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The Nature Conservancy's Northwest Atlantic Marine Ecoregional Assessment: Implications for the Rhode Island Ocean SAMP Region

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Executive Summary

The Nature Conservancy's Northwest Atlantic Marine Ecoregional Assessment identified places within a vast 140,000-square mile area that are important to marine biodiversity. The Rhode Island Ocean Special Area Management Plan covers a 1,547-square mile sub-set of the Assessment's study area, and is intended to be an ecosystem-based management plan for various ocean-based uses in Rhode Island waters and beyond. This report takes the broader Assessment data and 'down-scales' it to the Ocean SAMP study area, outlining regionally important areas of biodiversity to consider when making decisions about ocean uses.

This report reveals that there are several areas, species, and habitats within the Ocean SAMP that are regionally important for conserving the ocean's biodiversity. The inner shelf south of Long Island and Rhode Island has persistently abundant demersal fish. The southern ecotone formed by the transition from the rocky moraine to the sandy flats to the south seems to be particularly important. Smaller areas of "hard bottom" are unique habitats and are found throughout the study area in significant numbers.

There are also important aggregation areas of migratory species within the Ocean SAMP area. Although the units of analysis are necessarily coarser due to the data sources, the report shows that the region south of Long Island out to roughly the 50 meter isobaths, extending eastward to the south of Martha's Vineyard stands out as the place with the highest concentration of multiple, persistent large pelagic species.

The report recognizes that although there are limitations in using regional data sets in a smaller, state-level study area, that the methodology for analysis is sound and could be replicated using more localized data sets for a more refined analysis.

Table of Contents

List of Figures

List of Tables

Abstract

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Introduction

Recognizing the vital role of marine ecosystems to the health of the planet and the increasingly strong human dependency on ocean resources, The Nature Conservancy (the Conservancy) has synthesized data on species distributions, geology, oceanography, chemistry, biology and social science to identify conservation priorities and inform management decisions. This process, an "ecoregional assessment**"** is a fundamental building-block of the Conservancy's approach to conservation, and part of a wider effort (supported by the Conservancy's Global Marine Initiative) to protect and restore ocean and coastal ecosystems. The Conservancy has about 130 staff members working on marine conservation around the world and partners have completed 10 marine ecoregional assessments.

The Northwest Atlantic Marine Ecoregional Assessment ("the Assessment") spanned the area from Cape Hatteras in North Carolina to the northern limit of the Gulf of Maine in Canadian waters, and extended from the mean high tide mark seaward to the foot of the continental slope (depth of 2,500 m). The Northwest Atlantic region is known for both its cold, nutrient-rich, and highly productive waters in the northern portions of the region as well as the more temperate waters of the Mid-Atlantic, that have sustained regional economies for centuries. With its strong tidal flows, complex circulation patterns, and varied seafloor topography the region supports large diverse populations of bottom dwelling fish and an array of benthic communities. The deep basins and shallow banks of the Gulf of Maine, with seasonal concentrations of plankton and forage fish, attract an impressive number of marine mammals. Farther south, the broad continental margin, large estuaries, and deep submarine canyons function as nursery areas for estuary dependent fishes, critical stopover sites for millions of seabirds, migratory pathways for large pelagic species, and key habitat for coldwater corals.

This document is intended to summarize the most significant findings of the Assessment that illustrate places in and around the RI Ocean SAMP study area that have been identified as regionally significant contributors to the biodiversity of the Northwest Atlantic. The Conservancy believes the Ocean SAMP is a unique opportunity to implement ecosystem-based management through a rigorous marine spatial planning methodology. Ecosystem-based management is an integrated approach that considers the entire ecosystem, including humans, striving to maintain an ecosystem in a healthy, productive, and resilient condition so it can provide the services humans want and need. A key component of setting measurable priorities for ecosystem health is to develop a 'portfolio' of important places and adequately capture the representative biodiversity within the study area. The Conservancy believes that the Assessment,

when scaled to the Ocean SAMP study area, provides a unique decision support tool for making decisions about protecting, mitigating, and restoring marine biodiversity.

The primary sources of data for the assessment were at a scale that allowed for the comparison of places across the entire 140,745 square mile assessment area. Most of the analyses used ten-minute square units (roughly 100 square miles) to identify places that were consistently important for productivity and diversity over multiple decades. Since the Assessment was at such a large scale, it presented a challenge for assessing the value of smaller scale places such as those within the SAMP boundary. Nevertheless, the Assessment provides an important regional perspective that illustrates the unique combination of habitats- including highly productive coastal complexes of beaches, bluffs, dunes, rocky shores, bays, estuaries, mud flats, tidal wetlands and maritime forests- which support a variety of migratory species and shellfish and make the marine waters off of Rhode Island's coast an enormously valuable commercial and ecological resource.

The Assessment was conducted in two phases. The first phase (Greene et al. 2010) was a robust, transparent data baseline, serving as a regional information resource for the Conservancy and marine decision makers. Please refer to the original report for a more detailed breakdown of the methods and data, including descriptions of the analyses and species data used in the Assessment: http://nature.org/easternusmarine/.

The second phase (Anderson et al. 2010) presented a suite of high priority conservation areas by integrating the coastal, benthic, and migratory data from phase one. The primary objective of this synthesis was to identify places that merit conservation and management attention throughout the region. The suite of identified places, referred to as the "portfolio" is not meant to represent all of the important habitats of the region. An incomplete knowledge of this complex system and gaps in the data prevented us from making such definitive conclusions. We do, however, feel confident that the places that were identified within this portfolio contribute in significant ways to the ecological function, diversity, and productivity of the marine environment on a global scale.

Phase two report, maps, and data are available upon request from Jenn Greene at The Nature Conservancy's Eastern Division Office (jgreene@tnc.org).

Seafloor Portfolio

Benthic Habitats

In the Northwest Atlantic region, benthic habitats contain over two thousand species of invertebrates such as marine worms, sponges, shrimp, crab, clams, scallops, snails, sea stars,

corals, and anemone. A benthic habitat type is defined as a group of organisms repeatedly found together within a specific environmental setting. To describe and classify these seafloor habitats for the assessment, the Conservancy created two data products: Ecological Marine Units (EMUs) and Benthic Habitats.

EMUs are the three-way combination of physical variables: bathymetry (water depth), sediment grain size, and seabed forms (bottom topography). The statistical breaks in bathymetry and substrate grain size classes were based on the ecological thresholds revealed by a dataset of benthic organisms. Thresholds were created by classifying organism groups based on similarities in the composition and abundance of the benthic species using cluster analysis. In order to display EMUs at a regional scale in this report we have simplified them into broad classifications (Figure 1). Benthic Habitats are simply further aggregations of the original detailed EMUs based on their shared species assemblages (Figure 2 and Table 1). The places identified as components of TNC's conservation portfolio are displayed with the simplified EMU symbology (Figure 3-8).

The RI Ocean SAMP area sits on the northern end of the Southern New England subsection, a region characterized by coarse to fine sand flats with pockets of silt, distributions of gravel, and ancient river channels. The Ocean SAMP area is dominated by its glacial history. The terminal moraine forms a definite boundary between relatively flat, sandy depressions to the south and the rocky complex to the north. Ecotones (ecological transition zones) such as this are known to be important habitat and this was supported by the Assessment's analyses.

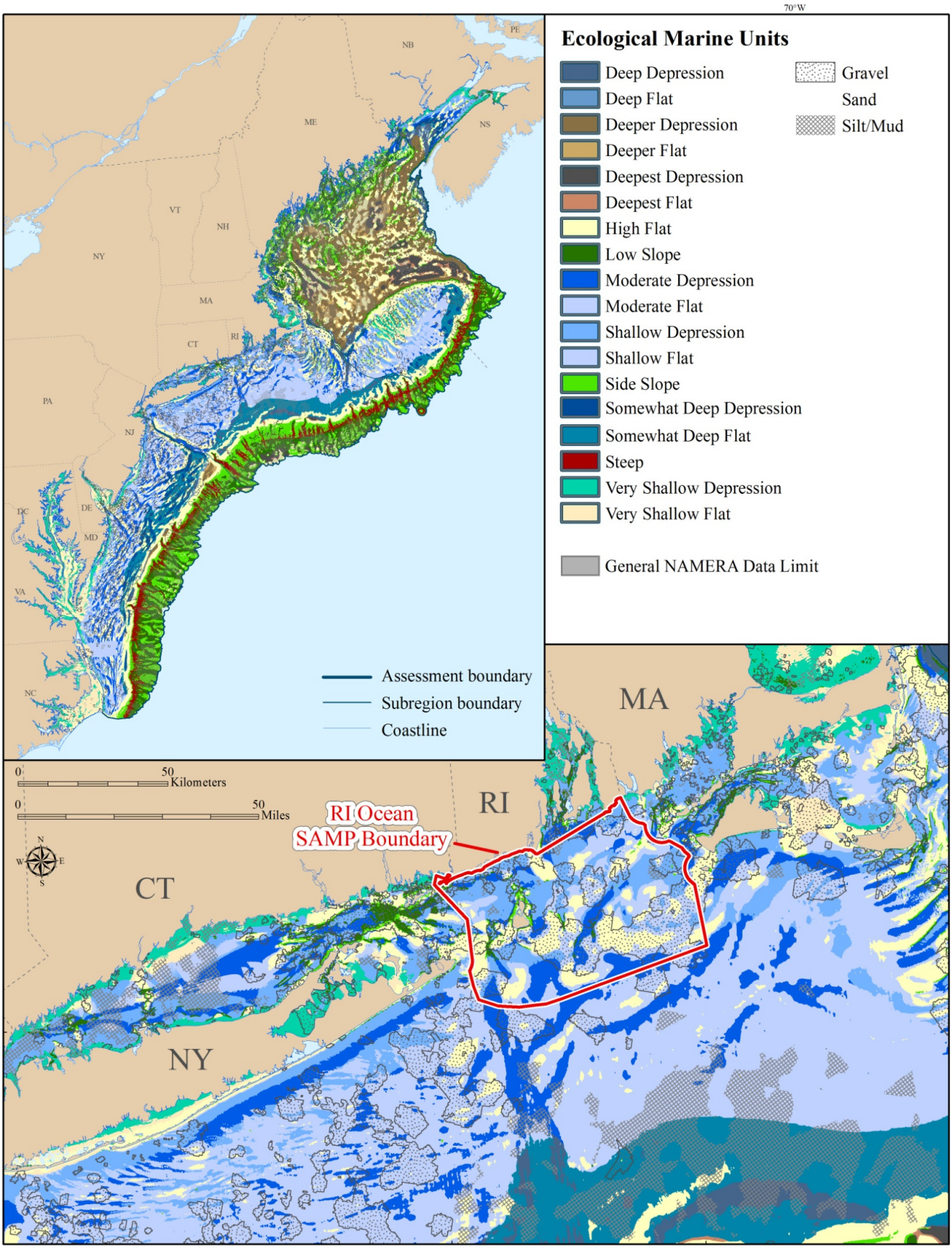

Figure 1 – Ecological Marine Units

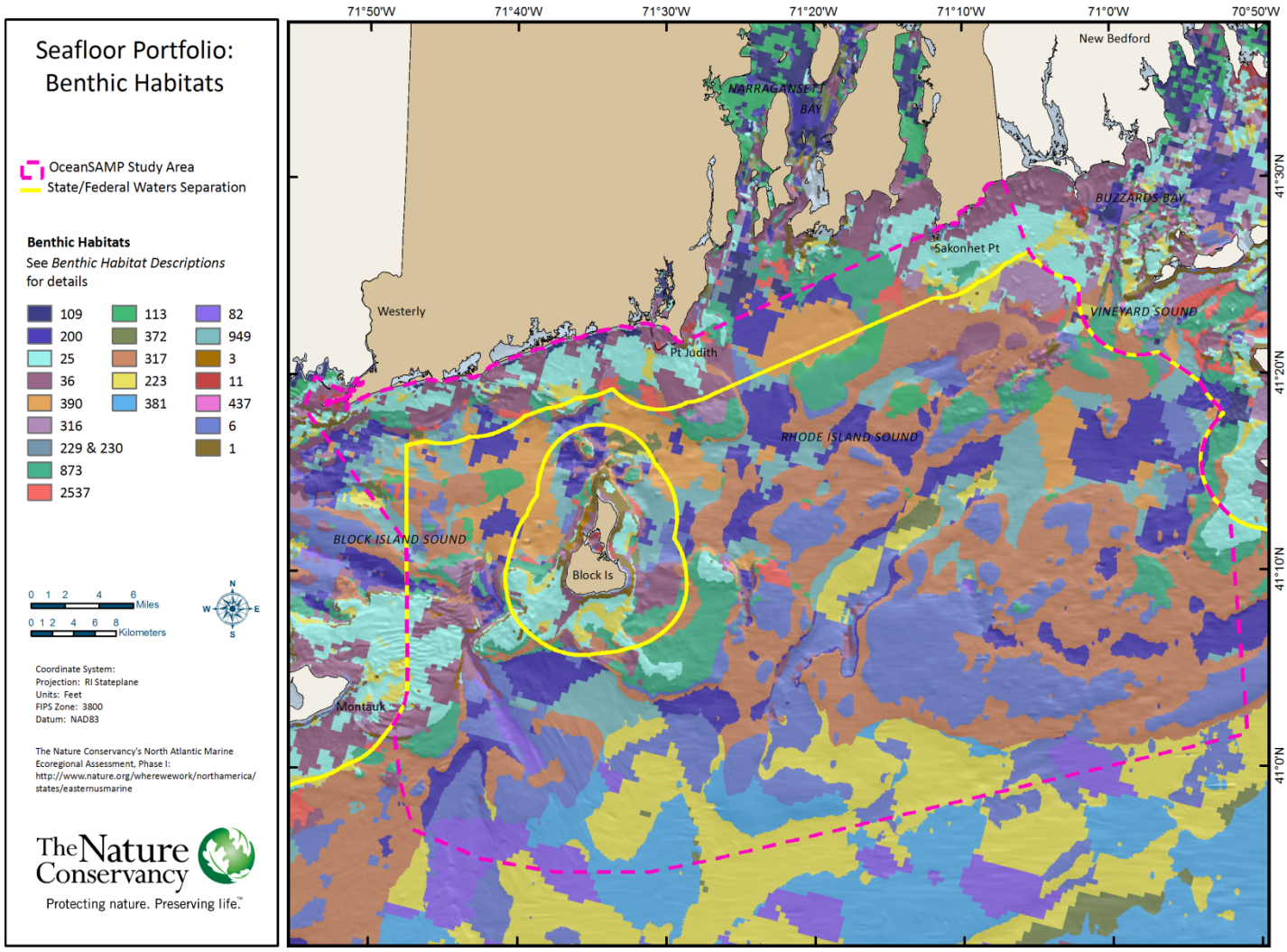

Figure 2 – Benthic habitats

Table 1 – Benthic habitat descriptions, Adapted from Chapter 3 of The Nature Conservancy's Northwest Atlantic Marine Ecoregional Assessment, Phase 1 Report

Benthic Habitat Descriptions

Shallow

109: Depressions in very shallow water (0 - 23 m) mostly on medium to coarse sand but occasionally on silt.

200: Depressions at very shallow to moderate depths (0 – 44 m) on very fine to medium sand.

25: Flats and side slopes in very shallow to shallow water (0 – 23 m) on fine to coarse sand.

36: Depressions and high flats in very shallow to moderate depths (0 – 75 m) on medium to coarse sand.

390: Depressions in shallow water (23 - 44 m) in very fine to fine sand.

316: Flats in shallow water (8-44 m) on very fine to medium sand.

229: Depressions in shallow depths (8.4 to 44 meter) on very fine sand.

230: Depressions in shallow depths (23 - 44 m) on very fine sand.

873: Flats and side slopes in shallow water (8 - 31 m) on very fine to medium sand.

2537: Depressions and high flats in shallow water (23 - 31 m) on very fine to fine sand.

Moderate Depths

113: Depressions and mid-position flats at moderate depths (23 - 44 m) on very fine sand.

372: Depressions and los slopes at moderate depths (44 – 75 m) on very fine sand.

317: Mid-position flats at moderate depths (31 - 75 m) on fine to medium sand.

223: Mid-position flats and depressions at moderate depths (44 - 75 m) on fine to medium sand.

381: Mid and high position flats in moderate depths (44 - 79 m) on fine to very fine sand.

Moderate to Deep Depths

82: All types of flats in moderately deep water (44 – 139 m) on medium to coarse sand.

949: Mid and low flats in deep water (75-139 m) on medium to fine sand.

3: Flats and slopes at moderate to very deep depths (average 128 m, min 44 m) on fine to very fine sand.

11: High slopes, canyons, flats in deep water (60 – 485 m) on medium to fine sand.

437: High flats and slopes in deep to very deep water (75 - 200 m) on fine sand.

6: High slopes and flats at moderate to deep depths (44 - 139 m) on coarse to fine sand.

1: Variable settings in a wide range of depths on fine to coarse sand. A very mixed set of samples with many un-identified species and few commonalities. Not a benthic habitat type, but listed here for completeness.

General Comments on Marine Fish Analysis Methods

The Northwest Atlantic is known for its highly productive waters, a result of strong tidal flows, complex circulation patterns, varied seafloor topology, and diverse sediment types. The diversity of available habitats results in an incredible diversity of benthic and pelagic fish and other organisms.

To identify the portfolio of habitats for the assessment, the Conservancy identified places that have been consistently important to fish productivity and diversity over decades. Abundance was considered, but it can vary greatly from year to year. Consequently, the analysis has placed greater emphasis on persistence. Only places that showed a consistently diverse collection of species were identified. These places correlate with habitats that are important to productivity and diversity.

Demersal Fish Persistence

Demersal or "bottom-dwelling" fish are characterized by their close association with the seafloor for feeding, spawning, and juvenile nursery areas. A set of 32 species representing a variety of preferred habitats, life history patterns, food habits, population trends and ecological roles, was chosen and data were extracted from 38 years of NMFS bottom trawl surveys. From this group, those ten-minute squares that had at least ten species having persisted for three or four decades were chosen (Figure 3).

The Assessment identified the inner shelf south of Long Island and Rhode Island as having persistently abundant demersal fish. This area includes the flat sandy depressions south of the moraine as well much of Rhode Island Sound to the north. Since the primary source of data, the NMFS bottom trawl dataset, is limited closer to the coast as well as by the type of hard structure found on the moraine, it is important not to infer from this that those areas are unimportant. It is equally important to acknowledge that the seafloor waters of Block Island and Rhode Island Sounds and the surrounding area identified on the map are regionally significant for their demersal fish productivity and diversity.

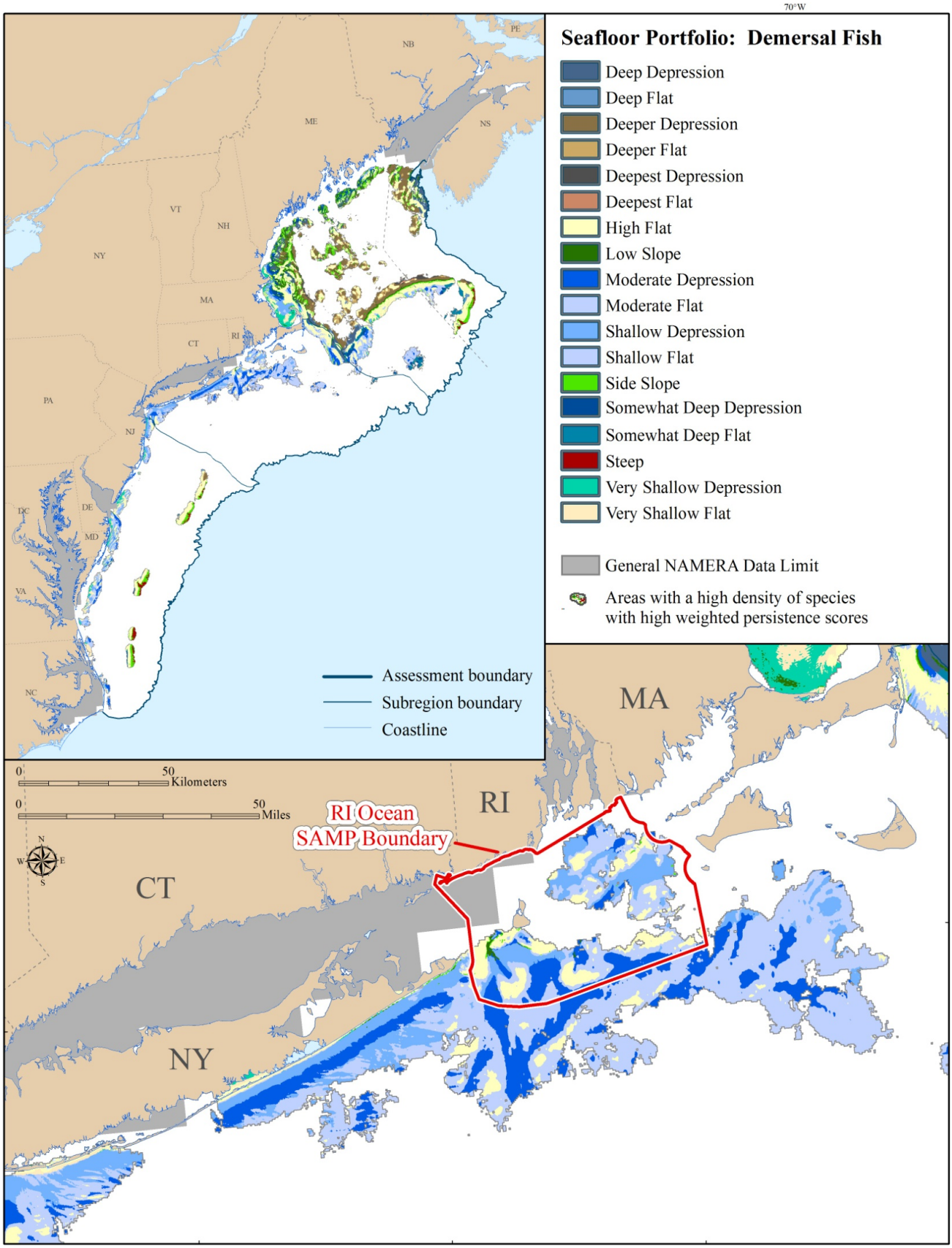

Figure 3 – Demersal fish portfolio

Demersal Fish Community Diversity

The bottom trawl survey samples were classified into distinct fish community types based on similarities in species composition and abundance among the samples. Unlike the demersal fish persistence analysis, this included all species captured. After excluding depauperate samples (those with fewer species than the average for each community type), those ten-minute squares with four or more community types present were selected for the portfolio.

Much of the same area identified in the demersal fish persistence analysis was highlighted here, with some key differences (Figure 4). For the Ocean SAMP region, the southern ecotone formed by the transition from the rocky moraine to the sandy flats to the south was more clearly isolated. As with the previous analysis, the source data is limited in-shore and on the rocky moraine, but the conclusion that this place is home to a diverse number of demersal fish communities is reasonable.

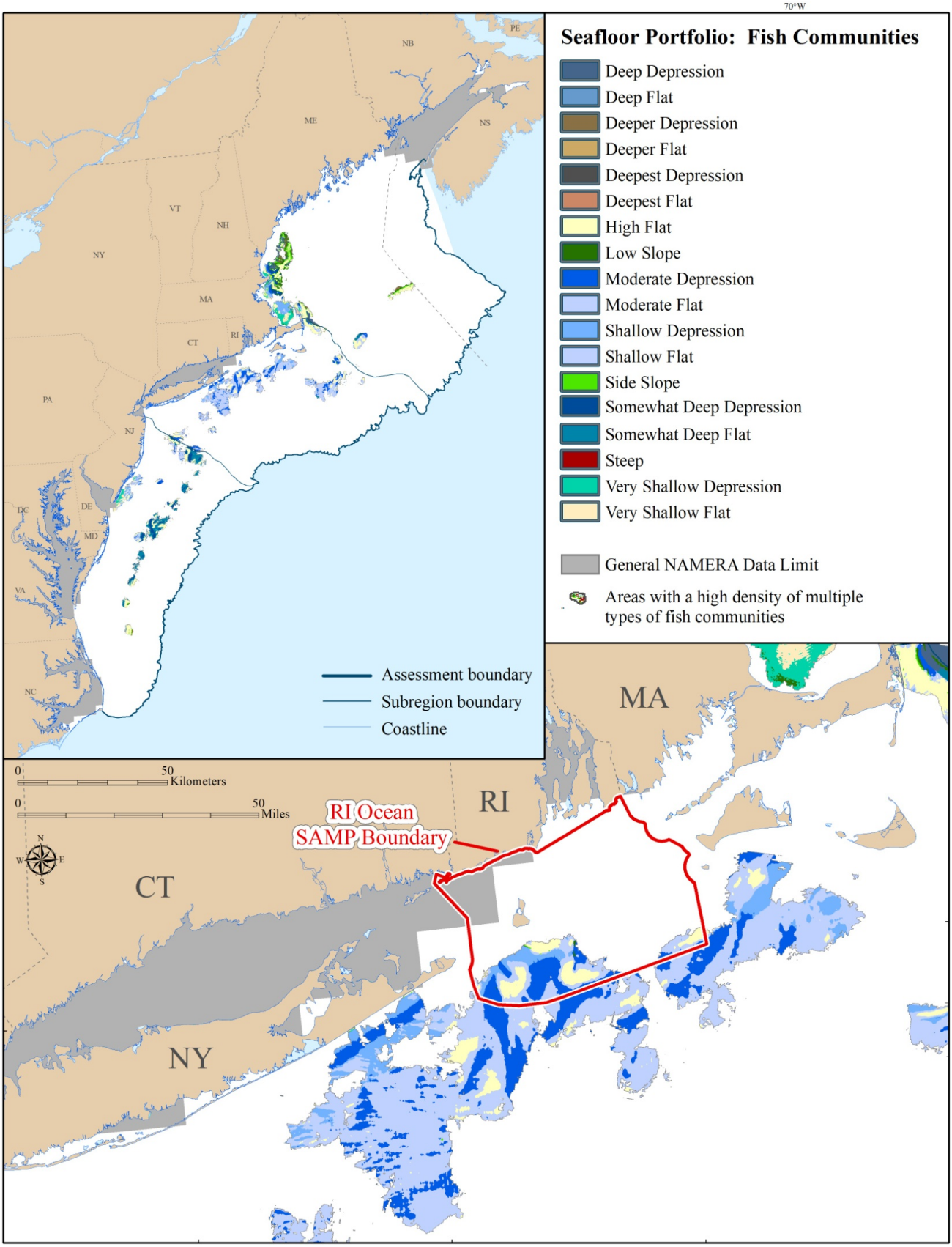

Figure 4 – Demersal fish community diversity portfolio

Hard Bottom and Seagrass Habitat

Hard bottom habitat refers to underwater rocky outcrops, flat pavements colonized by marine invertebrates, shallow drowned slopes supporting macroalgae, or hard bottom/gravel mixes that enhance the survival of juvenile fish, such as cod. These hard bottoms are sometimes called 'hard' or 'live' bottoms have a complex structure that attracts and holds an abundance and diversity of marine life and can be considered a cold water analogue to coral reefs. They are known for their diversity but are often under-represented due to the difficulty in sampling them with trawls. A variety of sources were compiled to create a point dataset of hard bottom habitat. Those places with a high density of points were selected for the portfolio and mapped. The glacial history of the waters off of Rhode Island's coast has created a complex of rocky structure that is highlighted in this analysis (Figure 5).

Seagrass beds are another structurally complex habitat that is particularly important for juvenile fish. Places with a significantly higher than average abundance were highlighted and added to the portfolio. In the SAMP study area, the seagrass beds found in Little Narragansett Bay extending to the west were included in the portfolio.

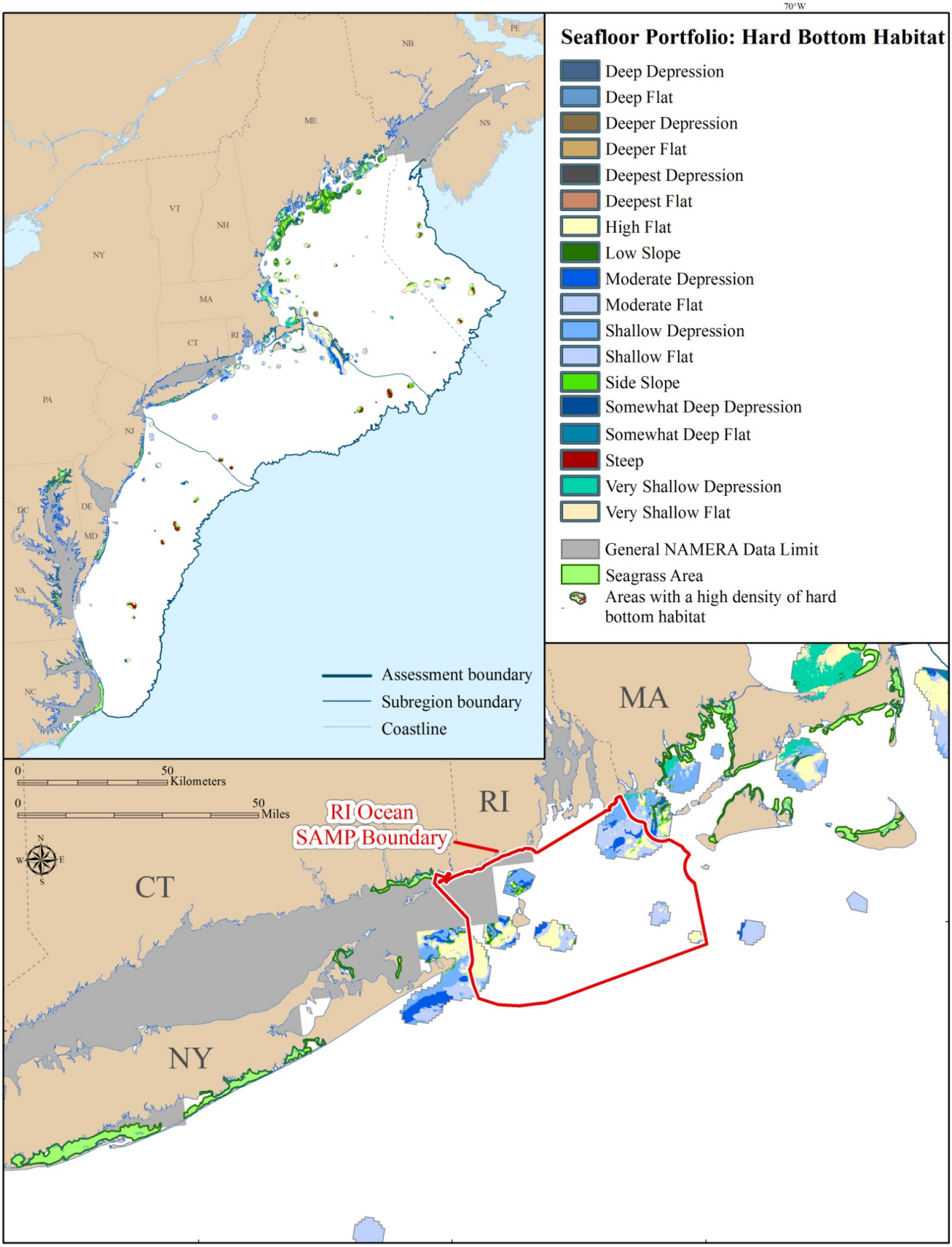

Figure 5 – Hard bottom habitat portfolio

Integrated Seafloor Portfolio

To identify important seafloor features, the persistence of demersal fish species, diversity of demersal fish communities, hard bottom, and seagrass habitats were combined (Figure 6). Corals and canyons were also identified and added, though none were present in the Ocean SAMP area; the closest being a group of corals found around Buzzards Bay.

The resulting map highlighted a number of well known, diverse and productive places. The waters of the Ocean SAMP are at the center of regionally significant, complex and diverse habitat that supports a large number and variety of bottom dwelling fish.

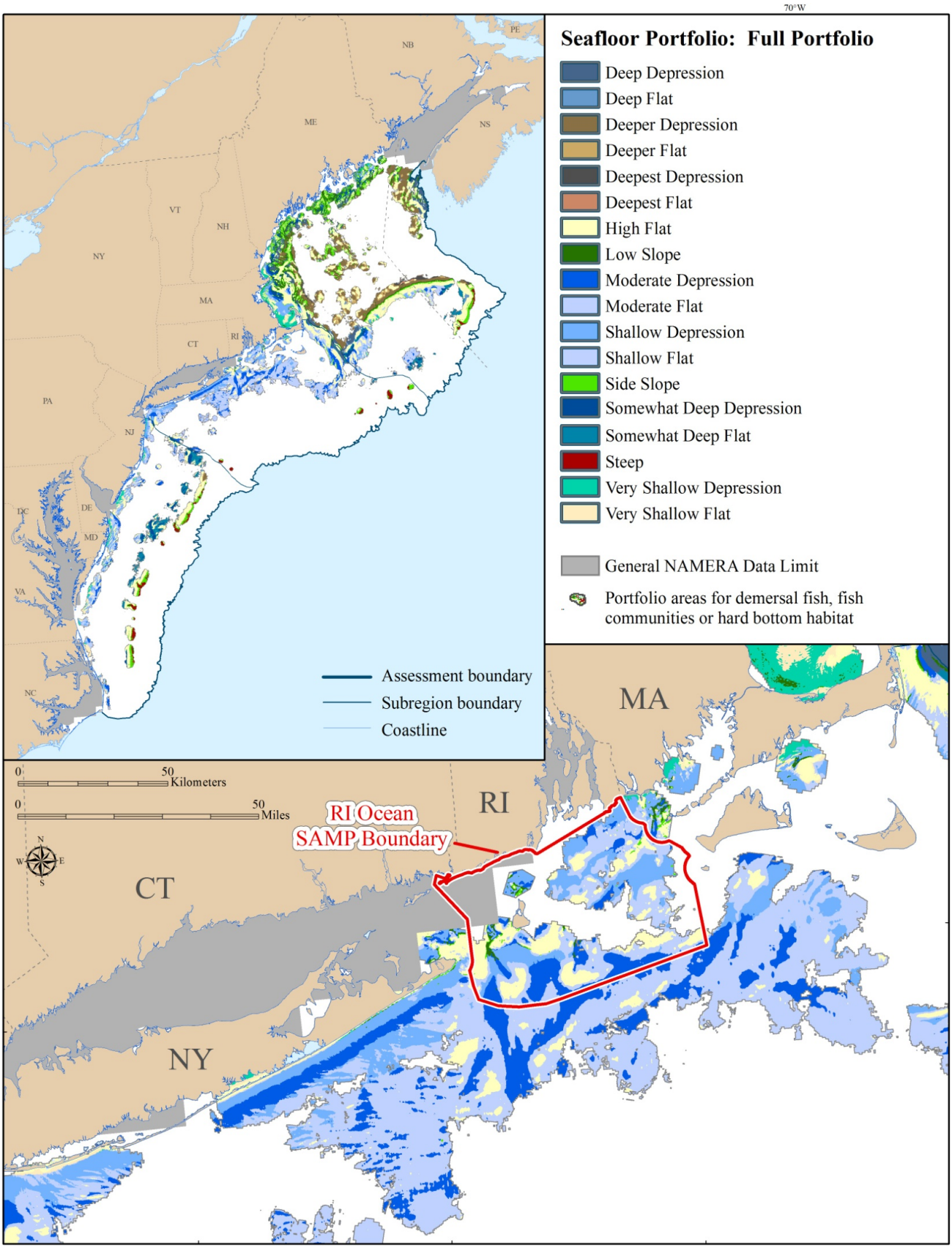

Figure 6 – Full seafloor portfolio

Migratory Portfolio

The large pelagic fish group included highly migratory species such as tuna, swordfish, billfish, and several species of sharks. The wide ranging distribution of these species across diverse habitat types, their roles as apex predators, and their threatened status made them prime candidates for inclusion in the assessment.

The observation data used in this part of the Assessment was mostly fisheries-dependent, tagging program data and cannot be used to estimate abundance. It was useful, though, in highlighting places with persistent richness of species. As with the other fish data, the persistence analysis was based on ten-minute squares. In addition to the large pelagic fish from the migratory species group, the Assessment also considered marine mammals and turtles, some of which travel through or use the waters off of Rhode Island, but these were not as obviously significant and are not highlighted in this appendix.

The region south of Long Island out to roughly the 50 meter isobath, extending eastward to the south of Martha's Vineyard stood out as the place with the highest concentration of ten-minute squares with multiple persistent large pelagic species (Figure 7). The majority of this portfolio occurs here and along the shelf slope break.

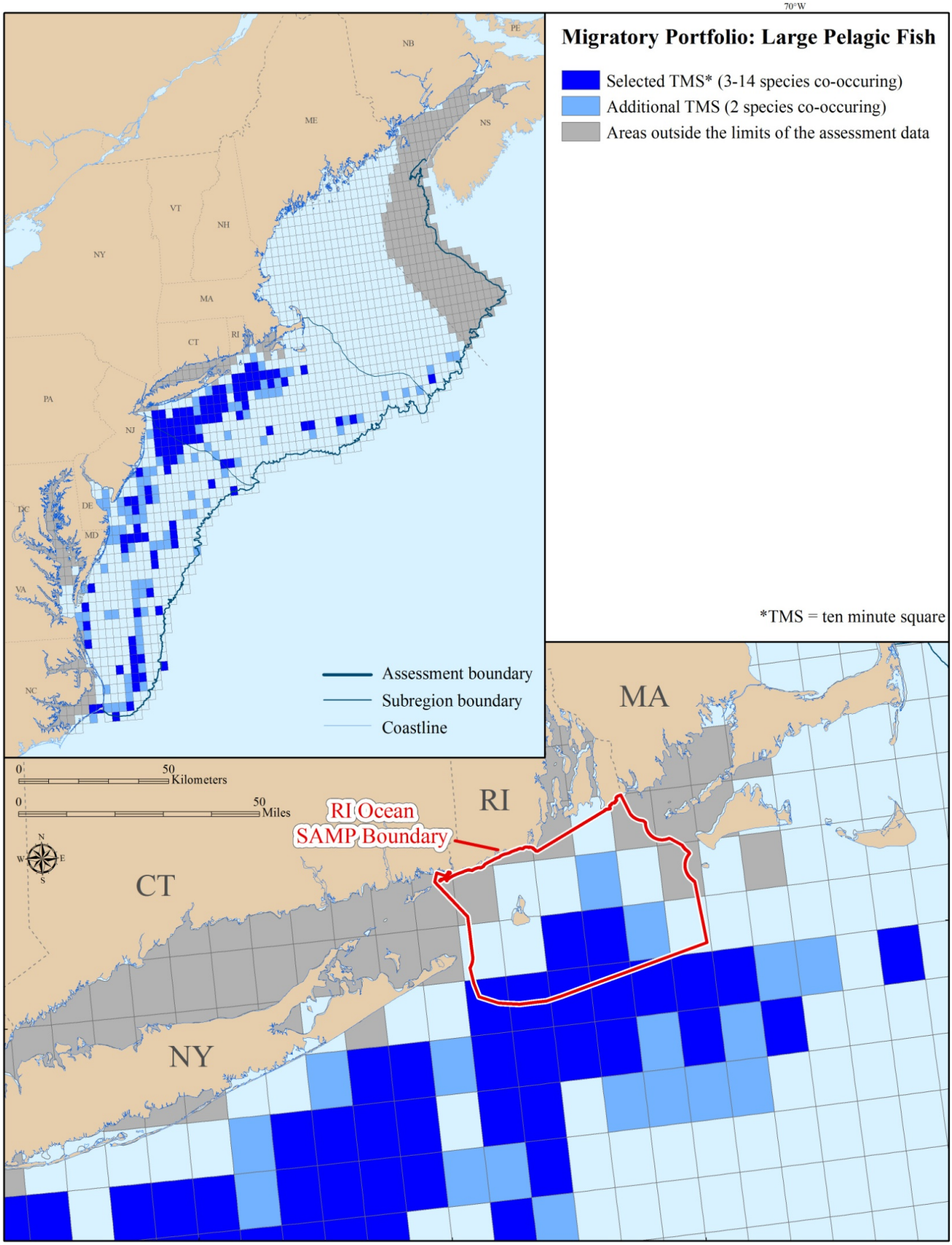

Figure 7 – Large pelagic fish portfolio

Integrated Portfolio

The second phase of the assessment looked at the coincidence of ecologically important seafloor, migratory and coastal habitats. The coastal habitat portfolio included the tidal marsh of Narragansett Bay and Long Island, which also scored highly for contributing to known estuary dependent fish concentrations. This summary focuses on those places that have been identified by the assessment as some of the most significant places for diversity and abundance of species in the Northwest Atlantic (Figure 8). The results highlight the Ocean SAMP area as a significant contributor to this diversity. The southern area of the SAMP contains an overlap of significant migratory and benthic habitats and stands out as one of the most consistently diverse places in the entire Northwest Atlantic region.

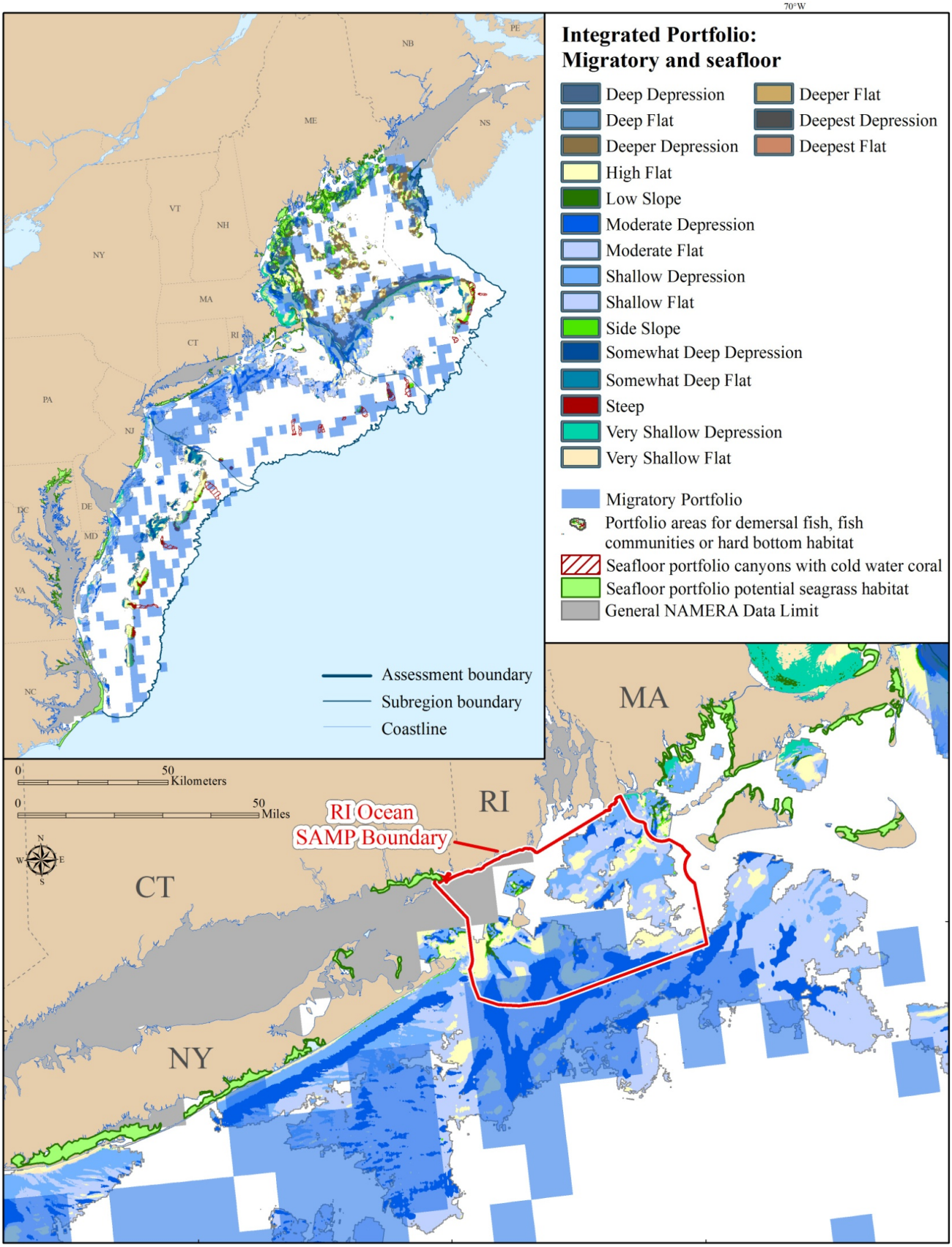

Figure 8 – Integrated seafloor and migratory portfolio

Conclusions

The purpose of this summary is to highlight the major findings of the Northwest Atlantic Marine Ecoregional Assessment at a scale usable for the RI Ocean SAMP. All of the maps of individual species distributions and detailed descriptions of the analyses that were used to form these conclusions are available for review.

The value of this assessment to the RI Ocean SAMP plan is primarily the broader, regional perspective that it brings. It highlights the incredible ecological value of the migratory pathways, tidal marsh, seagrass beds, diverse benthic habitats and productive waters around Rhode Island, when compared with the entire Northwest Atlantic. This seascape is uniquely positioned. It is sheltered by the remnants of its glacial past, with an abundance of hard bottom structure opening up to the sandy flats and depressions of the open ocean. It is this transitional zone that is highlighted most significantly by the Assessment, but the entire area of the RI Ocean SAMP is clearly important, particularly to demersal fish.

Given the inconsistent scales of the Assessment and the Ocean SAMP the most valuable contribution of the Conservancy's analysis are the methodologies developed and not the results. It is the Conservancy's recommendation that the methodology developed for the entire eco-region be adapted and scaled down to the Ocean SAMP area. This would allow for the incorporation of more detailed locally available data into an analysis that could provide spatially explicit results at a meaningful scale. The end product would be the identification of specific ecologically significant areas that warrant conservation under future ocean management/planning strategies in Rhode Island.

The ecological value of this region needs to be considered as human uses are proposed within it. More detailed study of the area, and of project sites, is needed to understand which habitats may be particularly vulnerable to proposed developments. A great deal of this detail is available within the body of the Ocean SAMP document and its appendices but more information, both general and site specific, will be needed in the future.

Literature Cited

Anderson, M.G, J. Odell, M. Clark, Z. Ferdaña, and J.K. Greene. 2010. The Northwest Atlantic Marine Ecoregional Assessment: Identifying Conservation Areas in the Northwest Atlantic Marine Region. Phase Two. The Nature Conservancy, Eastern U.S. Division, Boston, MA.

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