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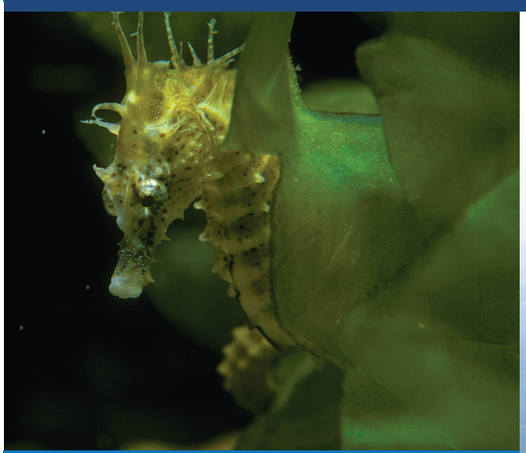
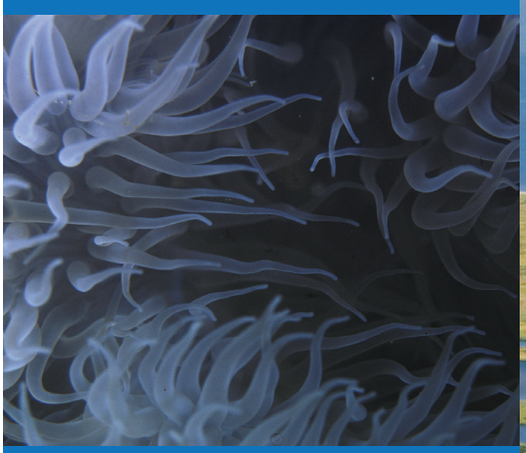
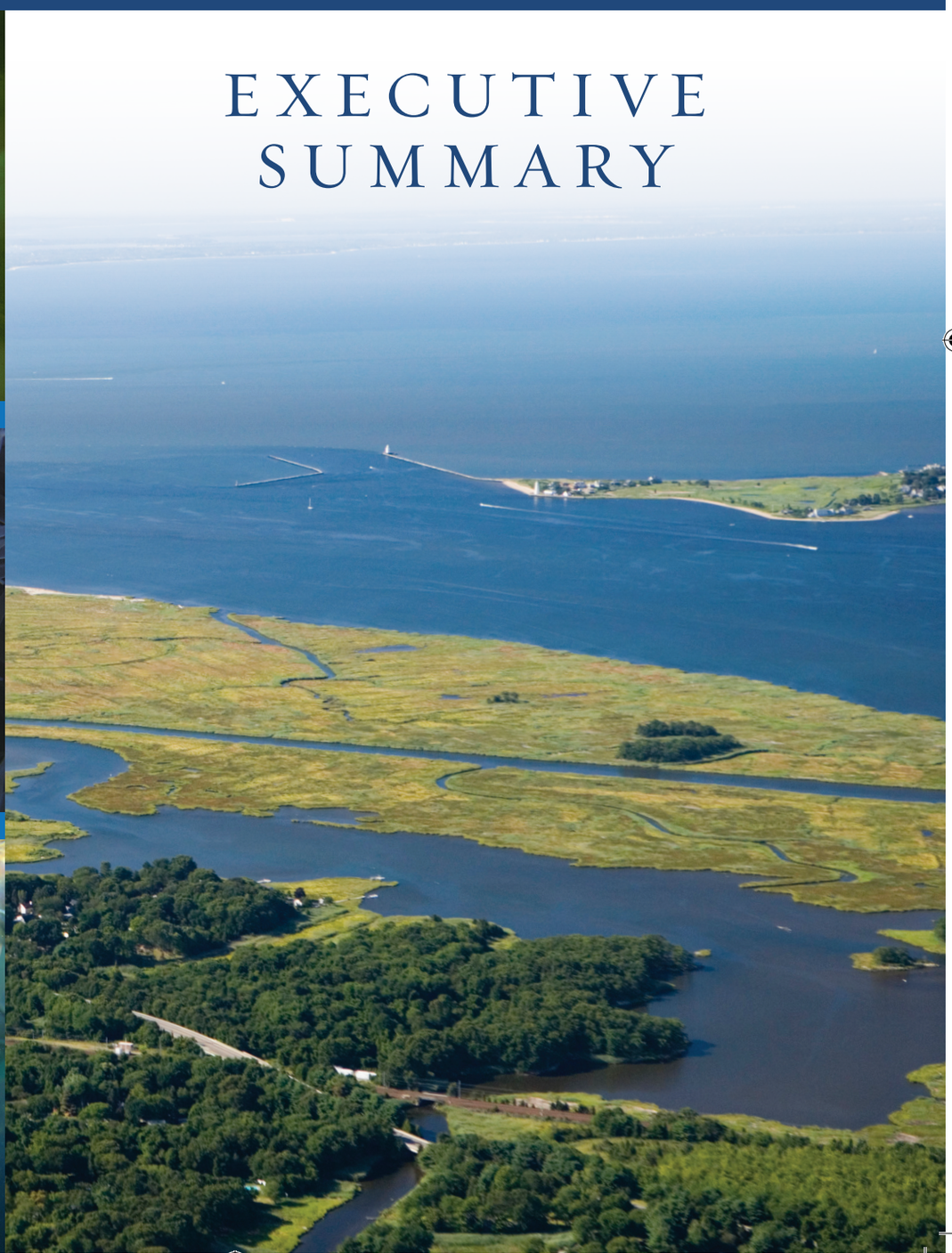
The Long Island Sound Ecological Assessment





EXECUTIVE SUMMARY



the Long Island Sound ecological assessment 2015

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Long Island Sound and its confluence with the Connecticut River, Old Lyme, CT
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Piping plover chicks
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acknowledgements

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The data sources obtained and used in the LISEA were the foundation of the project. The Nature Conservancy greatly appreciates the support of the Connecticut Department of Energy and Environmental Protection, the New York Department of Environmental Conservation, Suffolk County, the U.S. Geological Survey, Stony Brook University's School of Marine and Atmospheric Sciences, University of Connecticut's Department of Marine Sciences, NOAA's Northeast Fisheries Science Center, National Ocean Service and National Geophysical Data Center for their support of this project including the provision of key data sources.

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Piping plover
© David Gumbart/TNC

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Northern star coral © Robert Bachand
Opposite page: Blood star © Robert Bachand

executive summary

From oysters and clams to herring and bass, to the 21 million people who live within 50 miles of its shore, Long Island Sound is a hub of life. On the surface, this large body of water may look the same from one area to another, but its underwater terrain and marine life is remarkably varied and complex, with different species and habitats corresponding to distinct spatial areas or geographies. To better facilitate and locate both the use and conservation of Long Island Sound, it is critical to understand its water column and seafloor habitats, the geographic areas in which they occur and the potential ecological significance associated with each of them.

Despite the Sound's extraordinary importance to so many people and to the larger regional environment, no single comprehensive inventory of its most valuable and significant features exists to guide management, planning and conservation decisions. **The Long Island Sound Ecological Assessment (LISEA) is designed to enhance our understanding of ecologically notable places in Long Island Sound and the surrounding waters of Block Island Sound and the Peconic Estuary.** By contributing new information and an enhanced spatial understanding of these waters to decision-makers and stakeholders, The Nature Conservancy (the Conservancy) is working to support actions that reduce conflicts among human uses and ecologically important resources. In addition, the information and insights gained through this assessment will help shape the direction of the Conservancy's conservation work in Long Island Sound.

The LISEA identifies ecologically notable places and seafloor habitats for the Sound and surrounding waters derived from the collection, organization and spatial analysis of biological and physical data across the geography of the study area using a methodology based on the Northwest Atlantic Marine Ecoregional Assessment (NAM ERA Greene et al. 2010, Anderson et al. 2010). The NAM ERA is a large-scale marine assessment of ocean waters that extends from Cape Hatteras, North Carolina to the Bay of Fundy, Canada. Thanks to generous contributions from many scientists, the LISEA makes use of new and recently available data to identify spatial areas within Long Island Sound that emerge both for their biological significance and their distinct seafloor features. The term "spatial areas" refers to geographically specific locations, such as you would find on a map. It should be noted that data limitations are a factor in how complete and accurate any ecological assessment can be, including the LISEA.

Top: The NOAA research vessel Thomas Jefferson is participating in the Seafloor Mapping Project.
© NOAA

Opposite Page: A Conservancy volunteer examines a clam while collecting eelgrass.
© Mark Godfrey/TNC

This report addresses these limitations and identifies the types of data that remain critical to obtain.

The primary result of the LISEA is the identification of Ecologically Notably Places (ENPs) that help sustain the diversity of marine life in the Sound. These places were located using two complementary assessments: analysis of biological data (fisheries) and areas of seafloor complexity (complex bottom structure used as a proxy for marine life and habitats). Seafloor complexity tends to be found in areas where there is high biodiversity, rugosity or physical structure, but there is generally a lack of adequate biological data for these hard-to-sample areas. The biological data analysis focused on species persistence patterns and was produced from nearly 30 years of extensive fishery trawls courtesy of the Connecticut Department of Energy and Environmental Protection (CT DEEP). These data also allowed fisheries trends to be presented, although this was not the primary focus of the assessment.

The second major result of the LISEA is the identification of seafloor habitats described as Ecological Marine Units (EMUs). These serve as a contributing factor in identifying Ecologically Notable Places (ENPs) and provide a descriptive foundation for seafloor habitats in the Sound. They also delineate differences in seafloor habitats spatially.

As significant as these ENPs and EMUs are, they represent a partial view of Long Island Sound's complex ecosystem. They can contribute, however, to the broader picture of the Sound that is necessary for comprehensive, effective management and conservation. They should be used in conjunction with previous and future assessments to reveal a more complete picture of the Sound's interdependent habitats and ecological processes.

conservation purpose

The LISEA was developed to support conservation of ecologically and biologically significant resources in Long Island Sound, particularly those associated with the sea floor and within the water column.

Toward this end, the LISEA may serve multiple conservation interests. One of the most valuable contributions may be in support of coastal and marine spatial planning for the Sound, where ecological resources are given serious consideration in a process that seeks to compatibly integrate multiple and often competing human uses. Another benefit may be the contribution the LISEA can make to the Cable Fund Seafloor Mapping Project currently underway. The LISEA is also intended to support the Conservancy's Long Island Sound conservation and restoration efforts. Additionally, the LISEA contributes to a growing body of knowledge about methods and approaches for identifying ecologically significant areas within coastal estuaries.

seafloor habitats and ecologically notable places

Seafloor Habitats

To identify Long Island Sound's seafloor habitats ("Ecological Marine Units"), a geographically comprehensive map was created based on depth, sediment grain size and seafloor topography, and informed by the distribution of benthic organisms. Characterizing bottom habitat types provides a descriptive overview of the sea floor and allows for comparisons and correlations with other elements of the Sound's biota and ecology. In addition to Long Island Sound, seafloor habitats and seafloor complexity areas were also identified for Block Island Sound and the Peconic Estuary. See summary map below (Figure ES-1).

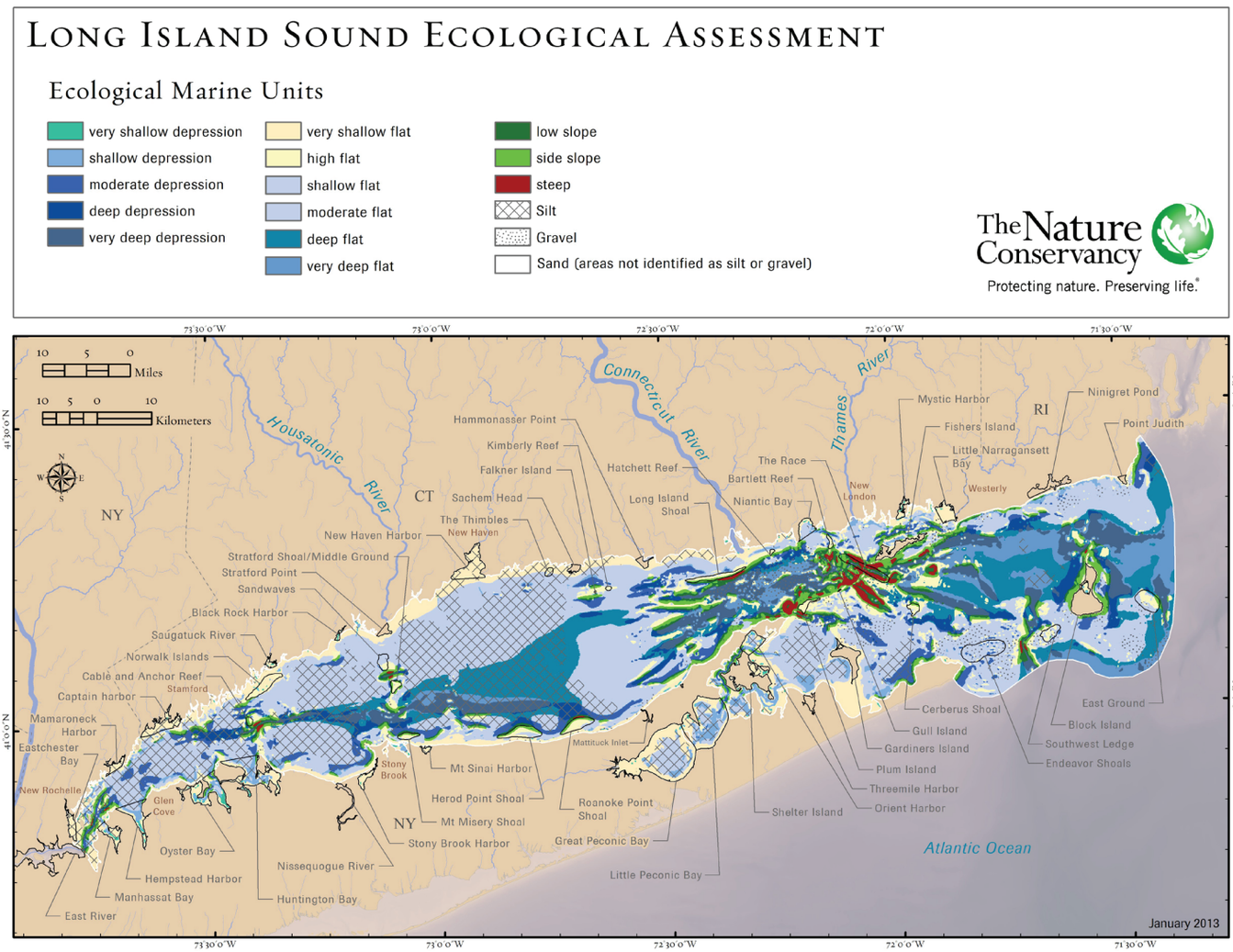


Figure ES- 1. Seafloor Habitats (EMUs) across the geography of the LISEA.

Note: areas characterized by silt are superimposed by a crosshatched pattern; areas characterized by gravel are superimposed by speckled dots; and areas of sand are those areas without texture that take on the color of the other features noted in the key.

Ecologically Notable Places

There are many potential ways to define what may be considered an ENP. This assessment generally considers four areas to be ecologically notable. The two most prominent examples are described below. The other ENPs the LISEA recognizes are those habitats or places that serve noteworthy ecological functions (e.g., seagrass beds) or areas that support rare or unusual species or habitats. Due to the current lack of comprehensive or Sound-wide data for many of these habitats and areas, only seagrass beds were included as a distinct ENP.

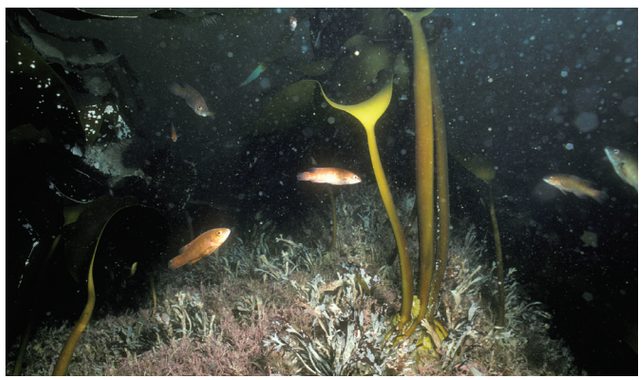
1. Geographic areas with sustained levels of marine diversity (Species persistence)

This refers to those spatially identified areas where there is a relatively sustained level in the richness and abundance of marine organisms. Because the Sound is such a dynamic environment, we used and emphasized the criteria of persistence over decades to identify areas of sustained significance, and focused this analysis on fish and invertebrate data. The availability of the CT DEEP trawl data allowed more than 100 fish and invertebrate species to be analyzed individually for persistence. The areas of high persistence, particularly those with persistence in diversity and relative abundance, are considered Ecologically Notable Places. These ENPs were identified for four groups and mapped as such: demersal fish, pelagic fish, diadromous fish and invertebrates. Although the trawl data is extensive in time and geography, it is relatively sparse in the western and eastern ends of the Sound and immediately along the coast, where sampling is difficult. This means the species persistence results, while strong for the areas sampled, need to be considered in comparison to the areas sampled rather than uniformly for the Sound as a whole.

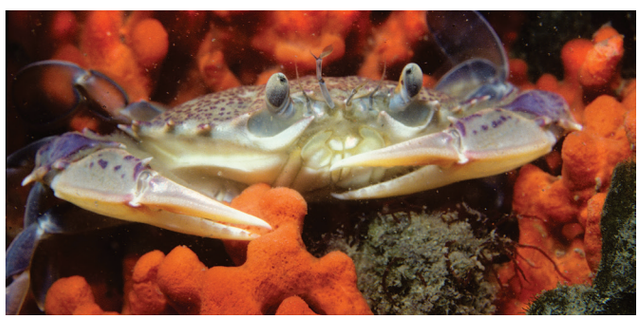
2. Geographic areas of diverse and complex bottom habitat types (Seafloor complexity)

Complex bottom habitats are known for their diversity of marine life, and the LISEA considers these areas ecologically notable because of the general correlation between physical complexity and biological significance. As such, seafloor complexity serves as a proxy for the marine life it is likely to support. Three elements of seafloor complexity were considered and mapped. These are a) hard bottoms such as bedrock or large rock formations like cobbles and boulder fields, b) complex bottom bathymetry and c) high levels of variability in seafloor characteristics (depth, shape, sediments) occurring within a given geographic area (EMU richness).

The pelagic fish species group includes Crevalle jack, shown here.
© Kevin Lawyer



Seafloor complexity is generally correlated with greater biological diversity and marine life activity.
© Peter Auster



Blue crab on bottom structure.
© Robert Bachand

depicting ecologically notable places in portfolios

ENPs were identified for seafloor complexity and also for species persistence, as described above. The next step was to re-group these ENPs into those associated with the sea floor and those associated with the water column. The ENPs associated with the sea floor were combined to make the seafloor portfolio. The ENPs associated with the water column were combined to make the water column portfolio. Finally, the seafloor and water column portfolios of ENPs were combined into an overall summary, or integrated portfolio.

Seafloor Portfolio

The ENPs contributing to the seafloor portfolio included: areas of notable seafloor complexity, demersal fish persistent areas, invertebrate persistent areas and seagrass beds.

Water Column Portfolio

The ENPs in the water column included: pelagic and diadromous fish persistent areas.

Integrated Portfolio

By combining the seafloor and water column portfolios into an integrated portfolio, an integrated set of ENPs is presented. This is the final culmination, or summary, result of the LISEA. See summary map on the next page (Figure ES-2). In the regions of Block Island Sound and the Peconic Estuary the ENPs do not represent biological data or species persistence, only notable seafloor complexity.

Ecological Importance of All Areas

The Integrated Portfolio map illuminates ENPs as shown by the various colors; however, it is important that this not be interpreted to suggest that other areas shown on the maps (as white or gray) are not ecologically important. Gray areas were not sufficiently sampled. White areas had adequate sampling and did not meet the LISEA-based selection criteria for ENPs, however both white and gray areas may be significant for other factors or considerations beyond the scope of the LISEA. All areas of the Sound contain some form of life or participate in some ecological process and may be ecologically important depending on what is being considered.

Ecologically Notable Places: Detailed Descriptions

To facilitate greater insight into what the ENPs look like on the sea floor or in the water column, we form a descriptive picture for each of the locations where ENPs are noted. The full set of descriptions, based on the underlying data, is found in Appendix D. In essence, the basis for the ENPs within each grid cell is "un-packed" and described along with other data and descriptive parameters. The descriptions include details about the ecologically notable species, habitats and/or seafloor complexity within the cell. It describes the EMUs there and associated physical features such as depth, shape or the presence of hard bottom along with additional information and parameters. An example is provided in Chapter 7 of the Project Report.

Atlantic salmon are included in the diadromous fish sampling.
© Hans-Petter Fjeld

Ecological Marine Units (EMU) distinguish seafloor habitats of Long Island Sound.
© Robert DeGoursey

Four-bearded rockling in western LIS.
© Robert Bachand

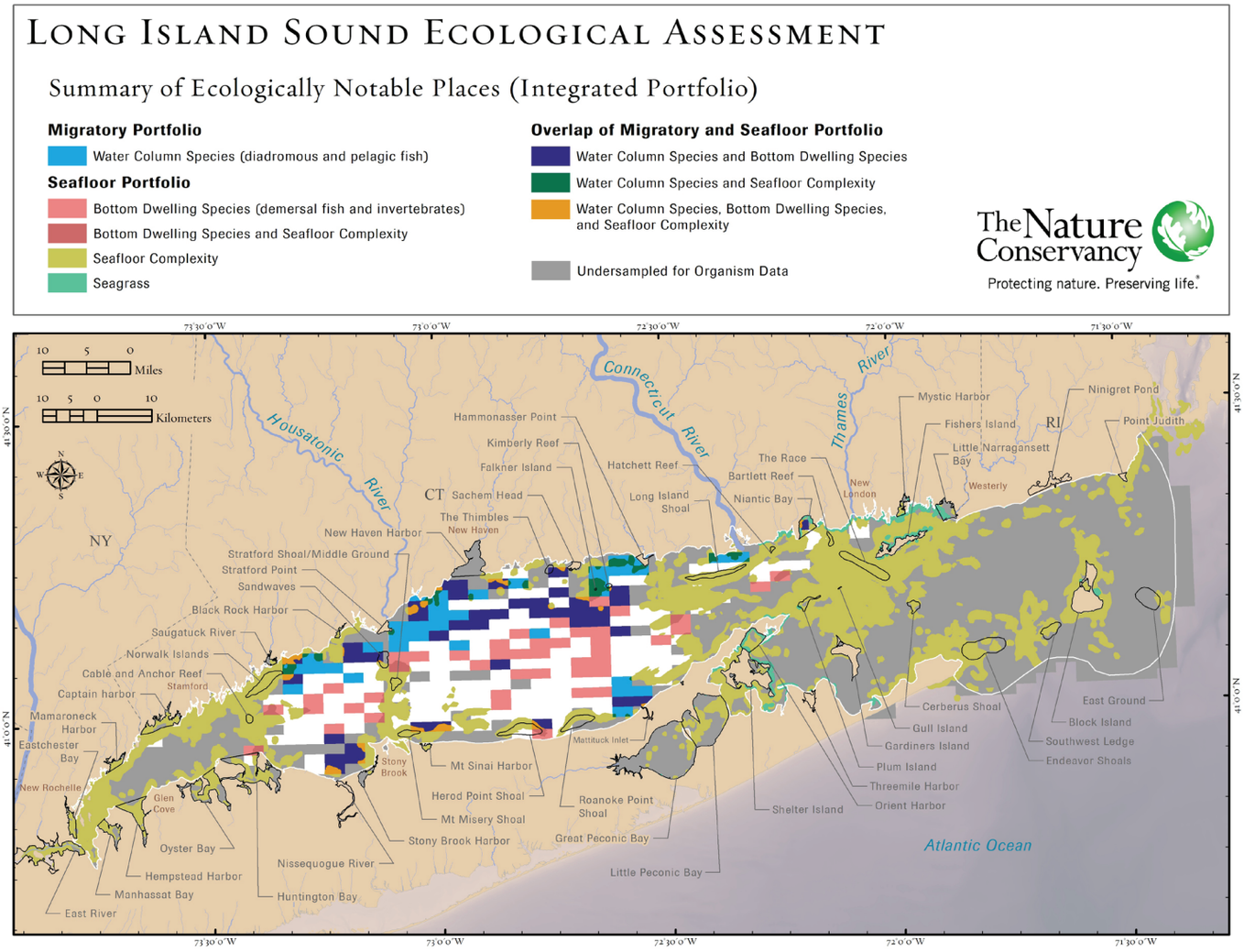


Figure ES- 2. Summary of Ecologically Notable Places: Integrated Portfolio (ENPs).

Note: white and gray areas do not suggest these areas are not ecologically significant or important. Gray areas were not sufficiently sampled, and both white and gray areas may be significant for any number of other factors or considerations not addressed by the LISEA methodologies or data.

discussion of results

The Seafloor Habitats (EMUs) and Ecologically Notable Places (ENPs) maps convey insights into the submerged environments of Long Island Sound. A few are noted here.

1. The eastern part of Long Island Sound and western portions of Block Island Sound contain the areas with the greatest slopes and bathymetric complexity.

2. The western-most part of the Sound contains similar, albeit less extensive, complexity from Stratford Shoal west to the East River, New York.

3. Hard bottom is particularly pronounced along most of the northern shore of the Sound in both Connecticut and New York. There is relatively little hard bottom on the south shore of the Sound.

4. The persistence of both diadromous and pelagic fish generally appears to be stronger near the coast than in other parts of the Sound.

5. Diadromous fish, as expected, are most persistent near the mouths of coastal rivers. The Housatonic and Connecticut Rivers along with the East and West Rivers in the Guilford area, and Nissequogue River on Long Island, were most notable.

6. The persistence of demersal fish is strongest in the middle of the Sound. It was particularly notable south of Falkner Island, an island of the Stewart B. McKinney National Fish and Wildlife Refuge.

7. The highest persistence of macroinvertebrates is concentrated along the western shoals.

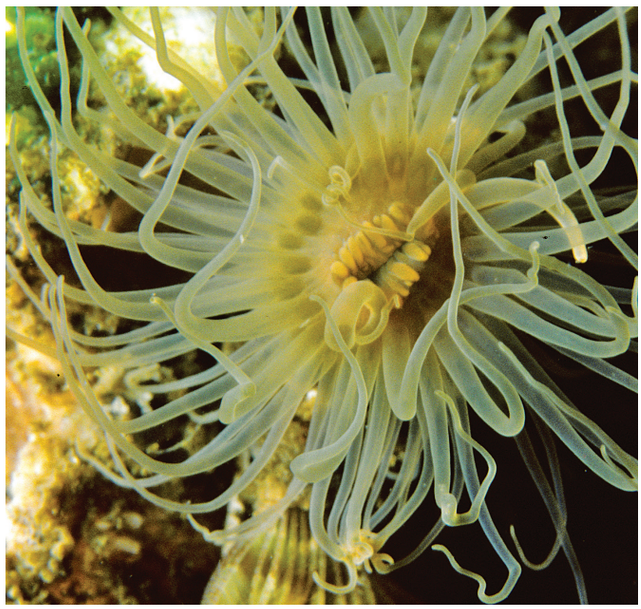
8. The highest levels of species richness (Chapter 6) tend to be located along the coast and at river mouths, and in the central depression of the Sound.

9. There appears to be a correlation between the demersal fish species persistence results and seafloor features in the central part of the Sound. However, beyond this apparent correlation there generally does not appear to be other obvious correlations between the seafloor habitats identified by the LISEA and the species persistence results for Long Island Sound. This may be because fish and invertebrate data generally was not available for the structurally complex, hard bottom areas where the correlation may be expected to be higher. Conversely, it may also be because the differences in EMUs in the areas where fish and invertebrate data exist may not be striking enough to correlate with the fish persistence results. It may also reflect distributional changes due to documented warming trends in the Sound and the Atlantic Ocean. These shifts may be confounding spatial correlations and may be more important than the lack of data from un-trawlable grounds. Further examination of the demersal fish and invertebrate results with the EMUs is warranted.

10. The ENPs are widespread and cover the broad geographic range of the Sound, including the western Sound. Despite better water quality and overall ecological integrity generally ascribed to the eastern part of the Sound,

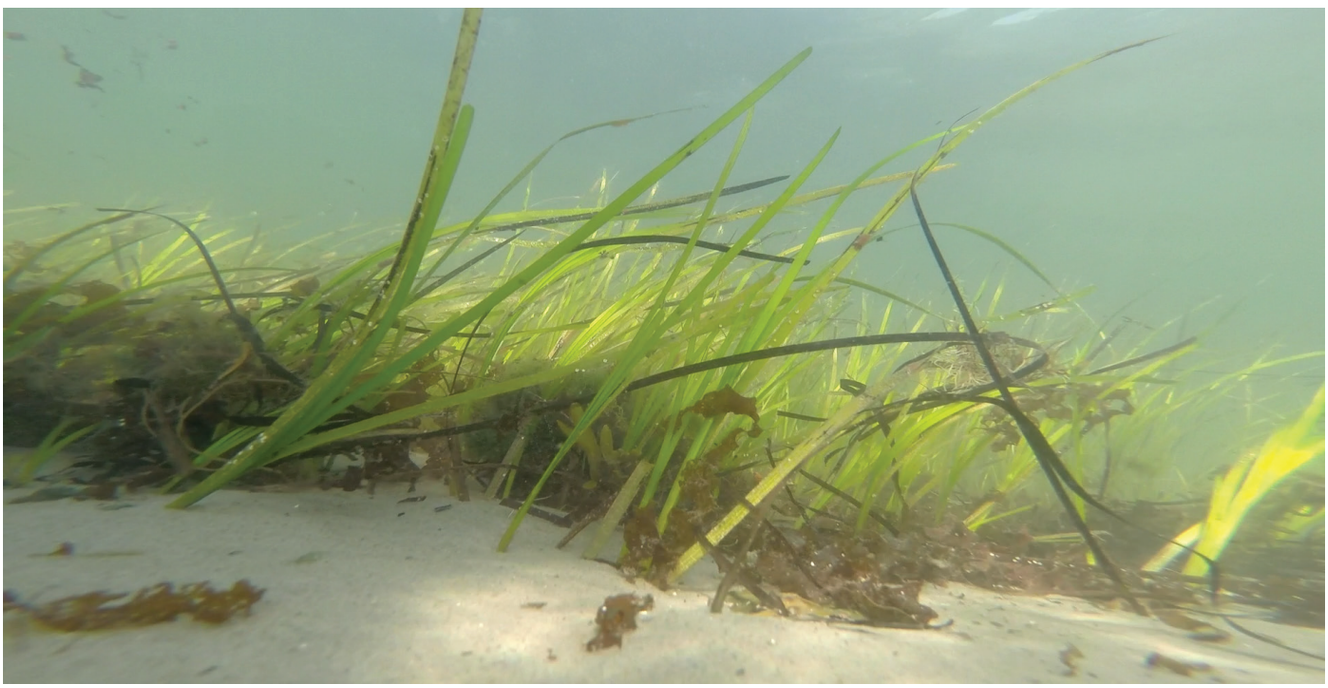
results of analyses presented here suggest that all sections of the Sound contain ENPs. These findings are based on both the distribution of areas of high species persistence and seafloor complexity.

11. Although not intentional in the design of this assessment, a more geographically complete picture of the Sound is portrayed by using both biological data and seafloor complexity. The biological data was used where it was available and seafloor complexity was available for the entire study area, serving as a proxy for locations where empirical biological data was sparse or nonexistent. The complex seafloor areas tend to occur in those places where there is a lack of viable biological data, and areas with robust biological data tend to be located in the areas without pronounced seafloor complexity. Although each of these two classification approaches are different and the results are therefore not directly comparable or uniform, together they allow depiction of ENPs across the Sound's diverse geography. This depiction also shows that a significant portion of the Sound is noted for some type of ecologically notable place.



Sea anemone, part of the complex ecosystem that is Long Island Sound.
© Robert Bachand

Opposite Page: Shellfish are an important part of the Long Island Sound Ecosystem.
© Carl Lobue/TNC



Seagrass located by Fisher's Island in the eastern part of Long Island Sound
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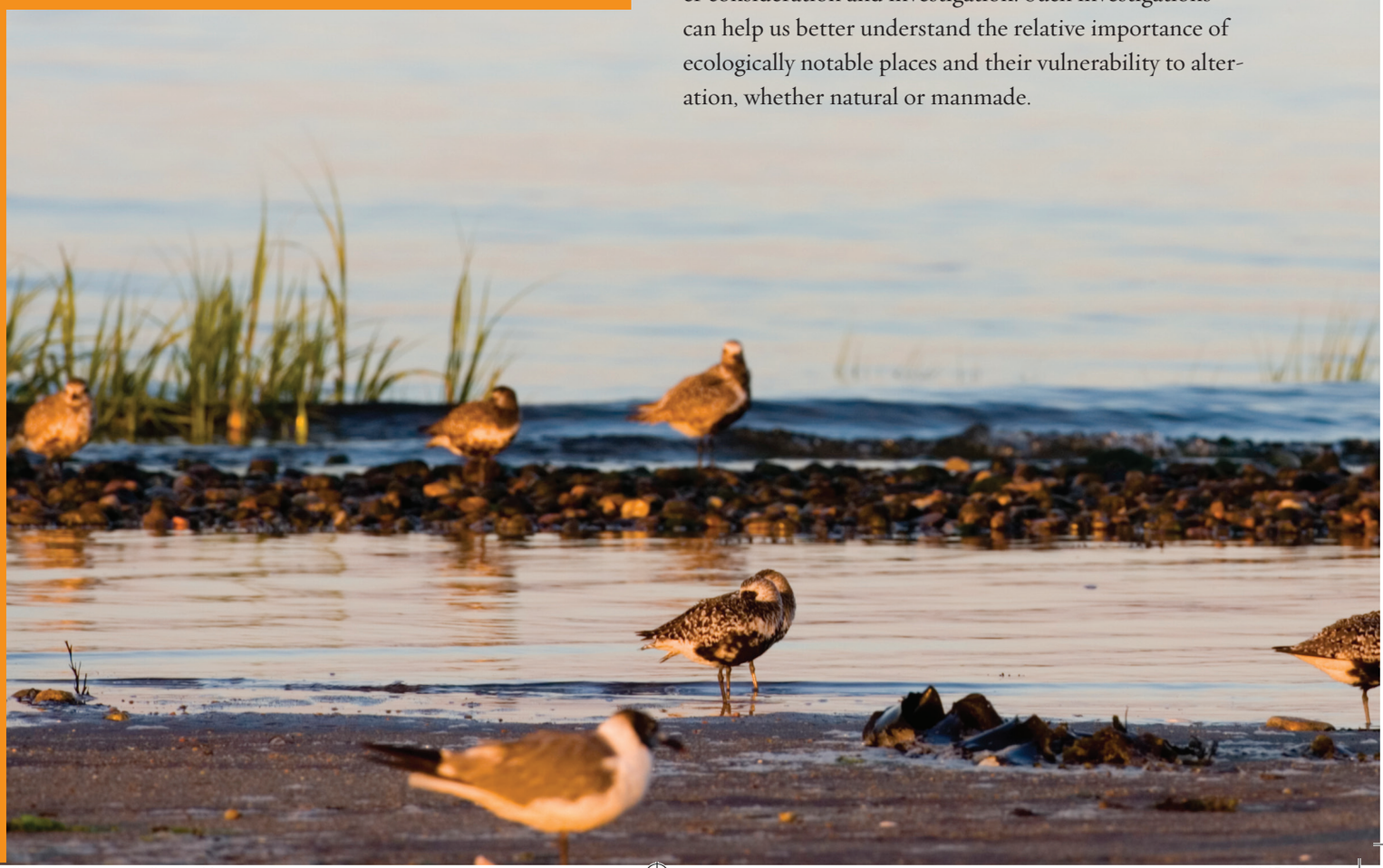
summary

The LISEA project has identified ecologically notable places in the submerged areas of Long Island Sound and seafloor habitats for Long Island Sound, Block Island Sound and the Peconics. This provides the Conservancy with its first significant guidance in understanding the aquatic and seafloor environments of Long Island Sound. There are several potential conservation uses of the LISEA by the Conservancy and others, which are addressed in the report.

The ENPs identified here are important to consider for conservation and management purposes. They represent some of the areas that play a key role in sustaining the marine life and ecological integrity of the Sound. As such, they make a valuable contributions to the economic and social well-being of people who rely on and enjoy the Sound—from commercial activities and recreational use, to the quality of life associated with a water body of high ecological integrity.

The identification of ENPs through the LISEA is based on what the available data and methods are able to show. There are likely additional and different ENPs that would emerge with new data, criteria and/or methods. The LISEA results presented here serve as a guide, calling attention to geographic or spatial areas that deserve greater consideration and investigation. Such investigations can help us better understand the relative importance of ecologically notable places and their vulnerability to alteration, whether natural or manmade.



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