



Rhode Island Wildlife Action Plan

Chapter 2

Rhode Island's Fish and Wildlife Habitat

Chapter 2: Table of Contents

Introduction 3

Rhode Island’s Landscape..... 4

 Physiography 4

 Geology..... 5

 Soils 8

 Climate 9

Ecological Regions of Rhode Island’s Landscape 10

Ecological Habitat and Vegetation Systems 12

 Uplands 15

 Early Successional Habitats 21

 Agricultural Lands 22

 Wetlands 25

Aquatic Habitat Systems 31

Lakes and Ponds..... 34

Marine Habitats 35

Identifying Key Habitats 38

Citations and Sources 47

Chapter 2: List of Figures

Figure 2-1. Physiography of Rhode Island..... 5

Figure 2-2. Bedrock Geology Map of Rhode Island..... 7

Figure 2-3. Soils Map of Rhode Island..... 9

Figure 2-4. TNC Ecoregions Map 11

Figure 2-5. EPA Ecoregions for Massachusetts, Rhode Island, and Connecticut..... 12

Figure 2-6. Land Use/Land Cover Map of Rhode Island 13

Figure 2-7. Extent of forest in Rhode Island. 17

Figure 2-8. Distribution of Forest Blocks >500 Acres 19

Figure 2-9. Distribution of Non-forested Upland Habitats in Rhode Island..... 21

Figure 2-10. Distribution of Farmland in Rhode Island 23

Figure 2-11. Distribution of Prime and Important Farm Soils in Rhode Island 24

Figure 2-12. Freshwater Wetland Distribution in Rhode Island 26

Figure 2-13. Distribution of Estuarine Wetlands in Rhode Island 29

Figure 2-14. Impaired Waters of Rhode Island for One of More Designated Uses 31

Figure 2-15. Distribution of Cold Water Streams in Rhode Island. 33

Figure 2-16. Bathymetry of Rhode Island Marine Waters..... 35

Figure 2-17. Rhode Island’s Marine Habitats..... 37

Figure 2-18. Habitat Resources Identified by the Rhode Island Resource Protection Project 39

Chapter 2: List of Tables

Table 2-1. Acreage of Forest Types in Rhode Island 16

Table 2-2. Approximate Forest Area in Rhode Island from 1630 to 2011 18

Table 2-3. Acreage of Non-forested Upland Habitats in Rhode Island..... 20

Table 2-4. Acreage of Fresh Water Wetland Habitats in Rhode Island 25

Table 2-5. Primary Flowing Water Habitats in Rhode Island
with Estimated Percent of Each in State 32

Table 2-6. Key Habitats for SGCN in Rhode Island..... 42

Introduction

The distribution and abundance of Rhode Island's wildlife is governed by the availability and quality of habitat. Habitat is defined as the place where an animal normally lives, often characterized by a dominant plant form or physical characteristic (e.g., stream habitat and forest habitat). The state's varied geology, soil types, topography, and hydrology support a range of plant communities that provide a complex ecological framework of habitats for Rhode Island's fish and wildlife diversity. This document uses the term "habitat" to include ecological communities, vegetation communities, geographic features, and other discrete entities that can be mapped that support fish or wildlife species of greatest conservation need (SGCN). This chapter identifies Rhode Island's Key Habitats, addressing Element 2 regarding their relative condition and extent in the state.

Rhode Island is part of the northeastern U.S. region that extends from Maine to Virginia. A brief overview of this region provides a context for understanding Rhode Island's contribution to regional biodiversity. The Northeast is more than 60% forested, with an average forest age of 60 years. It contains more than 200,000 miles of rivers and streams, 34,000 water bodies, and more than 6 million acres of wetlands. Eleven globally unique habitats, from sandy barrens to limestone glade, support 2,700 restricted rare species. Habitat fragmentation is one of the greatest challenges to regional biodiversity, as the region is crisscrossed by more than 732,000 miles of roads. The region also has the highest density of dams and other obstacles to fish passage in the country, with an average of 7 dams and 106 road-stream crossings per 100 miles of river (Martin and Apse 2011). Conversion to human use has also impacted much of the northeast landscape, with one-third of forested land and one-quarter of wetlands already converted from its natural state to other uses through human activity. Total wetland area has expanded slightly in the Northeast over the past 20 years, although 67% of wetlands are close to roads and thus have likely experienced some form of disruption, alteration, or species loss (Anderson et al. 2013a).

A conservation status assessment of regionally significant fish and wildlife species and habitats was completed by The Nature Conservancy (TNC) in 2011 with support from NEAFWA (Anderson and Olivero Sheldon 2011). TNC applied key indicators and measures for tracking wildlife status developed by the NEAFWA Monitoring and Performance Reporting Framework and detailed in the report *"Monitoring the Conservation of Fish and Wildlife in the Northeast: A Report on the Monitoring and Performance Reporting Framework for the Northeast Association of Fish and Wildlife Agencies"* (NEAFWA 2008) (refer to Chapter 5). The conservation status assessment reports the condition of key habitats and species groups (e.g., bird population trends) in the region, and this information is summarized below. http://www.rcngrants.org/sites/default/files/final_reports/Conservation-Status-of-Fish-Wildlife-and-Natural-Habitats.pdf.

The recent geospatial condition analysis project (Anderson et al. 2013b) assesses several important metrics of the condition of 116 terrestrial and aquatic habitats across the Northeast using the standardized region-wide habitat mapping data of streams and terrestrial ecosystems developed through the RCN Grant Program (Gawler 2008). The geospatial condition report is a companion to the Northeast Habitat Guides. It presents additional information on the condition and levels of human impact on the habitats in the region <http://nature.ly/habitatguides>.

One-sixth (16%) of the region is conserved and five percent of that land is secured explicitly for nature (GAP 1 or 2). The secured land is held by more than 6,000 fee owners and 2,000 easement holders. State government is the largest public conservation land owner, with 12 million acres, followed by federal government, which holds 6 million acres. Private lands held in easements account for 3 million acres and land owned by private non-profit land trusts accounts for another 1.4 million acres. Land conversion, however, outweighs land conserved by roughly 2:1 (28%:16%) (Anderson et al. 2013a).

Approximately 23% of the terrestrial habitats and 63% of mountain habitats are conserved in the Northeast. A few low-elevation coastal habitats including the Central Atlantic Coastal Plain Maritime Forest (89%) and Great Lakes Dune and Swale (69%) were also well conserved. Piedmont habitats were the least conserved habitats in the region, especially the Southern Piedmont Mesic Forest (3%), Southern Piedmont Dry Oak-Pine Forest (3%), Piedmont Hardpan Woodland and Forest (2%) and Southern Piedmont Glade and Barrens (0%). Among wetlands, the Atlantic Coastal Plain Peatland Pocosin and Canebrake (99%) and Atlantic Coastal Plain Northern Bog (72%) were habitats with a high percentage of conserved acreage (Anderson et al. 2013a).

The geospatial analysis also provides metrics which follow the Northeast Monitoring and Performance Reporting Framework (NEAFWA 2008). These are calculated relative to each habitat type using the region-wide maps, which allow each habitat in the region to be evaluated across its entire range. Please see:

<https://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/edc/Pages/geospatial.aspx>.

Rhode Island's Landscape

From the maritime beaches of South County and Block Island, to the extensive wetland systems of the Wood-Pawcatuck River watershed, to the rolling forests of western Rhode Island, and the farmland in Newport County, the state's total land area of 1,054 square miles supports a wide variety of habitats for fish and wildlife. Western Rhode Island is largely rural, while the region surrounding Narragansett Bay is increasingly urban. In fact, Rhode Island is the second-most densely populated state in the country and pressure from human use can be significantly greater during the summer, especially in coastal areas. Development pressures on the remaining natural landscape continue to rise, threatening the health of many of the state's ecosystems. The state has developed numerous conservation and management plans to protect its natural resources, and this SWAP serves as a catalyst to coordinate these existing plans.

Physiography

Rhode Island is divided into three main topographical regions. A narrow coastal plain with elevations of less than 100 feet lies along the south shore and around Narragansett Bay. A second region characterized by gently rolling uplands with elevations up to 200 feet lies to the north and east of the Bay. The western two-thirds of the state consist of predominantly hilly uplands, of mostly 200 to 600 feet in elevation; with the highest point located at Jerimoth Hill in Foster (elevation 812 feet) (refer to Figure 2-1).

Narragansett Bay and its tributaries dominate the eastern part of Rhode Island and a low-lying strip along the Bay's western shore. The Atlantic Ocean and Block Island Sound define the southern border of the state. There are more than 30 islands within Narragansett Bay which has 420 miles of shoreline. Block

Island is a well-known landmark 12 miles south of the Rhode Island coast and 14 miles from Montauk Point, Long Island. RI DEM has produced an interactive, on-line Environmental Resources Map that illustrates the state's topography at <http://www.dem.ri.gov/maps/index.htm#GV>.

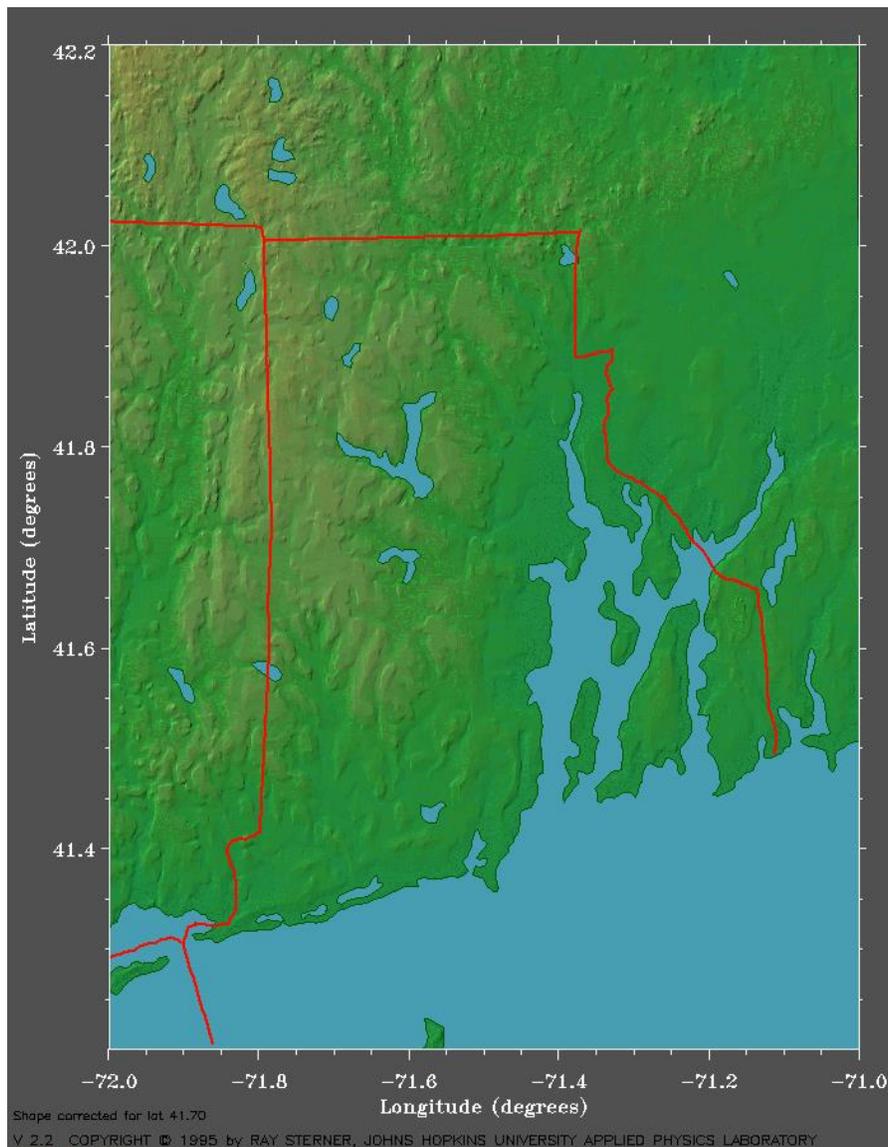


Figure 2-1. Physiography of Rhode Island. Source: Ray Sterner, John Hopkins University, Applied Physics Laboratory 2014

Geology

The geologic history of Rhode Island includes two periods of mountain-building followed by extensive periods of erosion that produced the state's current lowland and gently rolling topography (Gibbs et al. 1995; Quinn 1997). The fault lines produced by Rhode Island's mountain-building phases are still present in the Narragansett Bay area and occasionally rock the state with minor earthquakes. The highest magnitude earthquake centered within Rhode Island occurred on June 10, 1951, with an epicenter near Slocum and a magnitude of 4.6 (Wheeler et al. 2000). More recently, a magnitude 3.5 earthquake was felt near Newport on March 11, 1976 (Stover and Coffman 1993). Some areas of the state occasionally

experience stronger earthquakes that are centered elsewhere in the Northeast and eastern Canada (see Figure 2-2).

Most of the state is underlain by igneous and metamorphic rocks that are between 136 and 570 million years old (Figure 2.2; Quinn 1997). This bedrock is typically seen in natural formations along the coast where glaciers and waves have exposed the underlying rocks along the southern coast (e.g., south of Narragansett, Mt. Hope, and Purgatory Chasm). Otherwise, the state's landscape is covered with a mantle of sand and gravel that reflects the state's more recent glacial history. The bedrock is dominated by granites, with sedimentary rocks and coal beds found within and surrounding Narragansett Bay (Gibbs et al. 1995; Quinn 1997). The only known occurrence in the world of the mineral cumberlandite is found in Cumberland at Iron Mine Hill where it was mined during the 18th century. Fine-grained granite found in Westerly is also well-known and is one of the global standards for the granite rock type (Quinn 1997).



State of Rhode Island Archives

Erratic boulder from glaciation; Rolling Rock Wickford, RI circa 1907; Boulder destroyed as deemed hazardous

Rhode Island's more recent geologic history begins with the last period of glaciation roughly 14,000 years ago. The glaciers and the material they left behind (or took away) created Long Island, Long Island Sound, and Narragansett Bay. Conanicut and Aquidneck Islands are high points isolated from the mainland by rising post-glacial sea levels. The entire land form of Block Island is a pile of glacial till that is a remnant of the terminal moraine which once stretched continuously from Long Island (NY) to Cape Cod (MA). Erratics,

large boulders left behind by melting glaciers, are scattered throughout Rhode Island's forests, and the numerous stone walls crisscrossing the state are a legacy of the glaciers. Overall, the retreating glaciers left behind a covering of sand and gravel throughout Rhode Island (Gibbs et al. 1995; Quinn 1997). RI DEM has produced an interactive, on-line Environmental Resource Map that shows the distribution of bedrock formations and glacial deposits throughout the state at

<http://www.dem.ri.gov/maps/index.htm#GV>.

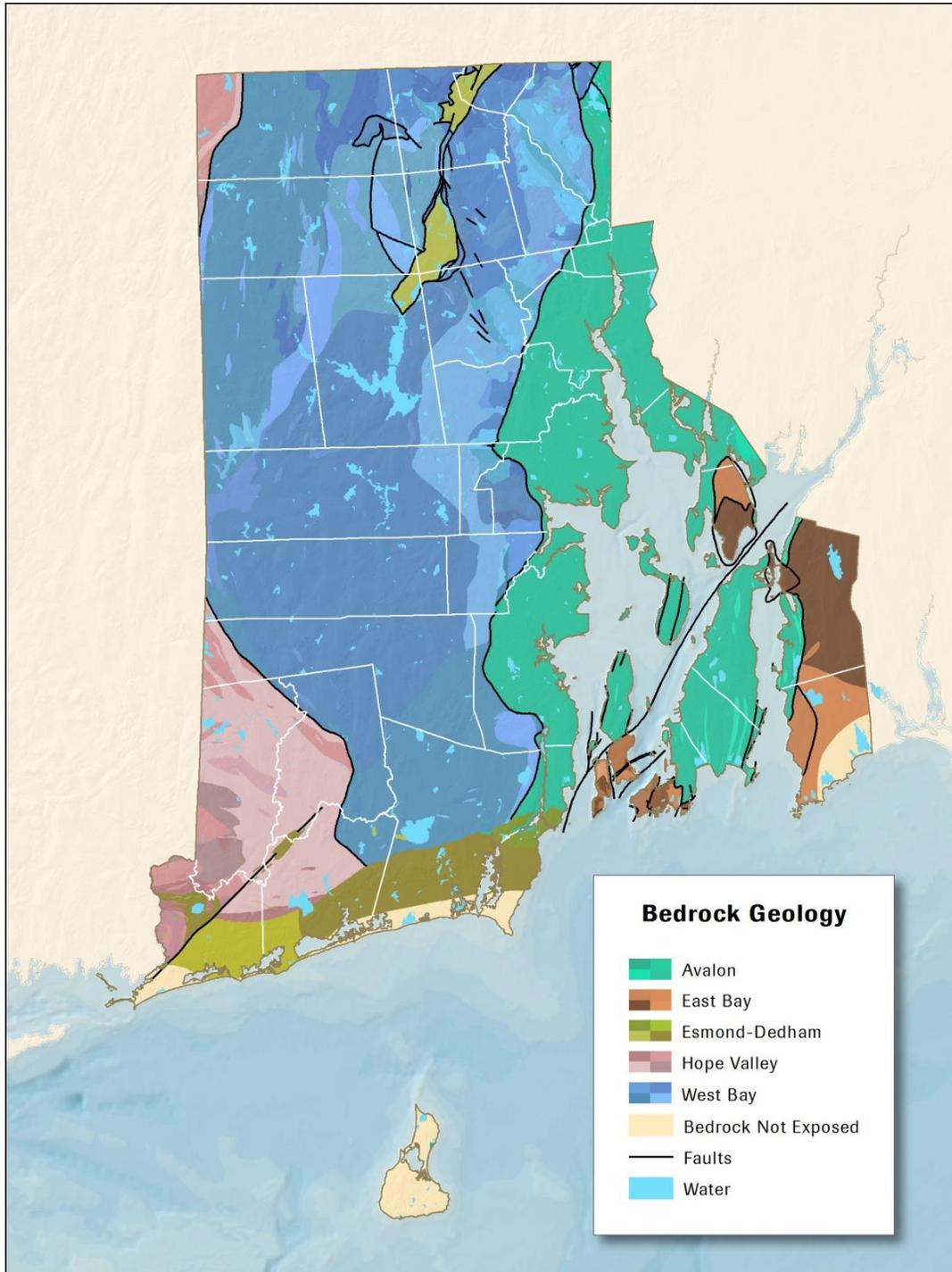


Figure 2-2. Bedrock Geology Map of Rhode Island. Source: RI TNC 2014

The glacial history of Rhode Island is the predominant factor responsible for the state's present landscape and landforms (Gibbs et al. 1995). The Charlestown Moraine, a ridge of sand and gravel, extends inland along the coast from Westerly to Narragansett and corresponds to similar landforms on Long Island (Gibbs et al. 1995; Quinn 1997). Worden Pond and Great Swamp in South Kingstown are remnants of a larger water body created behind the dam formed by the Charlestown Moraine. Other glacial features found in Rhode Island include drumlins; streamlined hills oriented in the direction the glacier moved

across the landscape; and eskers which are sinuous ridges of sand and gravel that formed underneath a melting glacier. Kettle holes are depressions created when chunks of glacial ice melted to form lakes, ponds and wetlands (Gibbs et al. 1995; Quinn 1997).

At the end of the last glacial period the climate warmed and melting ice eventually caused the sea level to rise several hundred feet. Long Island and Block Island Sounds were originally freshwater lakes that became sounds when flooded by marine waters. Narragansett Bay was once a series of inland river valleys that were drowned with saltwater, forming a network of estuaries and islands (Gibbs et al. 1995; Quinn 1997).

Soils

Heavily influenced by the state's glacial history, the majority of Rhode Island's soil types are derived from glacial till and glaciofluvial deposits. Sandy loam is the dominant soil type, covering more than half of the state on hills, drumlins, terraces, and outwash plains (Figure 2-3). These soils are moderately well-drained to well-drained and contain varying amounts of rock and stone that create an assortment of "very stony", "gravelly", or "extremely stony" characterizations. Silt loams are the second most abundant soil type, and along with the sandy loams form the basis for many of the state's Prime or Important Farmlands. Mucks, which are very poorly drained soils associated with wetlands, cover about 4% of the state and are derived from organic material. Other soil types are less abundant and more localized in their distribution, including beach soils, dune soils, peats, and bedrock outcrops. Mucky sandy and/or silt loams are characteristic of Rhode Island's floodplain soils, poorly to very poorly drained, and derived from alluvium and sandy glaciofluvial materials (NRCS 1981). RI DEM has produced an interactive, on-line Environmental Resource Map that maps the extent of the state's soil types at <http://www.dem.ri.gov/maps/index.htm#GV>.

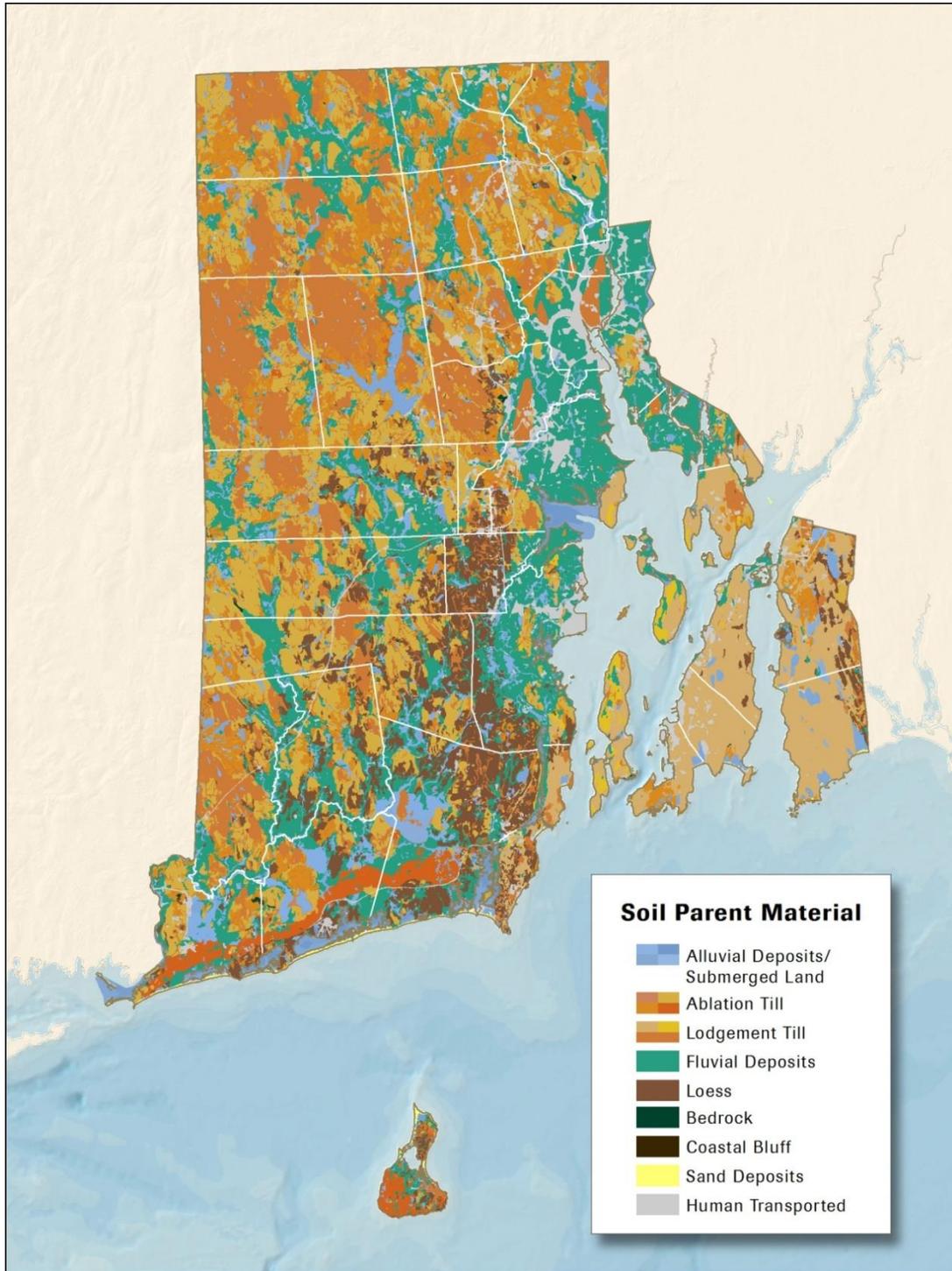


Figure 2-3. Soils Map of Rhode Island. Source: The Nature Conservancy, Rhode Island Chapter

Climate

Rhode Island's climate is largely governed by its proximity and exposure to the Atlantic Ocean, with coastal areas tending to have slightly moderated temperatures (Gibbs et al. 1995). Average precipitation in Rhode Island is approximately 43.09 inches annually, and the mean annual temperature is 49.4 °F. January is the coldest month of the year (mean temperature of 29.1 °F), and July the warmest month (mean

temperature of 70.4 °F; NOAA 2014). This annual variation creates distinct seasons that affect or influence use of the state's land and waterscapes by a variety of migratory fish and wildlife. Precipitation is more uniform than temperature through the four seasons, with summer (June through August) slightly drier than the other three seasons (NOAA 2014). Overall, the state's weather is known for its frequent and dramatic changes, with temperatures that can shift up to 50 degrees in one week (Gibbs et al. 1995). Blizzards and hurricanes occasionally affect the state, as do tornadoes, ice storms, and flash floods. The most significant recent storm to impact Rhode Island was hurricane Sandy on October 29, 2012. Damage from the storm resulted in more than \$35 million paid to flood insurance policy holders (FEMA 2013).

Many aspects of the global climate are changing rapidly, and the primary drivers of that change are human in origin. Evidence supporting climate change abounds, from the top of the atmosphere to the depths of the oceans (Kennedy et al. 2010). This evidence has been painstakingly compiled by scientists and engineers from around the world using satellites, weather balloons, thermometers at surface stations, and many other tools for monitoring the Earth's climate system. The sum total of this evidence tells an unambiguous convincing story that the planet is warming. Temperatures at the surface, in the troposphere (the active weather layer extending up to about 8 to 12 miles above the ground), and in the oceans have all increased in recent decades. Snow and ice coverage has decreased in most areas. Water vapor has been increasing in the lower atmosphere, due to increased evaporation from the warmer surface. Sea levels are rising. Changes in other indicators such as length of growing season have been observed in many areas. Worldwide, changes in average climate conditions have been accompanied by upward trends in extremes of heat, cold, drought, and heavy precipitation events (Alexander et al. 2006). Recent studies have already detected changes in the phenology (flowering time) of plants caused by global warming, including those of Miller-Rushing and Primack (2008) and Primack et al. (2004).

Rhode Island has been growing warmer and wetter since 1895, with annual precipitation increasing at a rate of approximately 1 inch per decade and the mean annual temperature rising at 0.2 °F per decade (NOAA 2014). Climate change is given special consideration in the RI WAP because its scope reaches beyond the state's borders and because it exacerbates many other threats to wildlife and affects each species differently. Thus, incorporating climate change considerations into the WAP is vital for the development and implementation of effective conservation actions.

The Manomet Center for Conservation Sciences and the National Wildlife Federation (MCCS and NWF 2012), and NatureServe (2014) have assessed the vulnerability of northeastern fish and wildlife and their habitats to climate change and published a series of reports to help effectively plan conservation efforts at state and regional scales under a changing climate regime. Their work identifies species and habitats that may be especially vulnerable to climate change and predicts how these species and habitats will adapt under different climate scenarios. The results of these studies relevant to Rhode Island habitats are detailed in Chapter 3. In addition, the reports outline potential adaptation options that can be used to safeguard vulnerable habitats and species, and this information is detailed in Chapter 4.

Ecological Regions of Rhode Island's Landscape

Several ecological classifications of the Northeast have been developed that place Rhode Island and its wildlife resources within a national setting, allowing Rhode Island to participate in and benefit from regional and national conservation efforts with a variety of partner agencies and organizations.

In a broad context, the U.S. Forest Service (USFS) classification system places Rhode Island in a single Ecoregional Province (McNab and Avers 1994; Bailey 1995; Rudis 1999), specifically within the Lower

New England Section of the Eastern Broadleaf Forest Province. The Lower New England Section is characterized by glacially-influenced landforms descending to coastal lowlands, with forests dominated by northern hardwoods, Appalachian oaks, and northeastern oak-pine associations. In this section, ecosystems have been disturbed by human settlement. This disturbance, in turn, has resulted in an ecological shift to a system that lacks large predators and suffers from an imbalance between plant resources and herbivores (Rudis 1999).

TNC has classified North American ecoregions to incorporate concepts of conservation biology and ecology when developing meaningful biodiversity conservation plans (Groves et al. 2002; see Figure 2-4). Characteristic species of flora and fauna and examples of characteristic natural communities have been used to develop conservation priorities for each ecoregion. According to the TNC classification the northwestern portion of Rhode Island falls within the Lower New England – Northern Piedmont Ecoregion, and the coastal area is within the North Atlantic Coast Ecoregion. TNC has drafted conservation plans for both ecoregions, describing the vegetative communities and biological resources of each (Sneddon et al. 1998; Beers and Davison 1999; Barbour et al. 2003).

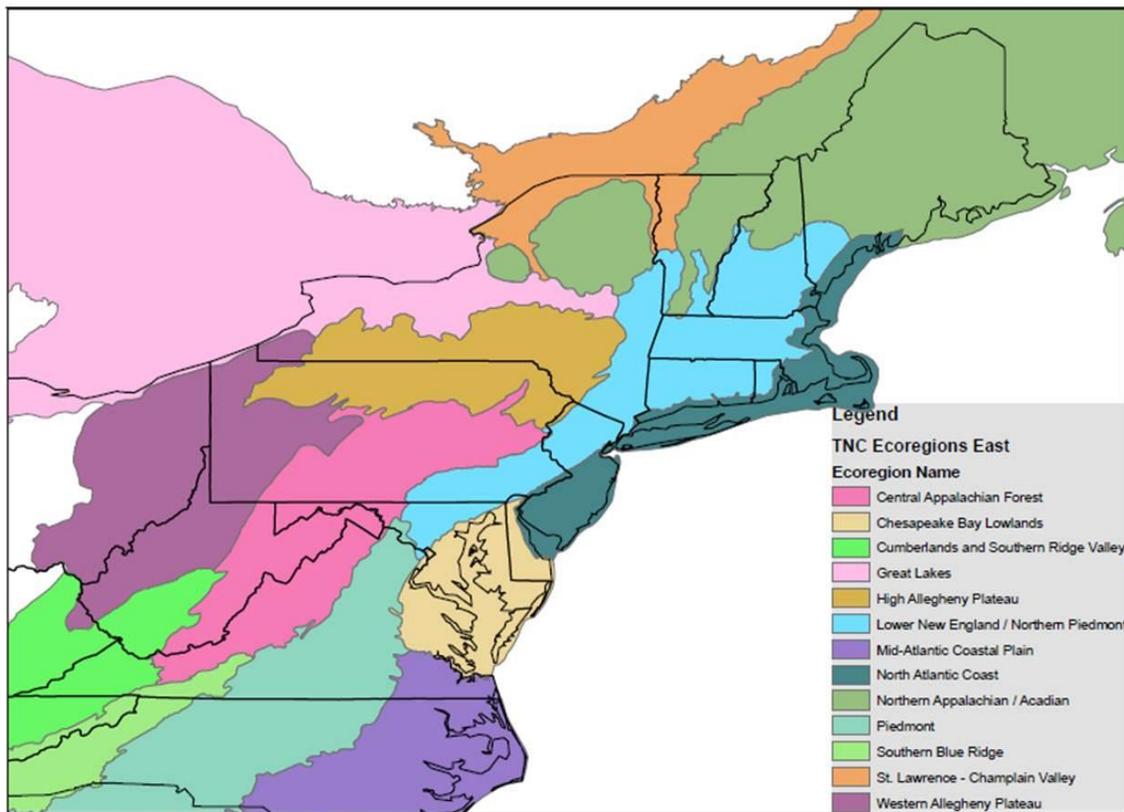


Figure 2-4. The Nature Conservancy Ecoregions Map.

Source: The Nature Conservancy, Rhode Island Chapter

EPA collaborated with the Massachusetts Department of Environmental Protection (MA DEP) to draft an ecoregion classification for Massachusetts, Rhode Island and Connecticut (Figure 2-5). The EPA system utilizes a hierarchical classification system with Rhode Island falling within the Northeastern Coastal Zone and Atlantic Coastal Pine Barrens Level III Ecoregions; only Block Island is in the latter, with the rest of the state in the former (Omernik 1995). Rhode Island is within three Level IV draft ecoregions –

the Southern New England Coastal Plains and Hills (western two-thirds of the state), the Narragansett/Bristol Lowland (eastern third of the state), and Cape Cod/Long Island Ecoregion (Block Island).

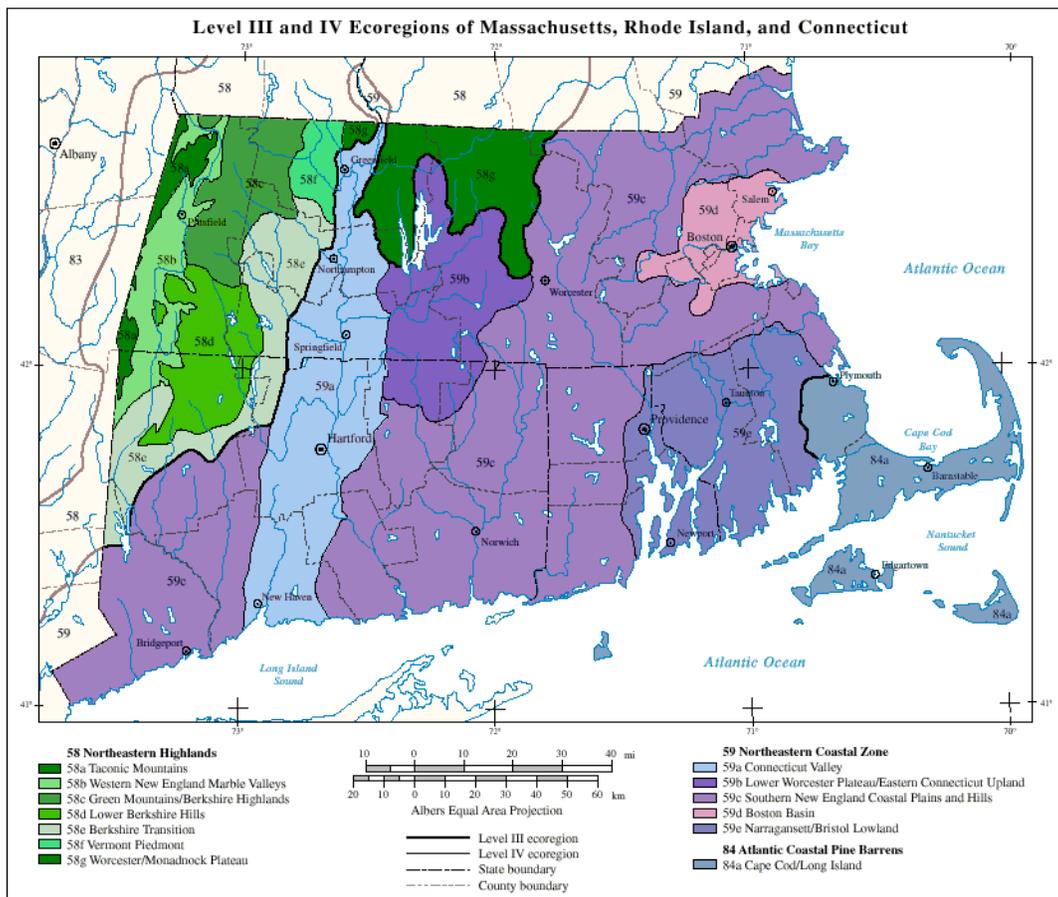


Figure 2-5. EPA Ecoregions for Massachusetts, Rhode Island, and Connecticut. Source: EPA

Finally, the World Wildlife Fund has divided North America into a series of terrestrial and freshwater ecoregions with Rhode Island delineated within the North Atlantic Ecoregion and the Temperate Coastal Rivers and Lakes Habitat Type (Abell et.al. 2000). Based on a Biological Distinctiveness Index (BDI) that utilizes species richness and endemism, Abell et al. (2000) ranked Rhode Island’s aquatic systems as Nationally Important with no rare ecological or evolutionary phenomena. The conservation status of the North Atlantic Ecoregion is classified as “vulnerable” but rises to an “endangered” status when the conservation status is weighted with a threats assessment (Abell et al. 2000). Additional information on this type of threats assessment is provided in Chapter 3.

Ecological Habitat and Vegetation Systems

The Land Use/Land Cover map shown in Figure 2-6 depicts the complexity and diversity of natural and anthropogenic habitats throughout the state. Describing this complexity is a challenging but important task. By doing so, we can better understand the history of natural communities and predict how communities and vegetation will respond to immediate or future threats. Although it appears complex at first glance, the land use/land cover map is based on broad habitat categories and thus does not show the true level of diversity that is present in the more than 60 community types found in Rhode Island.

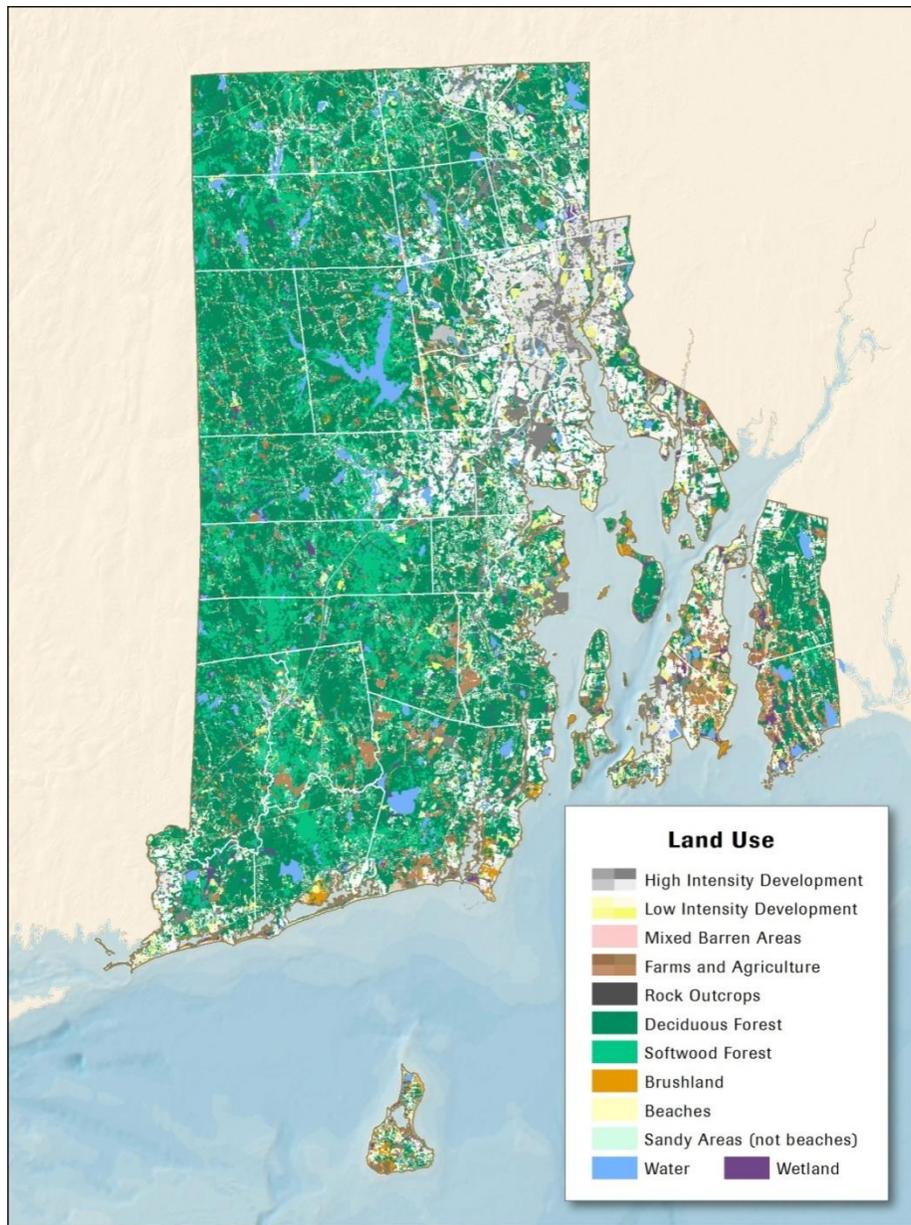


Figure 2-6. Land Use/Land Cover Map of Rhode Island.

Source: The Nature Conservancy, Rhode Island Chapter

A variety of classification systems that describe the natural communities of Rhode Island based on vegetation have been developed in recent decades. There has been a continuing effort to compile regional and national descriptions and inventory data so that a broad perspective of habitat types can be developed. This information will improve our understanding of the factors that govern the distribution of various species and how to conserve wildlife. For many wildlife species, especially amphibians, reptiles and invertebrates, the lack of distribution and abundance data means that key habitats and associated vegetative communities are the best available sources of information for appropriate conservation planning and decision-making.

The Northeast Terrestrial Habitat Classification System (NETHCS) (Gawler 2008) was developed as a comprehensive and standardized representation of wildlife habitats, one that would be consistent with

other regional classification and mapping efforts. This classification formed the basis for a GIS map of ecological systems based on 70,000 inventory points contributed by the State Natural Heritage programs (NHPs) and the U.S. Department of Agriculture (USDA)-USFS Forest Inventory and Analysis (FIA) program. The goal was to create an accurate model of where these habitats occur. In addition, the *Northeast Habitat Guide: A Companion to the Terrestrial and Aquatic Maps* has been published by TNC (Anderson et al. 2013b). It includes a profile of each habitat type in the Northeast, as well as distribution maps, state acreage figures, identification of species of conservation concern, and assessment of overall conditions in the region.

Ecological systems are defined as recurring groups of biological communities that are found in similar physical environments and are influenced by similar dynamic ecological processes, such as fire or flooding. They provide a classification framework that is readily able to be mapped, often from remote imagery, and also readily identifiable by conservation and resource managers in the field. They are based on biogeographic region, landscape scale, dominant cover type, and disturbance regime. Examples in Rhode Island include Central Appalachian Dry Oak-Pine Forest and Northern Atlantic Coastal Plain Sandy Beach.

Ecological systems are vegetation-based and may be described as a collection of plant associations that occur together in some combination on the ground. Individually, these associations can be used as relatively fine-scale mapping units. They can be useful in characterizing a specific area and driving local management decisions, but are often not amenable to mapping at a regional scale. The fine-scale classification of Rhode Island's ecological systems is provided by the Rhode Island Ecological Communities Classification (RIECC; Enser et al. 2011). This classification framework was designed to support development of a detailed ecological communities map and database serving multiple conservation needs in Rhode Island including, but not limited to, the RI WAP. RIECC was the predecessor of a project to acquire aerial photography (6" pixel resolution, 4-band orthophoto) and Light Detection and Radar (LIDAR) elevation data for the state of Rhode Island and, from this, to produce the digital (i.e., GIS) ecological communities database (RI DEM 2014).

The RIECC is an amalgamation of two previously published classifications: the NETHCS described above, and the Natural Communities of Rhode Island (NCRI; Enser and Lundgren 2005). The NCRI was developed by conducting on-site ecological surveys to describe the natural communities (associations) within Rhode Island. Site-based descriptions can provide a level of detail that would not be identifiable from remote imagery. Development of the NCRI was a joint project of TNC and the RI NHP to define the ecological diversity of natural communities in Rhode Island as a guide for conserving the full array of biodiversity in the state. It is essentially a catalog of the natural communities that occur in Rhode Island based on the physical environment, climate, and natural disturbance regimes in this part of the North American continent.

The NCRI does not include anthropogenic communities (those created by and persisting under the influence of humans). However, the NETHCS does provide guidance in assigning anthropogenic (cultural) communities which are included in the RIECC. The classification first defines three basic systems within which all communities can be grouped. These systems are Uplands, Palustrine, and Estuarine.

Uplands

This system consists of upland or terrestrial communities, forested and non-forested, which have well-drained soils and a vegetated cover that is never dominated by hydrophytes, even if the soil surface is seasonally flooded or saturated.

Forested Uplands

The Northeast was formerly 91% forested, supporting thousands of plant and animal species. Almost one-third of that original forested land, a total of 39 million acres, has since been converted to other land uses. Converted forest land exceeds the amount of forested land conserved for nature by a ratio of 6:1, and conserved lands are spread unevenly across forest types. For example, upland boreal forests are 30% conserved with 12% secured for nature. Northern hardwoods are 23% conserved with 8% primarily for nature. Oak-pine forests are only 17% conserved with 5% primarily for nature (Anderson and Olivero Sheldon 2011).

Forests in the Northeast region are fragmented by 732,000 miles of permanent roads. On average, 43% of the forest occurs in blocks less than 5,000 acres that are completely encircled by major roads, resulting in an almost 60% loss of local connectivity. Current patterns indicate that securing land has been an effective strategy for preventing fragmentation as there is a high proportion of conserved land within most of the remaining large contiguous forest blocks.

Forests in the region average only 60 years old, regardless of forest type, and they are overwhelmingly composed of small trees 2" to 6" in diameter. Upland boreal forests are the most heavily logged, and they differ from the other types in having fewer large-diameter trees. Out of almost 7,000 forest samples collected in this region by the USDA-USFS FIA program, no forest stands were dominated by old trees or had the majority of their canopy composed of trees more than 20" in diameter.

Situated in the southern New England portion of the Appalachian Forest, Rhode Island is naturally a forested place. There is general agreement among ecologists that prior to European settlement more than 90% of the state was forested by deciduous trees, primarily oaks and Red Maple. Coniferous forests constituted about 15% of the state's forest land with White Pine, Pitch Pine, and hemlock the only naturally-occurring upland species. Mature forests support a high diversity of wildlife species in an array of canopy, sub-canopy, shrub, and ground vegetation layers, and there is strong evidence that the largest forest tracts, ranging up to thousands of hectares, support the highest diversity of forest species.

In addition to spatial characteristics, the structure of forest vegetation is an important attribute determining the diversity of forest species. Historically, forests of interior New England have undergone frequent, small-scale natural disturbances in the form of tree wind-throws that removed individual trees or groups of trees, resulting in canopy breaks. Major catastrophic disturbances from hurricanes and wild fires occurred much less frequently. Natural disturbances create forests that are structurally diverse, with dense nesting cover at the shrub and ground levels that support a higher diversity of forest-nesting birds.

The European colonists that settled in Rhode Island cleared nearly all of the original deciduous, hardwood forest, about two-thirds of it for agriculture. By the mid-18th century, however, industry had replaced agriculture as Rhode Island's dominant employment and many farm fields were abandoned. An estimated 30% of the lost woodlands were restored through natural succession of these abandoned fields. As a result, almost all of the state's current forests are second-growth. Today's forests are concentrated in the

western part of the state, where RI DEM has several large preserved tracts and development pressures have been lower than in the highly urbanized coastal areas. Nevertheless, forestland is increasingly fragmented throughout the state as more of it is converted a second time to individual home sites.

The most recent USFS inventory of Rhode Island forests conducted in 2008 indicates that forest covers 52% of the state, or about 348,000 acres (RI DEM DFE 2010). The recently completed Photoscience project to digitally map the state's ecological communities calculated approximately 389,000 acres of forest, including more than 36,000 acres of ruderal forest (see description below). A breakdown of the forest types comprising the Rhode Island forest is shown in Table 2-1, and the extent of forest is shown in Figure 2-7.

Table 2-1. Acreage of Forest Types in Rhode Island

Forest Type	Acres
Oak Forest	209,382
Mixed Deciduous/Coniferous Forest	58,785
Deciduous & Coniferous Forested Swamp	48,142
Ruderal Forest	36,817
Coniferous Tree Plantation	31,837
Pitch Pine Woodlands/Barrens	3204
Northern Hardwood Forest	377
Hemlock/Hardwood Forest	227
Floodplain Forest	221
Total	388,992

Source: Data from Photoscience project using 2011 imagery

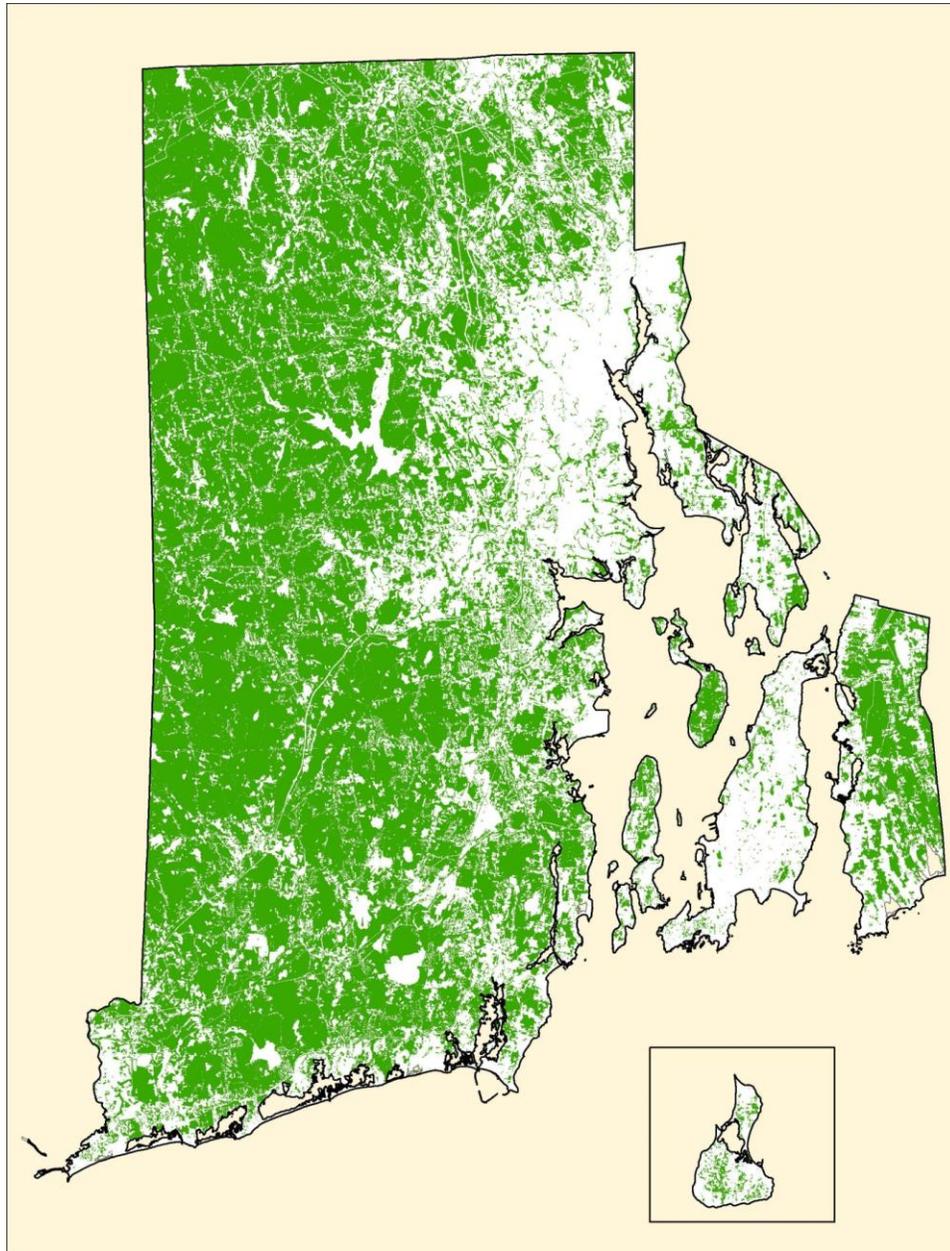


Figure 2-7. Extent of forest in Rhode Island. Source: RIGIS from aerial interpretation

Current forest total compares with 63.6% (411,800 acres) estimated in 1985, and 61% (393,000 acres) in 1998, or an average loss of roughly 2,770 acres/year during the past 23 years. However, the rate of loss has increased significantly during the ten-year span 1998-2008, resulting in an average loss/year of about 4,500 acres/year. These figures represent a significant loss of forest cover in Rhode Island since the modern-day peak in the 1960's when more than 75% of the state was forested. Although there is significantly more forest land today when contrasted with the agricultural era circa 1850, when about 20% of the state was forested; if current trends of forest loss continue less than 50% of Rhode Island will be forested by the year 2015.

Results of the USFS 2008 inventory also show that Rhode Island's forests have continued to mature at a steady rate, with 54% classified as saw-timber stands, which have the majority of their stocking in large

trees. An increase of 20% in this size class since 1985 reflects the aging of trees in the pole-timber category, which declined to 40% of forest cover during the same period, with seedling-sapling stands remaining consistent at 6% cover.

Although there is more forest acreage in Rhode Island today than there was 100 years ago (Table 2-2), few areas contain core habitats large enough to support the full complement of expected species and natural ecosystem processes. Key characteristics that determine a forest’s value for breeding bird habitat, for example, are its size and shape, nearness to other forest tracts, and surrounding land use. In contrast, Rhode Island forest patches are becoming smaller and more isolated, primarily due to fragmentation caused by housing, roads, and other developments.

The age and structure of forests influence the composition of the plant and animal communities that occupy these habitats. Along with the general maturation of Rhode Island forests, there has been a reduction in understory vegetation critical for ground-nesting birds. This change is partially the result of a proliferating White-tailed Deer population which contributes to the reduction of understory shrub and herbaceous plant cover through selective browsing. The creation of non-forested dispersal barriers has prevented some plant species from recolonizing, resulting in a further decline of understory and ground layer plant diversity. In such cases, even mature forests are still paying an “extinction debt” as small populations decline and disappear due to fragmentation and are not replaced (Vellend et al. 2007; Enser, in prep.).

Table 2-2. Approximate Forest Area in Rhode Island from 1630 to 2011

Year	Area (acres)
1630	599,500
1767	200,000
1887	159,900
1907	246,500
1938	353,000
1953	433,000
1963	433,000
1973	399,700
1985	411,800
1998	393,000
2008	348,400
2011	356,935

Source: Butler and Wharton 2002, Widmann 2002, RIGIS 2011

A glimpse of the current condition of Rhode Island’s forests can be viewed in Figure 2-8 which shows the distribution of forest blocks greater than 500 acres in size (RI DEM DFE 2010). This map illustrates the degree to which forests have been fragmented in Rhode Island. Fragmentation of forests into smaller patches reduces the value of these habitats for forest interior species, which is reflected in the number of these species identified as SGCN in Rhode Island. The continuing threat of fragmentation of Rhode Island’s forests is addressed in Chapter 3 of this document.

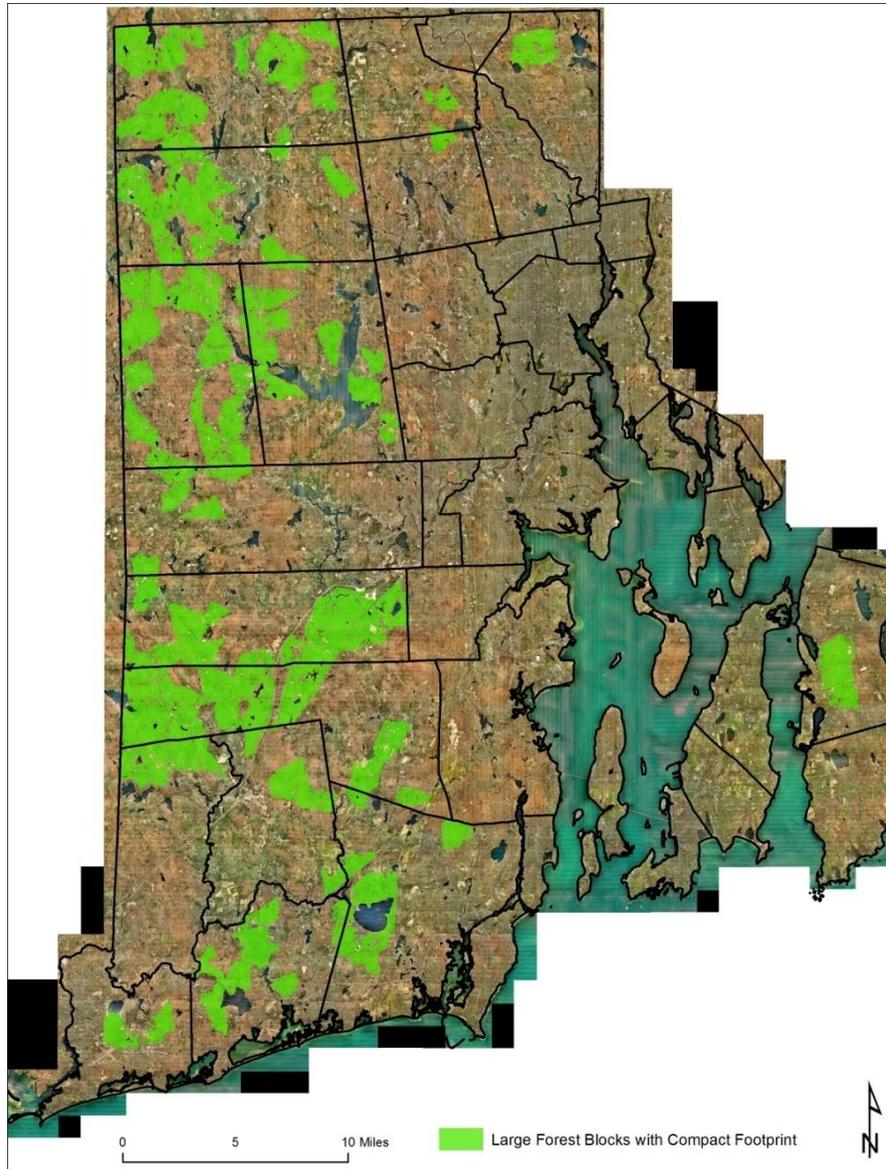


Figure 2-8. Distribution of Forest Blocks >500 Acres. Source: RI GIS 2010

Forests are also fragmented in ownership. Although forest ownership by public agencies and nonprofit conservation groups has increased in recent years, private individuals continue to own most (59%) of Rhode Island's forest land (RI DEM DFE 2010), with the majority of owners holding less than 10 acres. This overall ownership pattern complicates the management of species that require relatively large tracts of habitat.

Recognizing these issues, RI DEM DFW has actively pursued the acquisition of forest land, focusing on tracts that increase the size of existing Wildlife Management Areas. In particular, since 2005 SWG funding has supported the acquisition of 102 acres abutting the Black Hut Management Area, a tract that had previously been a large privately-owned inholding, and 183 acres that was incorporated into the Buck Hill Management Area, both of these areas located in the northwestern part of the state in the town of Burrillville. In addition, SWG funding has assisted in the acquisition of forest land at the 121-acre former

Tiverton Rod and Gun Club in Newport County, and over 400 acres of the Grills Preserve in Hopkinton, Washington County.

Statistics on forest cover in Rhode Island generally do not take into account the small tracts of forest that remain within the most heavily developed sections of the state such as in municipal parks, cemeteries, hospital grounds, schools, and other marginally protected sites. Ruderal forests, as these habitats are referred to in the RIECC, support a surprisingly high number of species that can include SGCN such as gray catbird and eastern towhee.

Ruderal forests are classified as such because the replacement of native species with exotics has altered the plant species composition dramatically. In these cases, the forest community is not recognizable as any RIECC forest type. Despite changes in species composition ruderal forests support canopy and cavity-nesting birds, and these upland forests are often associated with small wetlands, especially Red Maple swamps. Ruderal forests also serve as valuable resting and feeding areas for migrating birds.

Non-Forested Uplands

Under natural circumstances, non-forested uplands are created by disturbances to the forest which can be due to regular daily conditions (e.g., coastal wind and salt spray), or occasional catastrophic events such as hurricanes. Before European settlement, indigenous peoples periodically burned areas to maintain their openness, but after settlement most of the state was cleared for agricultural and other purposes. During the past century the landscape has been continually altered by clearing, regrowth of forest, and subsequently by more clearing, which has resulted in a wide distribution of non-forested habitats in various stages of successional development throughout the state (Figure 2-9). The recently completed Photoscience project to digitally map the state’s ecological communities calculated approximately 38,000 acres of non-forested upland habitats in Rhode Island (Table 2-3)

Table 2-3. Acreage of Non-forested Upland Habitats in Rhode Island

Non-forested Upland Habitat	Acres
Ruderal Grassland/Shrubland	22,919
Hayfields	8696
Pasture	4717
Maritime Shrubland	668
Maritime Grassland	602
Maritime Shrub Dune	366
Total	37,968

Source: Photoscience using 2011 imagery.

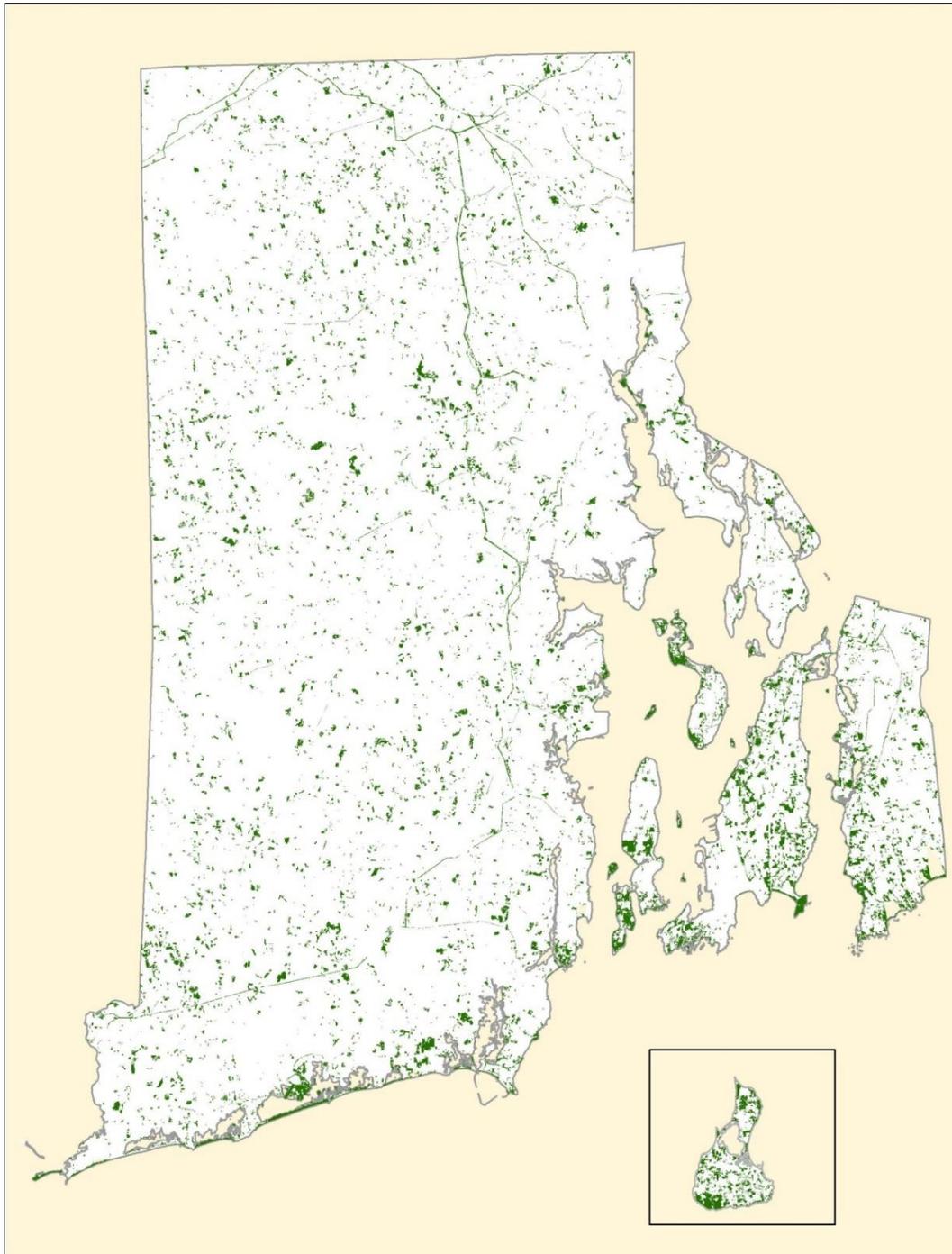


Figure 2-9. Distribution of Non-forested Upland Habitats in Rhode Island.

Source: RIGIS from aerial interpretation

Early Successional Habitats

Early successional habitats are defined as uplands where the potential natural vegetation is predominantly grasses, grass-like plants, forbs, or shrubs (Anderson et al. 1976). Ancestrally, these habitats would have developed in openings created within the predominantly forested landscape by natural disturbance, primarily severe storms and fires. Today, the majority of these habitats are anthropogenic in origin. The widespread clearing of the forest by the colonists for wood and farmland created a large amount of land

that could quickly return to early successional habitat. This pattern occurred mostly during the post-Civil War era, when large tracts of farmland were abandoned. Today, abandonment of farmland has stabilized and most old field habitat is created and maintained on State Managed Areas (SMAs), other conserved lands, and private properties under management agreements. Other places where early successional habitats are fostered include logging sites and utility rights-of-way (electric power-lines and gas pipelines) (Enser, pers. comm., March 5, 2014).

The condition of early successional habitats in Rhode Island depends on the reference point used to make the assessment. During the pre-settlement period, when natural disturbances governed the amount and distribution of shrublands, this habitat comprised an estimated 3% of inland habitats, where large-scale disturbances were very infrequent. Near the coast, with regular maritime winds and a higher storm frequency, shrublands were more extensive, comprising more than 15% of coastal forests, and populations of shrubland animals probably reached their greatest densities in these habitats (Litvaitis 2003).

Shrubland wildlife significantly benefited from the increase in old field habitat that reached its peak circa 1870 when less than 30% of the state was forested. Since that time there has been a steady decline in shrubland habitat as old fields succeed to forest and old farms are converted to residential and commercial developments. According to Buffum (2011), 3.3% of the state is currently shrubland habitat, although coverage varies widely. Coastal communities, where natural shrublands reach their greatest extent, have the highest coverage, for example Block Island (31%) and Jamestown (15%). Inland areas average roughly 2% shrub cover, mostly anthropogenic early successional types. Approximately 82% of the power-lines in Rhode Island were classified as shrublands based on the descriptive methodology used (Buffum 2011).

Wildlife managers cannot rely on natural disturbances to maintain or create enough shrubland habitat to support certain SGCN that require it. Therefore, anthropogenic methods are used to create and augment natural shrublands. Litviatis (2003) points out that such an approach should not jeopardize the survival of species affiliated with other habitats, especially mature forests, and efforts to provide shrubland habitats in human-dominated landscapes should incorporate existing modified lands to avoid additional habitat fragmentation. Large, clustered patches of shrubland habitat may be more practical and beneficial in coastal areas where the creation and maintenance of ruderal shrublands can augment naturally-maintained shrubland habitats.

Agricultural Lands

According to the USDA Census of Agriculture, there were 1,243 farms in Rhode Island in 2012, an increase of 44% from the 858 reported in 2002. Correspondingly, there was a 14% increase in farmed acreage during the same period, from 61,223 to 69,589 acres. Interestingly, the average farm size declined from 71 acres to 56 acres during the same period, and 35% of farms are currently less than 10 acres in size, reflecting the recent interest in establishing small operations to supply specific products for the clientele at farmer's markets (USDA 2014) (refer to Figures 2-10 and 2-11).

The market value of Rhode Island's agricultural operations is \$59.7 million, which is down 9% from a value of \$65.9 million in 2007. Approximately 61% of sales income is from nursery stock and turf (USDA 2014). A positive change in the agricultural industry in Rhode Island is the increase of direct marketing (i.e., the direct sale of agricultural products from the farm to the consumer). This form of marketing has led to an increase in the number of roadside farm stands, Pick-Your-Own operations, and

farmers' markets. The original 2005 RI WAP cited a total of 15 farmer's markets in Rhode Island. By 2013 that number had grown to 50 (RI DEM Div. Agriculture 2014). The cost of farmland also continues to rise, and farmers identify the lack of access to affordable farmland as a key challenge to agricultural growth and stability. At \$13,600 per acre, the value of Rhode Island's farm real estate is the highest in the country. For more information please see www.farmland.org/documents/RI_agriculture_5yr_strategicplan.pdf.

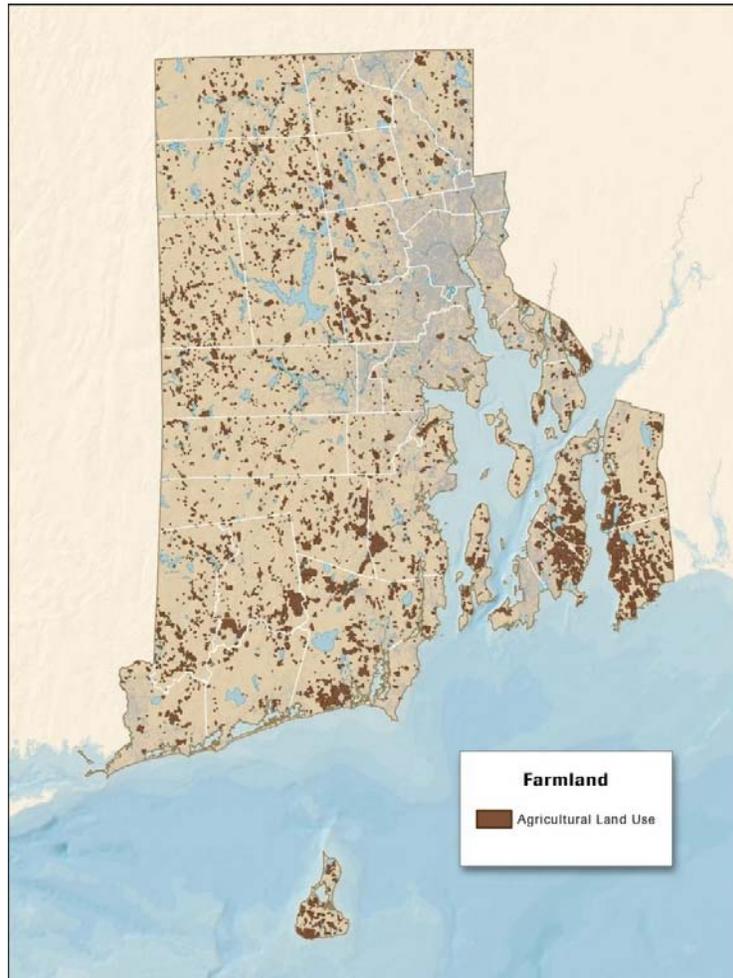


Figure 2-10. Distribution of Farmland in Rhode Island.

Source: The Nature Conservancy, Rhode Island Chapter

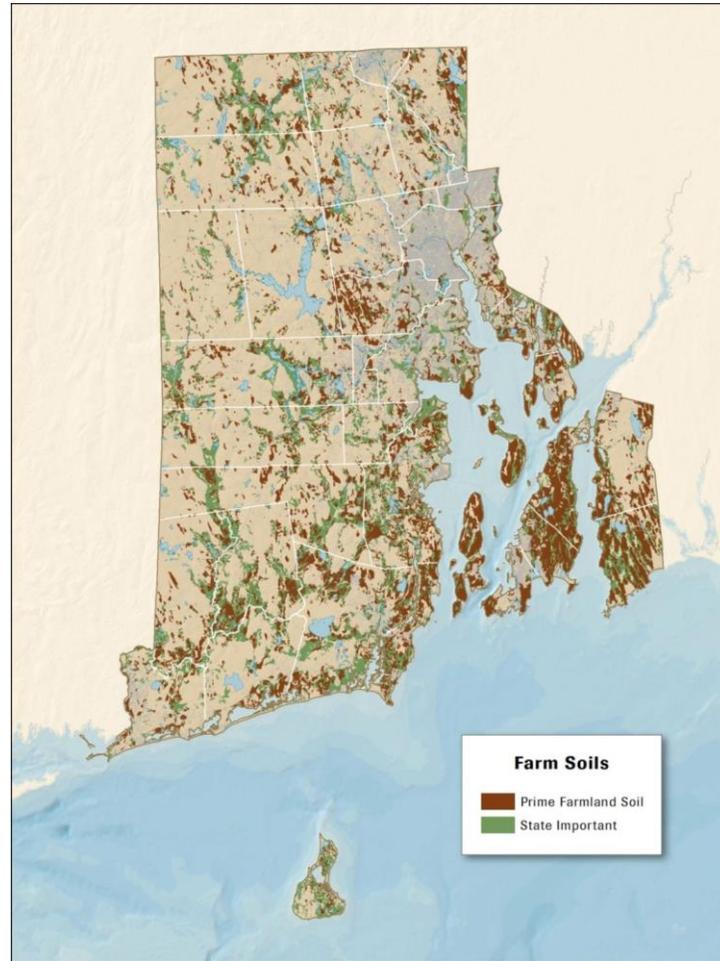


Figure 2-11. Distribution of Prime and Important Farm Soils in Rhode Island.

Source: The Nature Conservancy, Rhode Island Chapter

The most valued agricultural lands for wildlife are the grassland habitats provided by hayfields and pastures that support a distinct assemblage of nesting birds and invertebrates. Although the origin and history of this fauna in southern New England is conjectural, the conversion of much of the Rhode Island landscape to agriculture by 1850 created significant acreages of grassland habitat and consequent increases in grassland species.

However, unlike the naturally-maintained grasslands of the Midwest, grassland habitats in Rhode Island are ephemeral and dependent on continuing agricultural practices to maintain the open, grassy conditions. In 1908, there were still more than 250,000 acres of farmland in Rhode Island (Griffiths 1965). This figure currently stands at less than 70,000 acres (USDA 2014) and the decline is also reflected in the number of grassland-dependent SGCN.

Today, agricultural grasslands are widely scattered throughout the state, although most are concentrated near the coast, especially on Block Island; on Aquidneck and Conanicut Islands in Narragansett Bay; and in the seaside communities of Tiverton and Little Compton. State-listed grassland birds, including Barn Owl, Northern Harrier, and Grasshopper Sparrow, are most prevalent on Block Island where the largest patches of grassland habitat are found and where there is also a lack of mammalian predators. The Barn

Owl also nests on Aquidneck Island where some larger farms remain in the towns of Portsmouth and Middletown.

Grassland species have declined because much of the original farmland was abandoned or more recently sold and converted to other uses. In addition, farmland is managed more intensively today to maximize production, with more frequent haying schedules often coinciding with the nesting periods of grassland birds. Also, the amount of grassland in contiguous blocks is critical to determining the value of a specific tract of land for these grassland species. For example, Upland Sandpiper and Grasshopper Sparrow generally do not inhabit grasslands less than 50 acres in size. As a consequence, the distribution of these birds is mostly limited to larger non-agricultural grasslands found at airports and military reservations.

Wetlands

Palustrine, Fresh Water Wetlands

Approximately 11% of Rhode Island’s landscape (approx. 55,231 acres) consists of freshwater (palustrine) wetlands (Photoscience 2014) (Figure 2-12; Table 2-4). The majority of these wetlands (~ 48,000 acres) are classified as forested swamp, with most of that dominated by Red Maple (*Acer rubrum*). Atlantic White Cedar (*Chamaecyparis thyoides*) is the dominant tree cover in more localized forested peatlands.

Table 2-4. Acreage of Fresh Water Wetland Habitats in Rhode Island

Wetland Habitat	Acres
Forested Swamp	48,142
Shrub Swamp	4937
Emergent Marsh	1943
Managed Marsh	113
Peatlands	96
Total	55,231

Source: Photoscience using 2011 imagery

Approximately 7,000 acres of freshwater wetland are shrub and/or graminoid-vegetated communities, including floodplain shrub swamps, bogs and fens, and riparian emergent marshes.

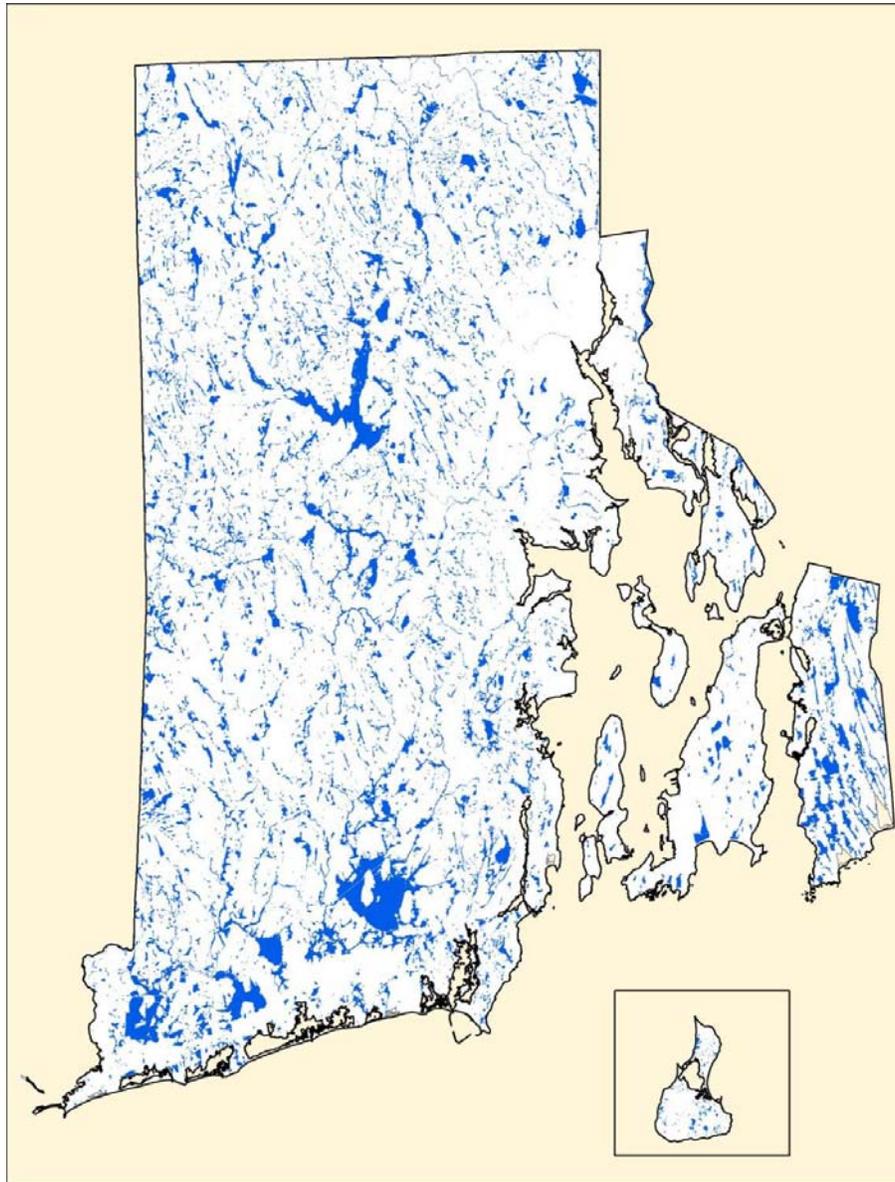


Figure 2-12. Freshwater Wetland Distribution in Rhode Island.

Source: Photoscience 2014

According to a USFWS analysis, Rhode Island has lost approximately 37% of its historic wetlands (Dahl 1990). In the Providence metropolitan area, urbanization was the dominant cause of historic wetland loss, while transportation projects and residential development became the leading contributors in rural areas during the mid to late 1900s.

The vast majority of freshwater wetlands within the state are privately owned. Sixteen percent are protected by federal, state, or municipal governments or by non-governmental conservation organizations such as land trusts, TNC, and the Audubon Society of Rhode Island (RI DEM OWR 2014). The federal government owns approximately 240 acres of the state's freshwater wetlands (less than 1%). These wetlands are concentrated in coastal watersheds including the Coastal basin, Narragansett Bay basin, and Point Judith sub-basin of the Saugatucket River basin (Figure 2-13). The state owns 60% of all protected wetlands (approximately 10,900 acres); and each of Rhode Island's watersheds contains state-owned

freshwater wetlands. Freshwater wetlands owned by municipal governments and non-governmental organizations also are found in each of the watersheds. Municipal governments own approximately 4,500 acres of wetlands; non-governmental organizations own approximately 2,400 acres.

Since 1998, the RI DEM has monitored freshwater wetland loss and gain through its wetland regulatory program, and results to date indicate that (permitted) freshwater wetland loss is minimal. From 2001 to 2003 there was a combined (permitted) loss of 4.72 acres of wetlands; in years 2007 and 2008 the combined loss was only 1.5 acres (RI DEM OWR 2009).

Wetland protection efforts have increased in recent years with several of the state's conservation and grant programs giving priority to projects that involve wetland restoration, enhancement or preservation. RI DEM, in conjunction with New England Interstate Water Pollution Control Commission, has published the Rhode Island Freshwater Wetland Monitoring and Assessment Plan (RIFWMAP, NEIWPC and RI DEM 2006). The long-term objectives of this plan are to develop baseline data to evaluate wetland condition and to assess the cumulative impacts on wetlands in Rhode Island. This plan is comprehensive and takes a landscape-level approach to assessment and management, utilizing identified core indicators such as wetland plant richness to assess wetland quality.

The initial work has focused largely on developing a Rhode Island-specific rapid assessment method (RAM), building on work that has been completed in other states. Development and application of a RAM will facilitate watershed-based conditional reporting and will support objectives identified in the RIFWMAP. With support of the EPA and the Rhode Island Natural History Survey, several projects have been completed that are of particular interest in assessing the condition of palustrine habitats. These include: *Rapid Assessment of Wetland Condition of Atlantic White Cedar Swamps, Bogs, and Fens* (Kutcher 2011); *Integrating Rapid Assessment with Biological and Landscape Indicators of Freshwater Wetland Condition* (Kutcher 2012); and, *Developing Floristic Quality Assessment Methods for Evaluating Freshwater Wetland Condition* (Kutcher 2013). An updated Wetland Assessment and Monitoring Plan is scheduled for completion in mid-2014 (Murphy, pers. comm., February 2014).

Estuarine Wetlands

With a coastline of more than 400 miles, Rhode Island supports a significant number of estuarine habitats, defined as wetlands where fresh and salt waters mix (Figure 2-13.). NOAA has recognized the ecological value of Rhode Island's estuaries by establishing one of 26 National Estuarine Research Reserves (NERR) in Narragansett Bay <http://www.census.gov/compendia/statab/2012/tables/12s0364.pdf>.

Estuarine habitats are primarily governed by the degree of daily tidal exchange and consequent water salinity. Habitats include tidal creeks, tidal flats, and salt marshes. Protected coves, bays, and lagoons of Rhode Island estuarine waters contain over 1,748 acres of sand and mud flats, also known as tidal flats. These dynamic habitats become fully exposed at low tide and are formed from the deposition of estuarine silts, clays and marine animal detritus. Tidal flats support a large population of wildlife, and are significant staging areas for large concentrations of migrating sandpipers, terns, plovers, and other shorebirds and waterfowl.

The predominant estuarine habitat in Rhode Island is salt marsh (~3438 acres), which is actually a mosaic of communities dominated by plants adapted to varying salinity levels that are maintained by the degree of daily inundation of salt water. The largest salt marsh complexes develop within protected coves, bays, and salt ponds (Figure 2-13), but about 10% of these habitats are fringe marshes less than 5 yards wide

and mostly found along the upper portions of Narragansett Bay and its tidal tributaries. Fringe marsh habitat is vulnerable to coastal development and the use of “hard” materials like concrete, metal, and stone to protect eroding shorelines. Over 30% of Rhode Island’s coastal shoreline has been displaced by hard materials (Freedman 2012).

Salt marshes are universally considered to be among the most important wildlife habitats in North America, and Rhode Island’s contribution to the regional distribution and conservation of this habitat is significant. Partners in Flight (PIF) have identified maritime marshes as the habitat that harbors the largest number of high priority birds in the region. Accordingly in 2010 the National Audubon Society Important Bird Areas (IBAs) program designated 16 IBAs in Rhode Island (refer to Chapter 1) that are primarily salt marsh and associated maritime habitats (National Audubon Society 2014). These areas were selected because they support Saltmarsh Sparrow and Piping Plover, considered by PIF as the two birds of highest conservation priority in this region. Moreover, according to PIF (Dettmers and Rosenberg 2000) a significant proportion of the world’s Saltmarsh Sparrows breed in the coastal marshes of the Southern New England region.



Richard Crossley/VIREO

Saltmarsh Sparrow

Warwick is the only remaining tidal waterway in Rhode Island exhibiting the natural progression of tidal wetlands from saline to fresh marsh. Brackish marshes dominated by cattails are also present in several ponds along the south shore of Washington County and within the Narrow River system (Enser and Lundgren 2007).

Brackish marshes occur in the upper reaches of tidal rivers and the upland edges of salt marshes where salinity levels are reduced. These marshes support a graminoid plant community similar to that found in salt marshes, but because of reduced salinity levels there is a higher diversity of plants. Brackish marshes are primarily transitional habitats that occupy limited areas for a combined total of less than 300 acres statewide. This figure is much reduced from the pre-settlement period before dams were constructed at the mouths of most rivers in the state that restricted tidal flow. Old Mill Creek in

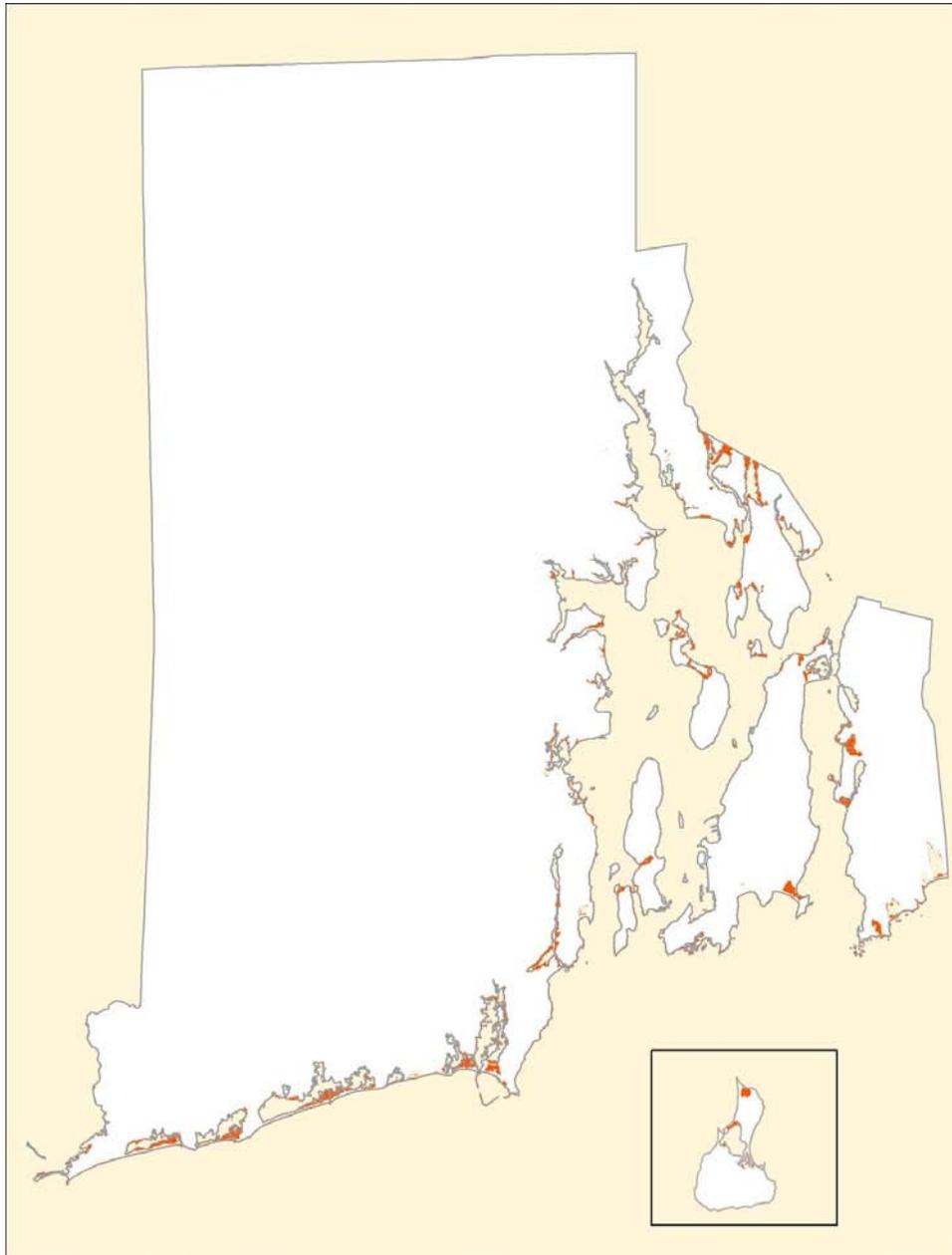


Figure 2-13. Distribution of Estuarine Wetlands in Rhode Island. Source: RIGIS 2011

Because of their rarity and limited extent, brackish marsh communities are extremely vulnerable to the impacts of climate change, especially rising sea level. Recently, application of SLAMM (Sea Level Affecting Marshes Model) modeling at several federal wildlife refuges in the Northeast has projected that the initial impact of sea level rise will be an increase in salt marsh (saline) habitats at the expense of brackish habitats (Manomet Center for Conservation Sciences and National Wildlife Federation 2012). SLAMM modeling is currently being applied to the entire Rhode Island coast (Boyd and Rubinoff 2014) and preliminary results indicate similar impacts, with the degree of brackish marsh loss dependent on the accessibility of adjacent upland and/or freshwater wetland sites for inland marsh migration.

More than 50% (approximately 4,000 acres) of the estuarine marshes present in Rhode Island at the time of European settlement have been lost (Cowardin et al. 1979), primarily by draining or filling to provide sites for coastal development, including docks, marinas, petroleum storage facilities, industrial parks, junkyards, and landfills. Moreover, most currently existing estuarine marshes have been ditched and sprayed for mosquito control. These impacts have been reduced or eliminated to varying degrees, but estuarine habitats face a newer threat. Climate change vulnerability assessments, including those prepared by the Manomet (Manomet Center for Conservation Sciences and National Wildlife Federation 2012), consistently identify brackish marshes as the most vulnerable to the impacts of climate change, especially rising sea level.

Subtidal estuarine aquatic Eelgrass beds are also a valuable habitat in Rhode Island. Eelgrass plays a crucial role in the health of coastal systems because it provides critical habitat for juvenile marine life, helps stabilize sediments, and aids in filtering particles from the water column. In 2006 and 2007, more than 400 acres of Eelgrass were mapped in Narragansett Bay, a significant increase compared to the approximately 100 acres mapped in 1996. However, it was also noted that although Eelgrass cover had increased during the past 10 years in Narragansett Bay, the acreage was still an order of magnitude less than the 6,000 acres of Eelgrass found in Buzzards Bay, Massachusetts, an estuary of comparable size to Narragansett Bay (Bradley, Raposa, and Tuxbury 2007). In 2012, a survey of all submerged aquatic vegetation (SAV) in Rhode Island coastal waters calculated a 23.6% increase in Eelgrass acreage in Narragansett Bay, from 408 acres to 504.2 acres. This survey found that most SAV in the survey area (89.4%) was Eelgrass, with an additional 146.5 acres of Widgeon Grass found in Greenwich Bay, Ninigret and Green Hill Ponds, and Briggs Marsh in Little Compton (Bradley et al. 2012).

The major causes of impairment in coastal and estuarine waters of Rhode Island are bacterial contamination and nutrient enrichment. Marine and estuarine waters are exhibiting an increased array of nutrient-associated symptoms, including low dissolved oxygen levels, fish kills, Eelgrass loss, macroalgae blooms, and a gradual shift in the dominant fish communities from benthic (i.e., bottom-dwelling) to pelagic (i.e., water column-dwelling) species (RI DEM 2003). The major sources of bacterial contamination are combined sewer overflows (CSOs) in certain locations, including the Upper Bay and Newport Harbor, and storm water discharges. Discharges from wastewater treatment facilities, CSOs, failing on-site wastewater systems, and urban runoff are the major sources of nutrient enrichment, which is integral to low dissolved oxygen problems in the estuarine portions of the Providence and Seekonk Rivers (RI DEM OWR 2012).

RI DEM OWR evaluates the capability of estuarine habitats to support their designated human-uses, and the most recent evaluation of nearly 100% of these habitats (158.96 sq. miles) was conducted in 2012. This evaluation determined that approximately 36% (56.97 sq. miles) of the total estuarine habitats are fully supporting all of their designated uses. Approximately 35% (56.26 sq. miles) are impaired for one or more of their designated uses (Figure 2-14), and 31.5% (50 sq. miles) have an impairment requiring Total Maximum Daily Load (TMDL) development. TMDL development are caps on the amounts of pollutants that waterbodies can receive and still meet water quality standards, and they are required by EPA for waters classified as impaired under the Clean Water Act. Data show that 54% (59.16 sq. miles) of the estuarine square miles assessed for aquatic life use are fully supporting that use; 76% (100 sq. miles) of the waters designated and assessed for shellfish consumption are fully supporting the use; and, 100% of the estuarine square miles assessed for fish consumption are considered to be fully supporting that use (RI DEM OWR 2012).

The RI DEM has also assessed the condition of approximately 79 miles of the marine shoreline, and none of these waters were found impaired for swimming or shellfishing (RI DEM OWR 2012). The relative condition of waters near Block Island is frequently monitored by URI. The RI DEM DFW monitors recreational and commercial fishing in the state's marine waters, collaborating with the NMFS and other partners to manage fish stocks and habitats as needed.

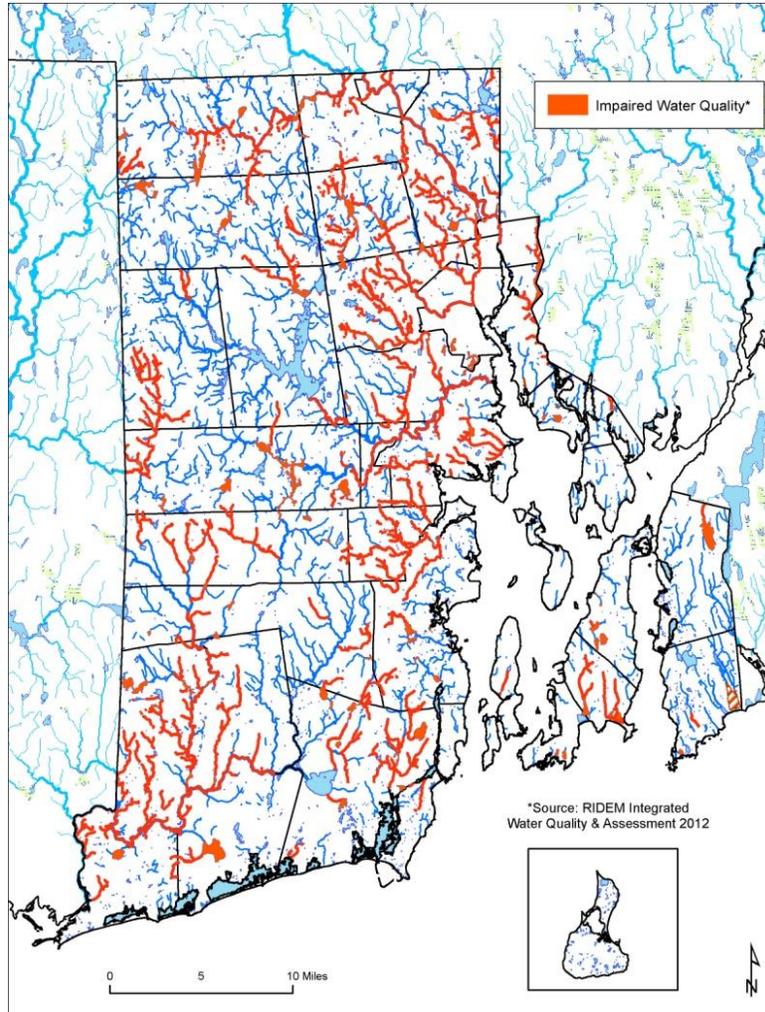


Figure 2-14. Impaired Waters of Rhode Island for One of More Designated Uses

Aquatic Habitat Systems

Aquatic habitats (Figure 2-14) are those of flowing or impounded fresh waters where emergent plants are sparse or lacking, but that may include areas with abundant submerged or floating-leaved vegetation. Because plant composition and abundance are highly variable in these open water systems, and because in some cases plants may not be present at all, a Northeast Aquatic Habitat Classification System (NEAHCS; Olivero and Anderson 2008) was developed to classify flowing water systems based on physical parameters including size, gradient, geology, temperature, and tidal regime.



Scott Ruhren

All five variables influence stream and river habitat types; however, some are more important in structuring stream versus riverine habitats. For example, headwaters, streams, and small rivers are defined using size, gradient, geology and temperature, whereas medium and large rivers are only split by gradient and temperature. The NEAHCS classifies three general flowing water habitat types in Rhode Island. These include headwaters and creeks, small rivers, and medium rivers, with each habitat type divided into subcategories based on gradient and

Abbot Run Brook, Cumberland, RI

temperature (Table 2-5).

Table 2-5. Primary Flowing Water Habitats in Rhode Island with Estimated Percent of Each in State

Aquatic Type	Gradient	Temperature	%
Headwater and Creek	Low	Warm	5.8
Headwater and Creek	Moderate	Cold	20.2
Headwater and Creek	Moderate	Cool	48.4
Headwater and Creek	High	Cold	9.4
Small River	Low	Cool	4.8
Small River	Moderate	Cool	6.2
Medium River	Moderate	Warm	5.2

Source: TNC 2013

Based on analyses conducted by Anderson, et al. (2013a), the overwhelming majority (68.6 %) of flowing water habitats in Rhode Island are moderate gradient, cold and cool headwaters and creeks. In general, these systems are moderately fast-moving small streams of low elevation hills and gentle slopes with good oxygenation, riffle-pool development, and substrates dominated by cobble, gravel, and sand with occasional small patches of boulders (Figure 2-15).

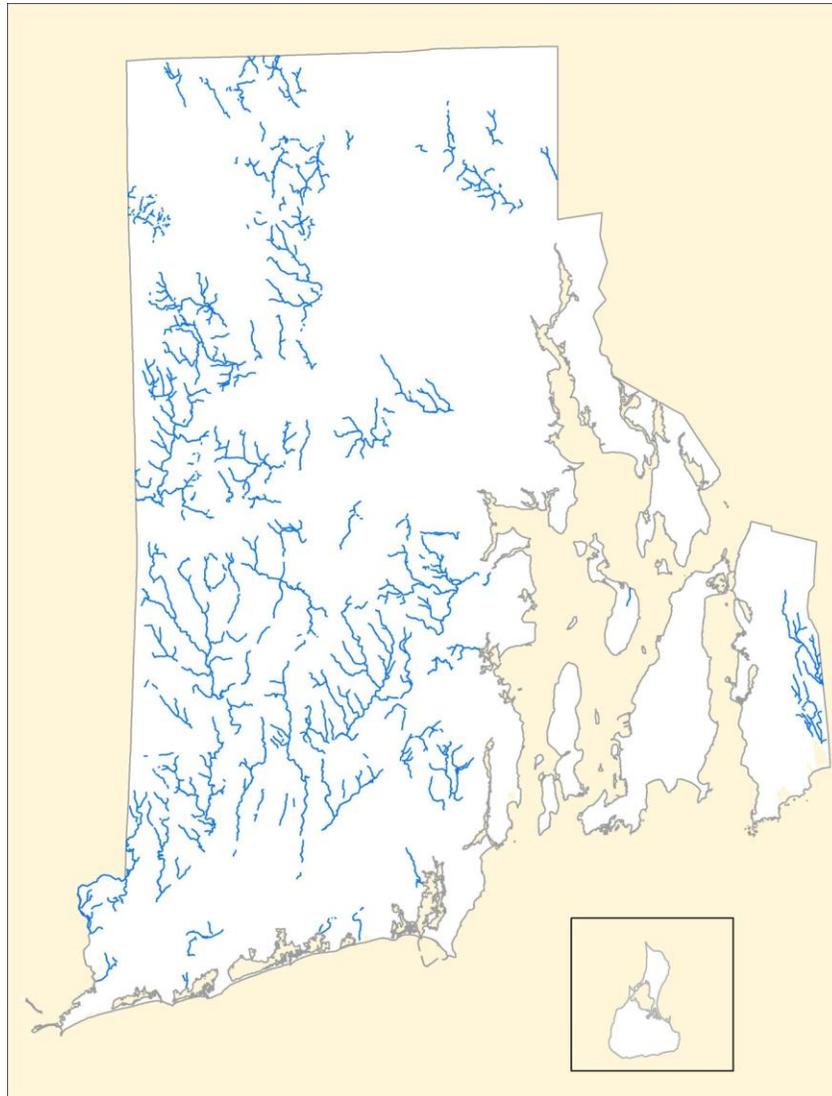


Figure 2-15. Distribution of Cold Water Streams in Rhode Island. Source: RIGIS 2014

The characteristic fish species of these streams is the Brook Trout, along with Fallfish, Blacknose Dace, and Longnose Dace. There is also a unique macroinvertebrate fauna of mayflies, stoneflies, caddisflies, midges, craneflies, blackflies, dragonflies and damselflies, crayfish, and mollusks.

At the other end of the scale, the largest rivers in Rhode Island are classified as medium-sized, warm water systems that have an average bank-full width of 115 feet. The Blackstone River, from the Massachusetts border in Woonsocket to its outfall 10 miles downstream in Pawtucket, is the one river in Rhode Island that meets the criteria for a medium river. Portions of this river in the northern part of the state are higher gradient with colder temperatures, but lower sections show the more typical pattern of higher sinuosity, broader floodplain valleys, associated riparian wetlands, and lower width/depth ratios. Fish communities are dominated by warm-water species, especially those able to cope with the legacy of pollution and other degrading impacts the Blackstone River has sustained during its history as the first industrialized river in the New World. The Blackstone maintains a healthy population of Common Carp, a fish first introduced to Rhode Island in 1880. The largest river system within the state is the Wood-Pawcatuck, which drains most of the southwestern portion of the state and portions of Connecticut.

There are 1,420 river miles in Rhode Island of which 882 miles (62%) were monitored in 2012 to assess their condition and ability to support aquatic life, fish consumption, water supply, and recreational uses. Overall, the majority (69%) of the miles assessed were found to fully support aquatic life; however, approximately 31% are considered to be impaired (Figure 2-18; RI DEM OWR 2012).

Pathogens are the major cause of impairment, originating from point and non-point sources such as CSOs, seepage from failing septic systems, runoff during storm events, and agriculture, as well as from natural sources (e.g., waterfowl). Other significant causes of impairment include biodiversity impacts (i.e., impairment of the biological community on wadeable streams). These appear to be mostly due to nonpoint sources of pollution such as runoff (RI DEM OWR 2012).

As the RI DEM OWR Aquatic Invasive Species program has expanded monitoring efforts, invasive plants have been found to be a management issue in rivers and streams (see Chapter 3). Another noted cause of non-support is from low levels of metals that arrive in aquatic systems from a variety of sources including permitted industrial and municipal discharges, CSOs, and storm drains. Another potential source of low level metals, one that is not routinely evaluated and characterized, is contaminated sediments. Non-point sources such as urban runoff and sources from outside the state's borders are also significant contributors of metals in Rhode Island's rivers (RI DEM OWR 2012).

Lakes and Ponds

The ecological communities of open water bodies are defined by physical characteristics including size, depth, and nutrient levels. Oligotrophic lakes and ponds are generally low in nutrients, well-oxygenated, and deep enough to undergo thermal stratification during the summer and winter. Only a few water bodies in Rhode Island exhibit these characteristics, the best examples being Wallum Lake in Burrillville and Beach Pond in Exeter. The majority of Rhode Island's ponds are eutrophic systems that are nutrient-rich and too shallow to undergo thermal stratification. Water clarity is usually reduced due to algae accumulation, and bottom sediments are mucky.

There are 20,749 acres of lakes and ponds in Rhode Island, and 70% are 50 acres or less. Only four exceed 500 acres: Watchaug Pond, Flat River Reservoir (Johnson's Pond), Worden Pond, and the largest, Scituate Reservoir, which at more than 13,000 acres supplies water to nearly half of the state's population (RI DEM OWR 2014).

The RI DEM OWR also assesses the water quality and aquatic health of the state's lakes and ponds. In 2012, this assessment covered 91% of the state's lake and pond acreage, with about 55% (8,454.78 acres) considered to be impaired for one or more of their designated uses. Major causes of non-support are high bacteria and nutrient levels, mainly from non-point sources such as urban and storm-water runoff. Internal nutrient recycling, waterfowl, wildlife, agriculture, and septic systems are suspected sources of non-support in lakes. Another major cause of non-support, in terms of total acreage affected, is from the incursion of metals. This major cause of impairment is largely associated with elevated levels of mercury found in fish tissue (RI DEM OWR 2012).

The largest cause of impairment to lakes and ponds in Rhode Island is due to the presence of aquatic invasive species. Documentation of this problem has been developed through seasonal surveys and coordinated reporting among RI DEM, URI Watershed Watch and the Rhode Island Natural History Survey. The resulting data allows a better characterization of the extent of aquatic invasive plants in

Rhode Island's freshwaters. This work has been consistent with the State of Rhode Island Aquatic Invasive Species Management Plan (RI Coastal Resources Management Council 2007).

Marine Habitats

Marine habitats consists of open-ocean overlying the continental shelf, the associated coastline that is exposed to wind and waves, and shallow coastal bays that are saline because they lack significant freshwater flow. The limits extend from mean high water seawater, beyond the limits of rooted vascular vegetation. Salinity is greater than 18.0 parts per thousand (ppt) ocean-derived salts. Marine habitats contain open-water (or pelagic) and varied seafloor (or benthic) habitats which are characterized by several features, including proximity to coast, water depth, and geology-morphology of the seafloor. Nearshore habitats include waters that are less than 10 m deep while offshore habitats are greater than 10 m deep. Habitat types for both nearshore and offshore habitats are further subdivided by either soft or hard rocky bottom sediments.

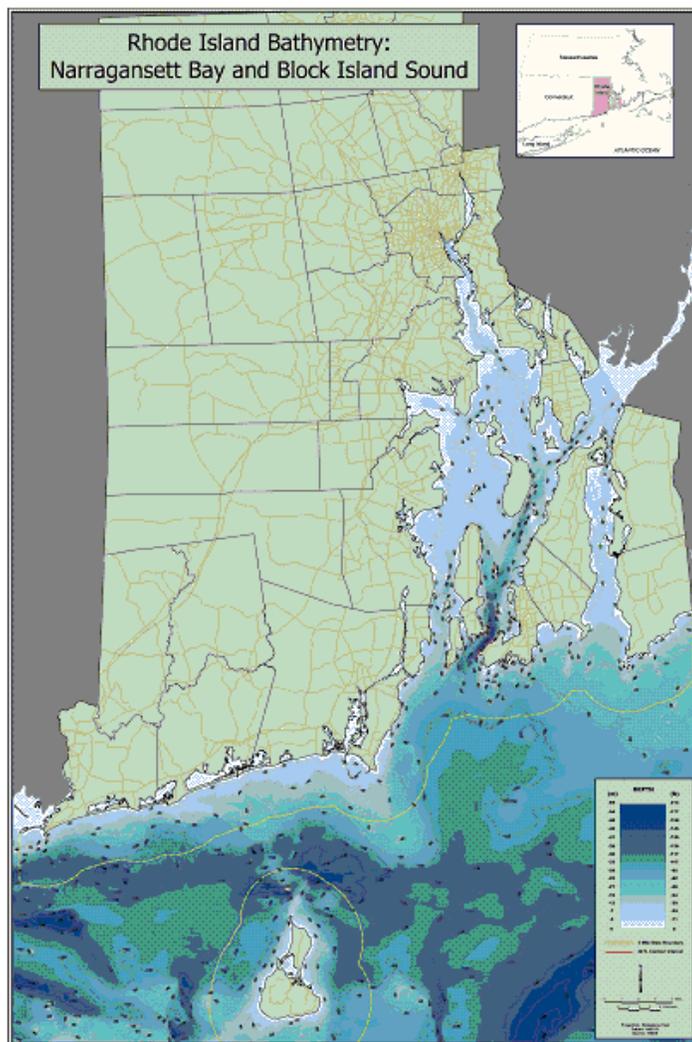


Figure 2-16. Bathymetry of Rhode Island Marine Waters. Source: RIGIS 2014

The pelagic habitat is the dominant type in Rhode Island coastal-marine waters. It is a dynamic environment with tidally and wind-driven circulation. A wide-variety of plankton and nekton are found in

open waters. In turn, this habitat provided food for a diverse assemblage of transient finfish, marine mammals, and sea turtles. The pelagic habitat also supports a number of commercial and recreational fisheries, such as Mackerel, Herring, and Butterfish that utilize Rhode Island's nearshore and offshore marine waters. Rhode Island's fishery has an estimated net worth of \$200 million and employs over 2,500 people.

The health of pelagic habitats is directly tied to seafloor habitats which are essential to fish and invertebrate spawning, foraging, resting and hiding from predators. Over 82% of Rhode Island's seafloor is composed of soft sediments which provide important nursery and spawning areas for commercially important fish such as the Winter Flounder and the American Lobster. Soft sediments support a diverse community of mollusks, crabs, and worms that live in and on the sediments. Tube-dwelling anemones, polychaetes, and amphipods can form dense mats in this habitat modifying the seafloor structure and environment.

Rocky habitats only make up a small percentage of marine habitats in Rhode Island waters. This habitat includes both natural and artificial rocky reefs. Typically the hard or rocky substrate will be covered with sessile invertebrates including sponges, bryozoans, corals, anemones, polychaete worms, and mollusks, and crustaceans. Sessile invertebrates provide food and shelter for many demersal (i.e., bottom-feeding) fish. For numerous species, this area may also provide nursery or spawning habitat. Commercially important finfish utilizing this habitat include Tautog, Cunner, and lobster, and migratory species such as Scup and Black Sea Bass. Artificial reefs, piers, wrecks and other man-made structures are important additions to this community type as they create artificial hard or rocky bottom habitat.

Various Rhode Island agencies have the authority to protect and restore marine areas. The Marine Fisheries Council, housed within RI DEM, may designate Shellfish and Marine Life Management Areas (R.I. Gen. Law § 20-3-4) and issue species-specific regulations (Marine Fisheries R. § 3.5.2). CRMC has authority to create Special Area Management Plans (SAMPS) which aim to preserve, protect, and restore coastal resources while addressing a range of issues on a watershed scale in areas that are under intense development pressure.

The need for a regional standard for habitat classification extends to the marine environment. The North Atlantic Landscape Conservation Cooperative (NALCC) utilized the national Coastal and Marine Ecological Classification Standard (CMECS) version 4.0 to classify estuarine and marine environments in the Northwest Atlantic region (Maine to Virginia). To date, existing state marine classification systems have been identified and cross-walked to CMECS (see Figure 2-17). TNC's Benthic Habitat Model from the Northwest Atlantic Marine Eco-regional Assessment (NAMERA) was applied at the regional scale (1:5,000,000) and the National Estuarine Research Reserve System Classification (NERRSC) scheme was applied at the intermediate scale (1:250,000). These data sets and map products are available online (www.conservationgateway.org).

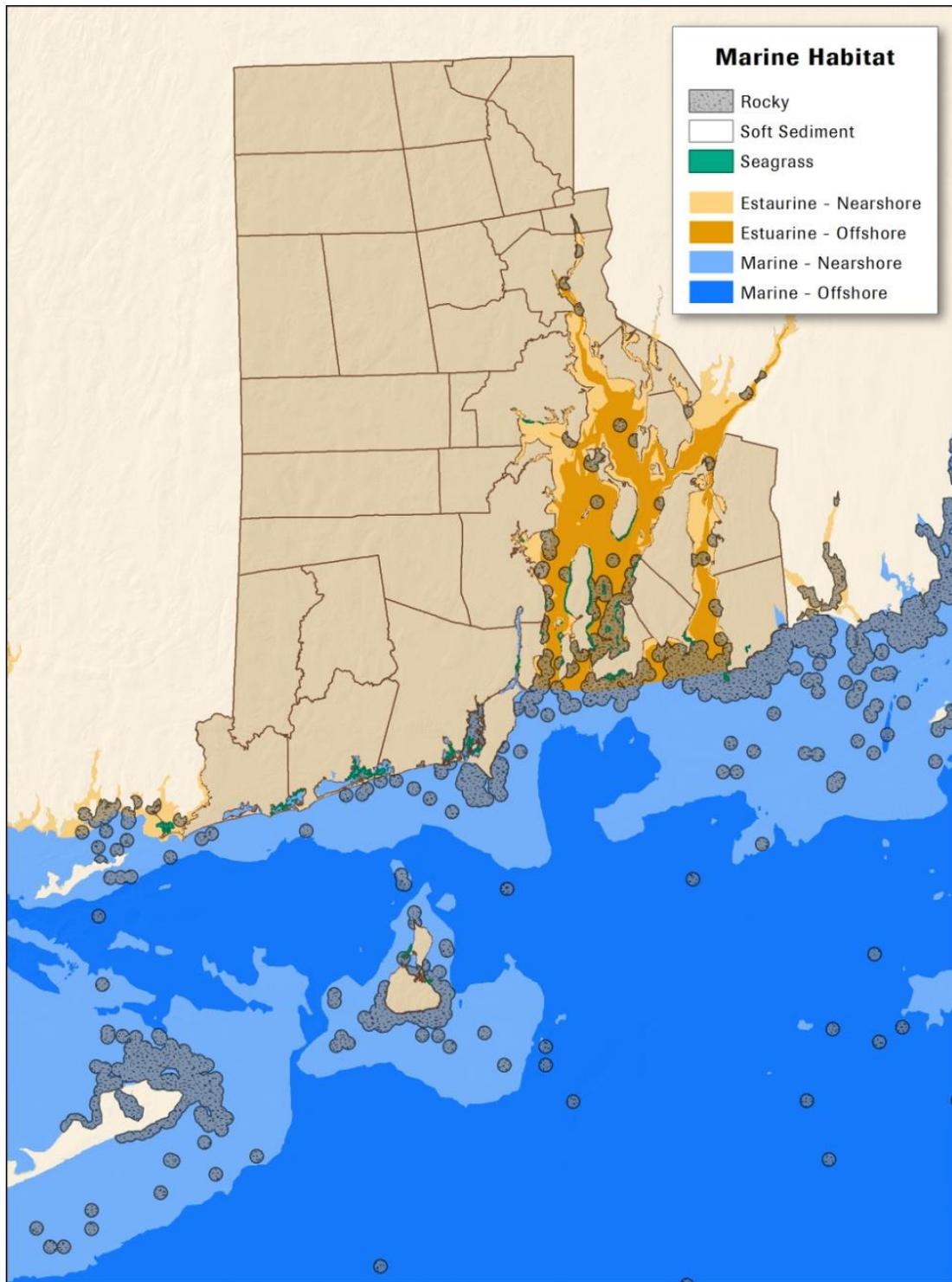


Figure 2-17. Rhode Island's Marine Habitats. Source: The Nature Conservancy, Rhode Island Chapter

Identifying Key Habitats

Identification of key habitats involved input and analysis/review by RI DEM DFW staff, and other scientific experts, and stakeholders. Information and updates of this process were also posted on RI DEM's website for public review throughout the development of the list of key habitats. This 2015 edition of the RI WAP provides a review and updating of the identification process that was conducted for the original 2005 plan, and as such it is pertinent to summarize that effort.

Assessment began with a review of relevant partner program efforts. RI DEM DFW had previously assessed the location and relative condition of rare species in the state (RI DEM 2001), and NHP and DFW rare species habitat information was also evaluated. Critical areas for rare species and biodiversity focus areas had also been identified by the NHP. Other previous efforts included RI's Environmental Sensitivity Index (ESI) project which identified key vulnerable coastal habitats, and the Rhode Island Resource Protection Project (2004), a joint effort between EPA and RI DEM that involved many natural resource partners and identified a spectrum of habitat resources recommended for protection (Figure 2-18).

Neighboring states were contacted for coordination and to provide regional consistency and standardization. The Technical Team assessed information from the standardized existing ecosystem and vegetative classification systems available at that time, with special emphasis placed on those systems and habitat codes that were represented in RI GIS to facilitate geospatial analysis and monitoring efforts. The RINCC (Enser and Lundgren 2005) and complimentary national and regional vegetation classifications provided the foundation for the key habitat identifications.

The 2015 process was improved by expanding the Habitat and GIS/mapping team and in using new state and regional classification systems. The RIECC was adopted as the state-level foundation for identifying key habitats because of its greater precision in naming and delineating community types. The foundations of the NETHCS and NEAHCS provide the regional perspective when determining condition, threats, and actions for each terrestrial and aquatic habitat. Marine habitats were also assessed using the new CMECS as a foundation.

An initial list of habitats important to fish and wildlife SGCN in Rhode Island was prepared by the Technical Team, generated from the primary habitat associations assigned to each species. The resulting habitat/community list was sorted according to the number of SGCN contained within each primary habitat to develop an inclusive list. Further analysis by the Habitat/GIS and Scientific teams helped to refine these habitats in terms of data available for mapping and evaluation of condition and location. Key habitats were cross-walked with the NETHCS and NEAHCS classifications for regional and national consistency, and profiles of each habitat with descriptions, their location and relative condition were produced.

**RHODE ISLAND RESOURCE PROTECTION PROJECT
HABITAT RESOURCES**

(draft 11/29/96)

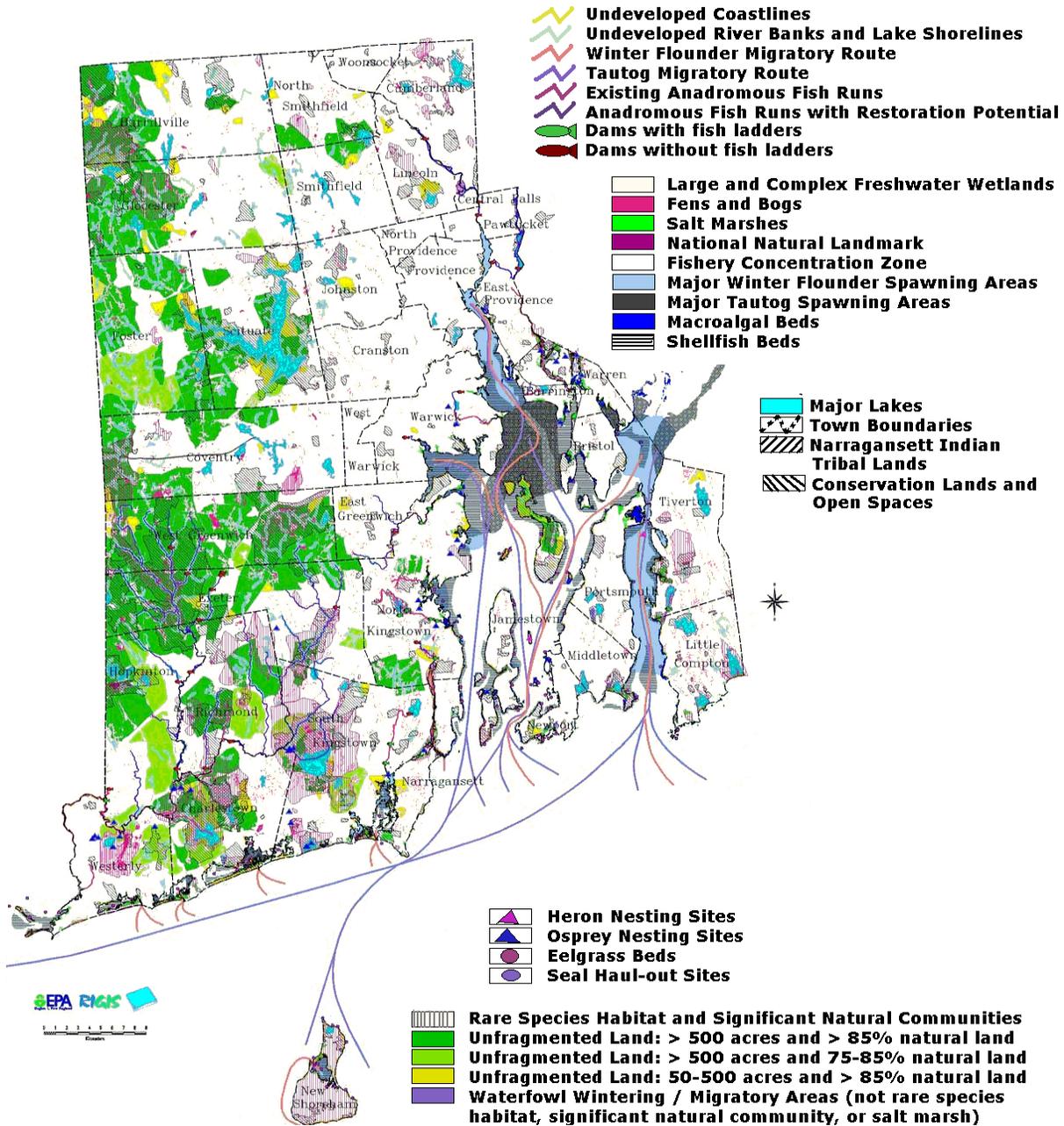


Figure 2-18. Habitat Resources Identified by the Rhode Island Resource Protection Project.

Source: RI RPP 2004

This process resulted in the identification of 84 key habitats (Table 2-6), a number that is 18% higher than the 58 key habitats identified in the 2005 Plan. The increase is due to recognition of the diversity among habitats provided through improved methods of classification and delineation in both the field and

remotely. Several measures were used to gain insight of the imminence of threat and vulnerability to decline for each community. These indices included a measure of condition, relative threat, biodiversity importance, and the specific threat from climate change. Chapter 4 includes more information for each key habitat, including location (with available maps) where known, condition, the SGCN they support, and detailed information on threats and the actions needed to address them.

The Technical Team assembled fish and wildlife SGCN lists associated with each of the key habitats to provide guidance in protecting multiple SGCN simultaneously by using an ecosystem-based approach to conservation. During this process, SGCN were assigned to primary, secondary and tertiary habitats recognizing and reflecting multiple levels of use in more than one habitat type. However, for the purposes of this document, SGCN are presented only once in their primary habitat, in an effort to focus conservation actions and reduce redundancy. An example is how marine and freshwater experts assigned anadromous fish to lower perennial river systems, although these species clearly occupy both freshwater and estuarine/marine systems. Lists of SGCN associated with each key habitat, categorized by taxa, are presented for each of the 84 key habitats in Chapter 4.

Appendix 2a summarizes the status of each of the 84 key habitats, including location, condition, biodiversity importance, degree of threat, and the specific threat from climate change. The relative condition of each community was assessed by consulting the best available information available from RI DEM and its partners, along with assessments from other databases and the published literature. With this information the RI WAP Habitat Technical Team assigned condition ranks as, excellent (3), good (2), fair (1), and poor (0).

The degree of threat, ranked as high (3), medium (2) or low (1), was determined by a review of the best available information on threats from existing conservation and management plans, published and unpublished literature, and the expert opinion of RI DEM DFW staff and its partners. A “U” (unknown) in either threat or condition column signifies that there is insufficient information and knowledge to assign a status to either. AFWA (2012) guidance and subsequent Steering Committee correspondence recommended use of crosswalk linkages to regional and national standardized classification systems for use in large landscape level analysis and monitoring.

Maps were produced for this RI WAP through a collaborative effort of the Habitat/GIS Team. This team was assembled to assess the available geospatial data, evaluate the status of key habitats and to map them at the most accurate level possible. The team identified and mapped key habitats according to the best geospatial data available, and identified the data that would be needed to map habitats at the scale necessary to capture the full catalog of Rhode Island’s ecological communities. It was determined that insufficient information existed to accurately map many of the rare habitats because of their limited distribution and/or small size, a circumstance that also makes assessment of condition and degree of threat of these habitats difficult to determine.

More detailed habitat information would benefit management planning for many SGCN. For example, an accurate assessment of the density of shrubs and saplings within forests is important information to know when planning management actions for New England Cottontail. Brackish marshes are difficult to distinguish from salt marshes in most areas because of the similar appearance of these two habitats on aerial photography; distinguishing these habitats will require extensive field survey combined with remote methods. A primary action identified in Chapter 4 is to conduct Phase 2 of the Photoscience mapping project which would provide the higher resolution for delineating the distribution of these rare habitats.



Napatree Point, Westerly RI

These maps resulted from the significant information and knowledge contributed from the team representing major federal, state, and local data sources. They would not have been possible without the extensive GIS efforts of Kevin Ruddock (TNC), Paul Jordan (RI DEM) and Peter August (URI EDC). Data sources and layers are indicated on each map.

Research to obtain the scientific data to improve these assessments was included as a priority research need in the 2005 RI WAP, and the “Photoscience” project completed in 2014 provides for greater accuracy in determining the distribution of all key habitats. The 2015 RI WAP has also been enhanced by the Habitat Team’s ranking of the condition, importance to biodiversity, degree of threat from climate change, and other key threats.

The assessment of condition of key habitats has also been improved with the recent publication of the Geospatial Condition Analysis project (Anderson et al. 2013b), which applies several important metrics to assessment of the condition of 116 terrestrial and aquatic habitats across the Northeast. It uses the standardized region-wide habitat mapping data of streams and terrestrial ecosystems and the NETHCS and NEAHCS classifications as a foundation for analysis.

Table 2-6. Key Habitats for SGCN in Rhode Island

2015 Habitats Classification Systems Terrestrial-(RIECC) Aquatic- NEAHCs freshwater and CMECS- Marine Ranked by RI WAP Habitat Team								
System	Class	Community	Type	Importance to Biodiversity High=3 Med=2 Low=1	Current Condition Good=3 Fair=2 Poor=1	Degree of Threat High=3 Med=2 Low=1	Vulnerability to Climate Change High=3, Med=2, Low=1	Over-all Rank
Upland	Open Uplands (Grassland & Shrubland)	Coastal Grassland	Maritime Beach Strand	3	2	3	3	11
Upland	Open Uplands (Grassland & Shrubland)	Coastal Grassland	Maritime Herbaceous Dune	3	3	2	3	11
Upland	Open Uplands (Grassland & Shrubland)	Coastal Shrubland	Maritime Shrub Dune	3	3	2	3	11
Upland	Deciduous Woodlands & Forests	Northern Hardwood Forest	Beech/Sugar Maple/Red Oak Forest	3	2	3	3	11
Palustrine	Forested Mineral Soil Wetlands	Floodplain Forest	Silver Maple/Sycamore FF; Red Maple/Pin Oak FF	3	2	3	3	11
Estuarine	Intertidal	Salt Marsh	Low Salt Marsh; High Salt Marsh; Panne; Salt Scrub	3	2	3	3	11
Estuarine	Intertidal	Brackish Marsh	Brackish Marsh	3	2	3	3	11
Estuarine	Intertidal	Intertidal Shore	Rocky Shore	3	2	3	3	11
Estuarine	Intertidal	Intertidal Shore	Mud Flat	3	2	3	3	11
Estuarine	Intertidal	Intertidal Shore	Sand Flat	3	2	3	3	11
Estuarine	Subtidal	Tidal River/Stream	Tidal River/Stream	3	2	3	3	11
Estuarine	Subtidal	Brackish Subtidal Aquatic Bed	Brackish Subtidal Aquatic Bed	3	2	3	3	11
Estuarine	Subtidal	Coastal Salt Pond	Coastal Salt Pond	3	2	3	3	11
Upland	Coniferous Woodlands & Forests	Hemlock/Hardwood Forest	Hemlock/Hardwood Forest	3	2	3	2	10
Upland	Open Uplands (Grassland & Shrubland)	Sparsely Vegetated Rock	Maritime Rocky Cliff	3	2	2	3	10
Upland	Coniferous Woodlands & Forests	Pitch Pine Woodland/Barrens	Pitch Pine Woodland/Barrens	3	2	3	2	10
Upland	Deciduous Woodlands & Forests	Maritime Woodland	Maritime Woodland	3	2	3	2	10

CHAPTER 2: RHODE ISLAND'S FISH AND WILDLIFE HABITAT

System	Class	Community	Type	Importance to Biodiversity High=3 Med=2 Low=1	Current Condition Good=3 Fair=2 Poor=1	Degree of Threat High=3 Med=2 Low=1	Vulnerability to Climate Change High=3, Med=2, Low=1	Over-all Rank
Upland	Open Uplands (Grassland & Shrubland)	Coastal Grassland	Maritime Grassland	3	2	3	2	10
Upland	Deciduous Woodlands & Forests	Northern Hardwood Forest	Mixed Hardwood Riverside Forest	3	2	3	2	10
Upland	Open Uplands (Grassland & Shrubland)	Coastal Shrubland	Maritime Shrubland	3	2	2	3	10
Palustrine	Forested Mineral Soil Wetlands*	Seeps, Springs, Vernal Pools	Seeps, Springs, Vernal Pools	3	2	3	2	10
Palustrine	Open Peatlands	Northern Peatlands	Black Spruce Bog	3	2	2	3	10
Palustrine	Open Peatlands	Coastal Plain Peatlands	Sea Level Fen	3	1	3	3	10
Palustrine	Open Mineral Soil Wetlands	Coastal Plain Pondshore	Seasonally Flooded; Semi-permanently Flooded	3	2	2	3	10
Palustrine	Forested Peatlands	Atlantic White Cedar Swamp	White Cedar-Hardwood Swamp	3	2	3	2	10
Palustrine	Forested Peatlands	Atlantic White Cedar Swamp	White Cedar-Rhododendron Swamp	3	2	3	2	10
Palustrine	Open Mineral Soil Wetlands	Emergent Marsh	Semi-permanently Flooded (Deep) Marsh	3	2	2	3	10
Palustrine	Open Mineral Soil Wetlands	Emergent Marsh	Seasonally Flooded (Shallow) Marsh	3	2	2	3	10
Palustrine	Open Mineral Soil Wetlands	Emergent Marsh	Freshwater Tidal Marsh	3	1	3	3	10
Palustrine	Forested Mineral Soil Wetlands	Forested Swamp	Hemlock/Hardwood Swamp	3	2	2	3	10
Estuarine	Subtidal	Tidal Creek	Tidal Creek	3	2	2	3	10
Marine	Subtidal	Nearshore-Soft Bottom	Nearshore-Soft Bottom	3	3	2	2	10
Marine	Subtidal	Nearshore-Hard, Rocky Bottom	Nearshore-Hard, Rocky Bottom	3	3	2	2	10
Upland	Open Uplands (Grassland & Shrubland)	Sparsely Vegetated Rock	Maritime Bluff	3	2	2	2	9
Upland	Mixed Deciduous/Coniferous Forests	Mixed Oak/White Pine Forest	Mixed Oak/White Pine Forest	3	3	2	1	9
Upland	Deciduous Woodlands & Forests	Oak Forest	Black Oak-Scarlet Oak/Heath Forest	3	2	3	1	9

CHAPTER 2: RHODE ISLAND'S FISH AND WILDLIFE HABITAT

System	Class	Community	Type	Importance to Biodiversity High=3 Med=2 Low=1	Current Condition Good=3 Fair=2 Poor=1	Degree of Threat High=3 Med=2 Low=1	Vulnerability to Climate Change High=3, Med=2, Low=1	Over-all Rank
Upland	Deciduous Woodlands & Forests	Oak Forest	White Oak/Mountain Laurel Forest	3	2	3	1	9
Upland	Deciduous Woodlands & Forests	Oak Forest	Chestnut Oak Forest	3	2	3	1	9
Upland	Deciduous Woodlands & Forests	Oak Forest	Mixed Oak – American Holly Forest	3	2	3	1	9
Upland	Deciduous Woodlands & Forests	Oak Forest	Mixed Oak/Hickory Forest	3	2	3	1	9
Upland	Open Uplands (Grassland & Shrubland)	Inland Sand Barren	Inland Sand Barren	3	2	3	1	9
Palustrine	Open Peatlands	Coastal Plain Peatlands	Graminoid Fen	3	2	2	2	9
Palustrine	Forested Mineral Soil Wetlands	Forested Swamp	Red Maple Swamp	3	2	2	2	9
Palustrine	Open Mineral Soil Wetlands	Shrub Swamp	Shrub Swamp	3	2	2	2	9
Palustrine	Open Peatlands	Northern Peatlands	Dwarf Shrub Fen/Bog	3	2	2	2	9
Palustrine	Open Peatlands	Coastal Plain Peatlands	Coastal Plain Quagmire	3	2	2	2	9
Palustrine	Forested Mineral Soil Wetlands	Forested Swamp	Swamp White Oak Swamp	3	1	3	2	9
Palustrine	Open Mineral Soil Wetlands	Wet Meadow	Wet Meadow	3	1	3	2	9
Marine	Subtidal	Offshore-Soft Bottom	Offshore-Soft Bottom	3	3	1	2	9
Marine	Subtidal	Offshore-Hard, Rocky Bottom	Offshore-Hard, Rocky Bottom	3	3	1	2	9
Riverine	Upper Perennial	Fine Sediment	Cold Water	2	2	2	3	9
Riverine	Lower Perennial	Coarse Sediment	Cold Water	2	2	2	3	9
Riverine	Lower Perennial	Fine Sediment	Cold Water	2	2	2	3	9
Estuarine	Subtidal	Nearshore-Soft Bottom	Nearshore-Soft Bottom	3	1	3	2	9
Estuarine	Subtidal	Nearshore-Hard, Rocky Bottom	Nearshore-Hard, Rocky Bottom	3	1	3	2	9
Estuarine	Subtidal	Offshore-Soft Bottom	Offshore-Soft Bottom	3	1	3	2	9
Estuarine	Subtidal	Offshore-Hard, Rocky Bottom	Offshore-Hard, Rocky Bottom	3	1	3	2	9
Upland	Agricultural	Hayfields/Pasture	Hayfields	2	2	3	1	8
Upland	Agricultural	Hayfields/Pasture	Pasture	2	2	3	1	8

CHAPTER 2: RHODE ISLAND'S FISH AND WILDLIFE HABITAT

System	Class	Community	Type	Importance to Biodiversity High=3 Med=2 Low=1	Current Condition Good=3 Fair=2 Poor=1	Degree of Threat High=3 Med=2 Low=1	Vulnerability to Climate Change High=3, Med=2, Low=1	Over-all Rank
Upland	Mixed Deciduous/ Coniferous Forests	Mixed Oak/Pitch Pine Forest	Mixed Oak/Pitch Pine Forest	3	2	2	1	8
Palustrine	Open Mineral Soil Wetlands	Modified/ Managed Marsh	Impoundment	3	3	1	1	8
Marine	Subtidal	Pelagic	Pelagic	2	3	1	2	8
Riverine	Upper Perennial	Coarse Sediment	Warm Water	2	2	2	2	8
Riverine	Upper Perennial	Fine Sediment	Warm Water	2	2	2	2	8
Riverine	Lower Perennial	Coarse Sediment	Warm Water	2	2	2	2	8
Estuarine	Subtidal	Pelagic	Pelagic	2	1	3	2	8
Riverine	Upper Perennial	Coarse Sediment	Cold Water	2	1	2	3	8
Riverine	Lower Perennial	Fine Sediment	Warm Water	3	1	2	2	8
Upland	Plantation & Ruderal Forest	Tree Plantation	Tree Plantation	1	3	2	1	7
Upland	Open Uplands (Grassland & Shrubland)	Ruderal Grassland/ Shrubland	Utility Rights-of-Way	2	3	1	1	7
Upland	Open Uplands (Grassland & Shrubland)	Sparsely Vegetated Rock	Inland Rocky Outcrop	2	2	2	1	7
Upland	Open Uplands (Grassland & Shrubland)	Ruderal Grassland/ Shrubland	Old Field	2	2	2	1	7
Upland	Plantation & Ruderal Forest	Ruderal Forest	Ruderal Forest	2	2	2	1	7
Lacustrine	Eutrophic Pond	Shallow	Warm Water	3	1	2	1	7
Lacustrine	Oligotrophic Pond/Lake	Deep	Cold/Warm Water	2	1	2	2	7
Upland	Agricultural	Cropland	Vegetables; Turf; Nursery; Orchard; Vineyard; Christmas Trees	1	2	2	1	6
Upland	Developed	Urban/ Recreational Grasses	Lawn; Park; Golf Course; Airfield/Runway Margin; Highway Median	1	3	1	1	6
Upland	Developed	Extractive Industry	Active Sand/Gravel Pit; Rock Quarry	1	3	1	1	6
Palustrine	Open Mineral Soil Wetlands	Modified/ Managed Marsh	Ruderal Marsh	2	2	1	1	6
Upland	Developed	Urban/Suburban	Urban/Suburban	2	2	1	1	6

CHAPTER 2: RHODE ISLAND'S FISH AND WILDLIFE HABITAT

System	Class	Community	Type	Importance to Biodiversity High=3 Med=2 Low=1	Current Condition Good=3 Fair=2 Poor=1	Degree of Threat High=3 Med=2 Low=1	Vulnerability to Climate Change High=3, Med=2, Low=1	Over-all Rank
Upland	Developed	Urban/ Recreational Grasses	Cemetery	1	2	1	1	5
Upland	Developed	Extractive Industry	Abandoned Sand/Gravel Pit; Rock Quarry	1	2	1	1	5
Upland	Open Uplands (Grassland & Shrubland)	Ruderal Grassland/ Shrubland	Clearcut	1	2	1	1	5
Upland	Open Uplands (Grassland & Shrubland)	Ruderal Grassland/ Shrubland	Hedgerow	1	2	1	1	5

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