, which means most samples are observational and are crudely classified from written descriptions.
(3) Many areas in Massachusetts are not sampled, so interpolation between points may incorrectly represent bottom types. Furthermore, usSEABED data were gridded and the recently collected acoustic data are contiguous coverages, which inherently results in the loss of data resolution.

The following figures illustrate the differences in resolution and accuracy between the interpolated usSEABED data and the high-resolution acoustic data being collected by the CZM-USGS Seafloor Mapping Program in an area of Salem Sound (Figures 25 and 26). Figure 1 shows a number of NW-SE trending rocky zones; however since there are very few rock or hard-bottom samples represented in the usSEABED, a very limited area of the seafloor is actually classified as rocky/hardbottom. Most of the rocky areas are classified instead as class 3 (gravelly sediment) which is not a correct classification or description for rocky/hardbottom area (e.g., bedrock or boulder). Three cells are classified as muddy in the northern part of Figures 25 and 26. The muddy classification was based on a single bottom sample from the usSEABED. Figure 26, displaying the backscatter intensity data, shows that the muddy sample was taken from a very thin ribbon characterized in the imagery as low backscatter which probably does correlate to mud or sandy mud. This thin ribbon of sediment is, however, flanked by relatively large areas of higher backscatter (relatively harder bottom) and appears to occur on the NW facing base of a topographic high area which is probably a rocky outcrop (seismic reflection data could verify this interpretation). The interpolation process used for creating the sediment type map resulted in three cells classified as mud, which is obviously incorrect when observing the grid and contiguous bathymetric and backscatter intensity data.

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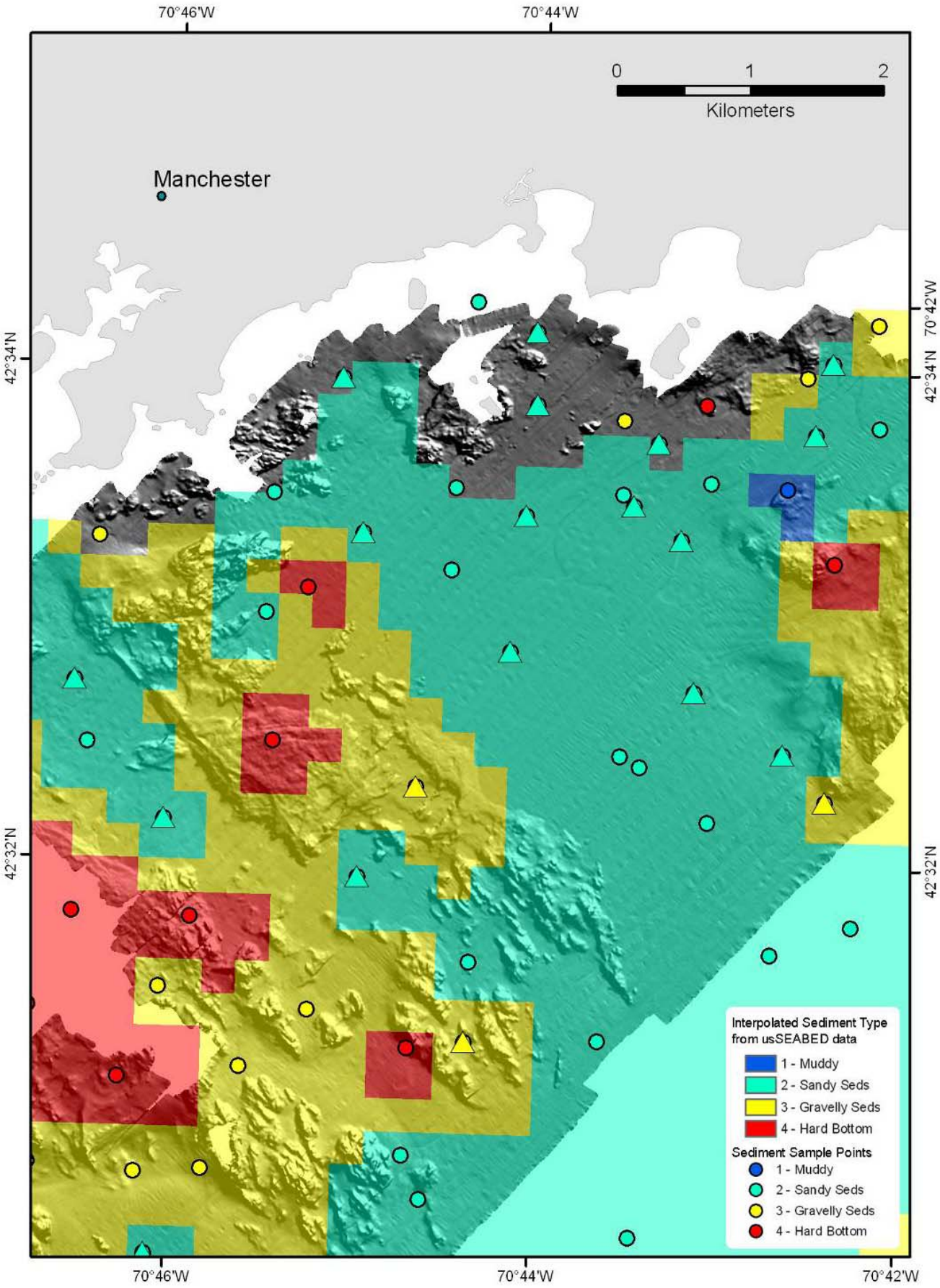

Figure 25. Interpolated usSEABED sediment layer overlaid on hillshaded bathymetry grid (5m resolution) from USGS Open-File Report 2005-1293 (Barnhardt et al. 2005). Triangles are sediment samples from USGS survey 04002. Circles indicate samples from usSEABED.

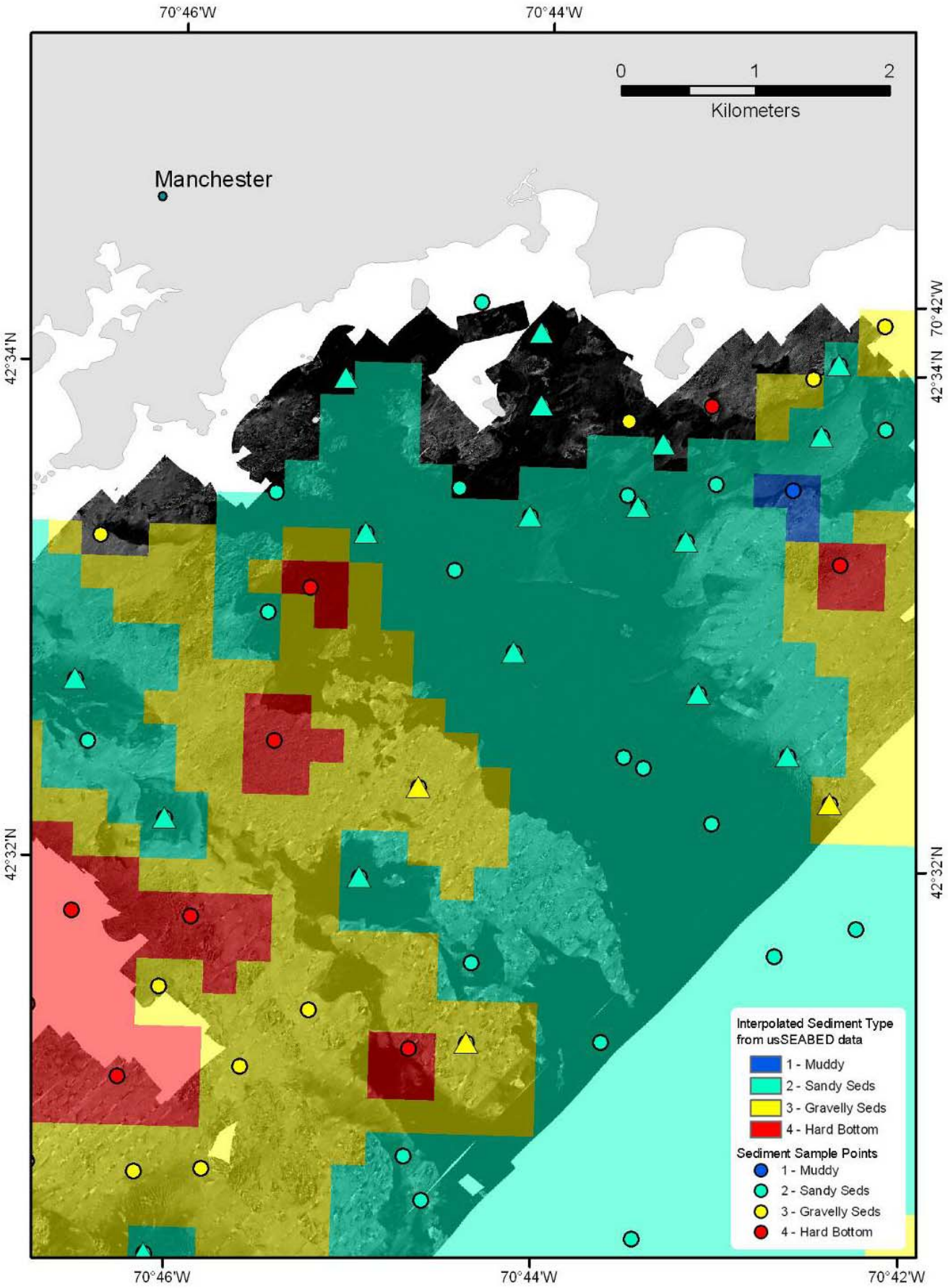

Figure 26. Interpolated usSEABED sediment layer overlaid on backscatter intensity imagery (1m resolution) from USGS Open-File Report 2005-1293 (Barnhardt et al. 2005). Triangles are sediment samples from USGS survey 04002. Circles indicate samples from usSEABED.

Appendix E:
Regulatory Summary

Appendix E: Habitat Regulatory Summary

Many state and federal regulatory and/or management authorities have habitat protection as either a primary or secondary goal. The following summaries were taken directly from the CZM document *Environmental Permitting in Massachusetts*. Some of these entries were updated by the Habitat Work Group.

AREAS OF CRITICAL ENVIRONMENTAL CONCERN

Authorities: M.G.L. c. 21A, § 2(7): Areas of Critical Environmental Concern; 301 CMR 12.00: Areas of Critical Environmental Concern.
Jurisdiction: Designated coastal and inland Areas of Critical Environmental Concern (ACEC).
Applicability: Massachusetts Environmental Policy Act (MEPA) review thresholds are reduced in ACECs, therefore most project proposals must go through the MEPA review process. Certain activities regulated under the Department of Environmental Protection (MassDEP) Wetlands and Waterways Programs, such as dredging or new pier construction may be prohibited. Check with ACEC staff to confirm the applicability of ACEC regulations to the proposed project.
Regulatory Summary: The purpose of the ACEC Program is to preserve, restore, and enhance environmental resources and resource areas of statewide significance. To accomplish this, the Program: (1) identifies and designates critical resources and resource areas; (2) increases the level of resource protection in designated ACECs; and (3) engages municipalities, state agencies, non-governmental organizations, and individuals in planning and carrying out resource management planning in ACECs. Generally, municipalities and citizen organizations nominate proposed ACECs. Once designated by the Massachusetts Secretary of Environmental Affairs, resource protection is enhanced by the reduction of MEPA thresholds for projects proposed in ACECs, thus ensuring a closer regulatory scrutiny by state agencies. The MassDEP Wetlands and Chapter 91 Waterways Programs also include provisions in their regulatory reviews that protect the resources of ACECs. Certain activities, such as improvement dredging and new pier construction, are prohibited until the specific activity is incorporated into a Resource Management Plan approved by participating municipalities and the Secretary of Environmental Affairs.

MASSACHUSETTS ENDANGERED SPECIES ACT

Authorities: M.G.L. c. 131A: Massachusetts Endangered Species Act; 321 CMR 8:00: List of Endangered and Threatened Species; 321 CMR 10:00: Massachusetts Endangered Species Regulations.
Jurisdiction: Plants and animals in the Commonwealth that are endangered, threatened, or species of concern, and their habitats.
Applicability: Alterations of endangered or threatened species habitat, as designated by the Natural Heritage and Endangered Species Program (NHESP), may require a permit from the NHESP.
Regulatory Summary: The state's Endangered Species Act provides for listing of endangered or threatened species or species of concern, and of their habitat. Once listed, the Act prohibits the taking, possession, transport, export, processing, sale or purchase of such species and any other species listed under the federal Endangered Species Act. The Act is administered by NHESP within the Massachusetts Division of Fisheries and Wildlife. The NHESP publishes maps of Estimated Habitats and Priority Habitats for Rare Species every two years. The Massachusetts program also coordinates with the federal Endangered Species Act, administered by the U.S. Fish and Wildlife Service (http://endangered.fws.gov).

FEDERAL ENDANGERED SPECIES ACT

Authorities: 16 U.S.C. § 1531 et seq.: Endangered Species Act of 1973; 50 CFR 17.00: Endangered Species and Threatened Wildlife and Plants.
Jurisdiction: Plants and wildlife of the United States that are listed as endangered or threatened, and their habitats.

Applicability: Non-federal projects that "take" federally-defined endangered or threatened species must have an Incidental Take Permit. The permit is issued in the context of a Habitat Conservation Plan filed by the applicant.
Regulatory Summary: The federal Endangered Species Act conserves the ecosystems on which endangered and threatened species depend. Species are protected under the Act as either endangered or threatened. Endangered means a species is in danger of extinction throughout all or a significant portion of its range. Threatened means a species is likely to become endangered within the foreseeable future. The National Marine Fisheries Service (NMFS), which is responsible for marine species, and the U.S. Fish and Wildlife Service (USFWS) jointly administer the law, which is responsible for terrestrial and freshwater species.

OCEAN SANCTUARIES ACT

Authorities: M.G.L. c. 132A, §§ 12A-16F, 18: Ocean Sanctuaries Act; 302 CMR 5.00: Ocean Sanctuaries.
Jurisdiction: There are five Ocean Sanctuaries in Massachusetts waters including the Cape Cod, Cape Cod Bay, Cape and Islands, North Shore, and South Essex Ocean Sanctuaries. These include most state waters with the major exception of an area east of Boston Harbor. The landward boundary of the sanctuaries is the mean low water mark and the seaward boundary is the limit of state waters, generally three miles offshore. The boundaries are statutory and are described at M.G.L. c. 132A, § 13. Jurisdiction is over any activity that would seriously alter or endanger the ecology or appearance of Ocean Sanctuaries or the Cape Cod National Seashore.
Applicability: Structures and activities that significantly alter the ecology and appearance of the Ocean Sanctuaries are prohibited except as they may be allowed under section 302 CMR 5.08 of the Ocean Sanctuaries regulations.
Regulatory Summary: The Office of Coastal Zone Management (CZM) administers the Ocean Sanctuaries Program. The Act prohibits activities that may significantly alter or endanger the ecology or appearance of the ocean, seabed, or subsoil of sanctuaries or the Cape Cod National Seashore. To accomplish this goal the Act prohibits (1) building structures on or under the seabed; (2) construction or operation of offshore or floating electrical generating stations; drilling or removal of sand, gravel (except for the purposes of beach nourishment), other minerals, gases, or oils; (3) dumping or discharge of commercial, municipal, domestic or industrial wastes; (4) commercial advertising; and (5) incineration of solid waste or refuse on vessels within sanctuary boundaries. These prohibitions may be waived if a finding of "public necessity and convenience" can be made for the proposed project or activity. Under the Ocean Sanctuaries Act, CZM does not issue any licenses or permits but acts through the regulatory process of other agencies, particularly the Chapter 91 Waterways Program.

MASSACHUSETTS ENVIRONMENTAL POLICY ACT

Authorities: M.G.L. c. 30, §§ 61-62H: Massachusetts Environmental Policy Act; 301 CMR 11.00: MEPA Regulations.
Jurisdiction: Projects requiring a state environmental license or permit, or funding.
Applicability: Proposed projects are subject to Massachusetts Environmental Policy Act (MEPA) review if they equal or exceed the MEPA thresholds. Examples of threshold activities include:

- Alteration of 25 or more acres of land.
- Alteration of designated significant habitat, and/or taking of endangered or threatened species or species of special concern.
- Alteration of coastal dunes, barrier beaches, or coastal banks; alteration of 500 ft. of fish run or inland bank; alteration of 1,000 square feet (s.f.) of salt marsh or outstanding resource waters; alteration of 5,000 s.f. of bordering or isolated vegetated wetlands; new or expanded fill or structure in a velocity zone or regulatory floodway; alteration of one-half acre of other wetlands.
- Projects proposed within an Area of Critical Environmental Concern (ACEC).

See 301 CMR 11.03: Review Thresholds for a complete discussion of these thresholds.

PLEASE NOTE: It is important to thoroughly review the complete list of MEPA thresholds for applicability to a particular proposal.

Regulatory Summary: The MEPA Unit, within the Executive Office of Energy and Environmental Affairs, administers this review. MEPA provides opportunities for public review of the potential environmental impacts of projects for which state agency action is required; and helps state agencies to satisfy their obligation to avoid damage to the environment, or if damage to the environment cannot be avoided, to minimize and mitigate the damage to the maximum extent practicable. State agency action includes activities that are undertaken, permitted, and/or funded by agencies of the Commonwealth, and the transfer of lands owned or controlled by the Commonwealth. Major categories of project impacts subject to review include land; rare species; wetlands, waterways and tidelands; water; wastewater; transportation; energy; air; solid and hazardous waste; historical and archeological resources; and state-designated ACECs.

The intent of the MEPA review is to inform project proponents and state agencies of potential adverse environmental impacts while a proposal is still in the planning stage. The proponent, through the preparation of one or more review documents, identifies required state agency actions and describes the means by which the proposal complies with applicable regulatory standards and requirements. All relevant state agencies are required to identify any aspects of the proposal that require additional description or analysis prior to completion of the agency action, most commonly issuance of an environmental permit.

NATIONAL ENVIRONMENTAL POLICY ACT

Authorities: 42 U.S.C. §4321 et seq.: National Environmental Policy Act of 1969; 40 CFR 1500: Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act.

Jurisdiction: Projects or programs requiring a federal agency action.

Applicability: Federal agencies must evaluate the environmental effects, including alternatives, to the proposed action or program.

Regulatory Summary: NEPA established environmental protection as a national policy goal and directed all federal agencies to consider the environmental consequences of their projects and permitting actions. The NEPA review provides opportunities for integration of national environmental policy into project planning; public and agency review of potential environmental effects of federal actions (including issuance of federal permits) and programs; coordinated and inter-disciplinary program planning; and resolution of disputes among agencies. Most federal agencies have promulgated regulations governing the incorporation of NEPA's reviews into their programs.

MASSACHUSETTS WETLANDS PROTECTION ACT and RIVERS PROTECTION ACT

Authorities: M.G.L. c. 131, § 40: Massachusetts Wetlands Protection Act; 310 CMR 10.00: Wetlands Regulations.

Jurisdiction: Any wetland, including:

- Any bank, freshwater wetland, coastal wetland, beach, dune, tidal flat, marsh or swamp bordering on the ocean, any estuary, creek, river, stream, pond, lake, or certified vernal pool;
- Land under any of the water bodies listed;
- Land subject to tidal action, coastal storm flowage, or flooding; and
- Riverfront areas in the Commonwealth of Massachusetts.

In addition, a 100-foot buffer zone around any fresh water or coastal resource listed above is subject to jurisdiction.

Applicability: Any alteration of a wetland resource, including intertidal and subtidal habitat, is subject to the provisions of the Wetlands Protection Act (WPA).

Regulatory Summary: Local Conservation Commissions and the Department of Environmental Protection (MassDEP), Wetlands Program administer the WPA (310 CMR 10:00: Wetlands Regulations). The purpose of the WPA is to protect Massachusetts wetlands resources and to ensure that the beneficial functions of these resources are maintained. The resources identified are protected because they fulfill the public interest to protect public and private water supply, protect

fisheries, protect groundwater supply, provide flood control, protect land containing shellfish, prevent storm damage, protect wildlife habitat, and prevent pollution. These interests are protected by a "no net loss of wetlands" policy. Projects that affect wetlands are required to avoid impacts where possible, minimize unavoidable impacts, and mitigate for unavoidable impacts. Performance standards define the levels of environmental impacts that cannot be exceeded.
Projects proposed in wetlands resource areas or in the buffer zone around them must obtain a local Order of Conditions. Wetland resources include land under the ocean, coastal banks, coastal beaches and tidal flats, coastal dunes, barrier beaches, rocky intertidal, salt marshes, land under salt ponds, Designated Port Areas, land containing shellfish, and land on the banks of fish runs.

401 WATER QUALITY CERTIFICATION FOR DREDGING

Authorities: 33 U.S.C. 1341 et seq., § 401: Federal Water Pollution Control Act, M.G.L. c. 21, §§ 26-53: Massachusetts Clean Water Act; 314 CMR 4.00: Surface Water Quality Standards, 314 CMR 9.00: 401 Water Quality Certification.
Jurisdiction: Dredge and/or fill projects in waters and wetlands subject to state and federal jurisdiction if a federal permit is required for the project.
Applicability: Any activity that would result in a discharge of dredged material, dredging, or dredged material disposal greater than 100 cubic yards that is also subject to federal regulation must obtain a 401 Water Quality Certification.
Regulatory Summary: The Division of Wetlands and Waterways in the Department of Environmental Protection (MassDEP) administer the 401 Water Quality Certification Program. The 401 review ensures that a proposed dredge and/or fill project that can result in the discharge of pollutants complies with Massachusetts Surface Water Quality Standards, the Massachusetts Wetlands Protection Act, and otherwise avoids or minimizes individual and cumulative impacts to Massachusetts waters and wetlands. As the authority to administer the 401 Water Quality Certification is derived from the Federal Water Pollution Control Act, only projects that require a federal permit are subject to 401 review.

CHAPTER 91 WATERWAYS

Authorities: M.G.L. c. 91: Public Waterfront Act; 310 CMR 9.00: Waterways Regulations.
Jurisdiction: Dredging, placement of structures, change in use of existing structures, placement of fill, and alteration of existing structures in any of the following coastal areas (recognizing that MGL Ch. 91 applies more broadly than to coastal areas):

- Flowed tidelands - projects in, on, over, or under tidal areas between the mean high water (MHW) line and the limit of state territorial waters (generally 3 miles from shore).
- Filled tidelands outside Designated Port Areas (DPAs) - projects up to the first public way or 250 feet from MHW, whichever extends farther inland.
- Filled tidelands inside DPAs - projects between the present and historic MHW (i.e. all filled areas inside DPAs).

For moorings, floats, rafts, and other bottom-anchored structures, an annual Section 10A permit may be obtained from the local harbormaster in lieu of a Chapter 91 license.
Applicability: Any project proposed in, under, or over flowed or filled tidelands or great ponds requires a Chapter 91 license or permit. A Simplified Chapter 91 Waterways License is available to owners of small residential docks, piers, seawalls, and bulkheads. Water-Dependent Chapter 91 Waterways Licenses cover all new or unauthorized water-dependent use projects that are not eligible for the Simplified License. All new or unauthorized nonwater-dependent uses must obtain a Nonwater-Dependent Chapter 91 Waterways License. The term of a Simplified License is 10 years, all others are 30 years.
Work not involving fill or structures, such as dredging, may apply for a Chapter 91 Waterways Permit. The term of a Permit is 5-10 years.
Regulatory Summary: The Division of Wetlands and Waterways in the Department of Environmental Protection (MassDEP) administers the Chapter 91 Waterways Program. Chapter 91 is the Massachusetts public trust statute and, as such, protects the public's rights to fish, fowl, and

navigate below the current or historic high water line, as well as in great ponds and navigable rivers and streams in Massachusetts, the so-called public trust lands. Waterways regulations promote the preservation of tidelands for water-dependent uses that require direct access to the water. In addition, the regulations seek to ensure that areas in jurisdiction are maintained for public use and enjoyment when privately developed.
Projects are reviewed to ensure that they: (1) do not unreasonably interfere with navigation, (2) are structurally sound, (3) provide a proper public purpose, (4) do not interfere with public rights or rights of adjacent property owners, (5) will not adversely affect natural resources, and (6) preserve DPAs for maritime industrial use.

FEDERAL CONSISTENCY REVIEW

Authorities: 16 U.S.C. 1451 et seq.: Coastal Zone Management Act of 1972, as amended, 15 CFR 930; M.G.L. c. 21A, §§ 2, 4: Massachusetts Coastal Zone Management Act, 301 CMR 20.00: Coastal Zone Management Program, 301 CMR 21.00: Federal Consistency Review Procedures.
Jurisdiction: Any project undertaken by a federal agency, requiring a federal permit, requiring a federal offshore oil and gas lease, or receiving federal funding that is in or may affect the land or water resources or uses of the Massachusetts coastal zone. The Massachusetts coastal zone is the area bounded by the seaward limit of the state's territorial sea (generally 3 miles from shore) to 100 feet landward of specified major roads, railroads, or other visible right-of-way (generally the first major transportation corridor inland of the shoreline). Projects outside this area but which may affect it may be subject to jurisdiction.
Applicability: Any project proposal that is above certain thresholds (generally, the Massachusetts Environmental Policy Act thresholds) and that requires a federal license or permit must be found to be consistent with Massachusetts Office of Coastal Zone Management's (CZM) coastal policies.
Regulatory Summary: CZM's federal consistency review ensures that any federal activity in or affecting Massachusetts coastal resources is consistent with state coastal policies. These policies, the so-called enforceable program policies, are based on existing Massachusetts statutes and regulations and offer policy guidance on management of water quality, marine habitat, protected areas, coastal hazards, port and harbor infrastructure, public access, energy, ocean resources, and growth management. The project-specific federal activity cannot take place until CZM concurs that the project is consistent with state coastal policies.

U.S. ARMY CORPS OF ENGINEERS PERMITS

The following permits are considered together as they are administered together by the U.S. Army Corps of Engineers (Corps) Regulatory Branch through a single permit application.

- RIVERS AND HARBORS ACT OF 1899 (SECTION 10)

Authorities: 33 U.S.C. §§ 401-413: Rivers and Harbors Act of 1899; 33 CFR 323: Permits for Structures or Work Affecting Navigable Waters of the United States.

- CLEAN WATER ACT (SECTION 404)

Authorities: 33 U.S.C. §1251 et seq.: Federal Water Pollution Control Act; 33 FCR 322: Permits for Discharges of Dredged or Fill Material into the Waters of the United States.

- MARINE PROTECTION, RESEARCH AND SANCTUARIES ACT, (SECTION 103)

Authorities: 33 U.S.C. §1401 et seq.: Marine Protection, Research and Sanctuaries Act; 33 CFR 324: Permits for Ocean Dumping of Dredged Material.

- MASSACHUSETTS PROGRAMMATIC GENERAL PERMIT

Authorities: 33 CFR 320-330: U.S. Army Corps of Engineers Regulations.
Jurisdiction: Construction or placement of structures, dredging, and dredged material disposal in the waters of the United States.
Applicability: Any project in or affecting the waters of the United States must comply with the conditions of the Massachusetts Programmatic General Permit (PGP) or, in the case of larger projects, the conditions of an Individual Permit.
Regulatory Summary: A Section 10 permit is required for all work, including structures, seaward of the annual high water line in navigable waters of the United States, defined as waters subject to the

ebb and flow of the tide, as well as a few of the major rivers used to transport interstate or foreign commerce. A Section 404 permit is required for activities that involve the discharge of dredged or fill material into waters of the United States, including not only navigable waters, but also coastal waters, inland rivers, lakes, streams, and wetlands. A Section 103 permit is required to transport dredged material for the purpose of disposal in the ocean.

The Corps, New England District has issued a PGP for work in Massachusetts. The PGP provides for three levels of regulatory review:

- Category I - Activities of minimal environmental impact that do not require Corps regulatory review and are classified as non-reporting. While no written notification to the Corps is required for these "minor" projects, they must comply with the conditions contained in the PGP.
- Category II - Activities likely to be of minimal environmental impact but that have the potential to have adverse effects. A project-specific review and authorization from the Corps in writing are required. Copies of the Massachusetts Chapter 91 (21) application and plans, or the 401 Water Quality Certification (18) application and plans, are usually sufficient for Category II review.
- Category III - Activities that have potential to cause adverse environmental impacts. These projects must get an Individual Permit from the Corps, and therefore require project-specific review, are available for public review and comment, and may require preparation of an Environmental Impact Statement.