

Rhode Island's Comprehensive Wildlife Conservation Strategy

Division of Fish and Wildlife

State of Rhode Island
Department of Environmental Management

September 2005



The Rhode Island Division of Fish and Wildlife Mission Statement

Our mission is to ensure that the Freshwater, Marine and Wildlife resources of the State of Rhode Island will be conserved and managed for equitable and sustainable use.

A message from the Chief...

The Division is extremely proud of the plan that it has produced in consultation with Terwilliger Consulting, Inc., all three sections of the Division staff, (Freshwater Fisheries, Marine Fisheries and Wildlife), spent countless hours obtaining data, conducting meetings with stake holders and brainstorming strategies in order to produce the final plan for Rhode Island. We hope that NAAT will look favorably upon the plan as they read through the extensive text, tables and data sets that make up Rhode Island's CWCS. As a Division employee for 37 years and currently Acting Chief I know that the development of this plan is the most significant accomplishment in the Division's history, and will change wildlife conservation programs in Rhode Island for the near and distant future. It will define the Division's mission, which is to "ensure that the freshwater, marine and wildlife resources of the state of Rhode Island will be conserved and managed for equitable and sustainable use".

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Executive Summary

This document presents the results of a two-year process to develop an effective strategy for wildlife conservation in Rhode Island as enabled through the State Wildlife Grants (SWG) federal program that provides funding and administration for this effort through the U.S. Fish and Wildlife Service (USFWS), Office of Federal Aid. The goal of this document is to provide direction and coordination of wildlife conservation efforts for the next decade and address the required elements outlined in the legislation. It represents a vision and a strategy for the Rhode Island Department of Environmental Management's Division of Fisheries and Wildlife (RI DEM DFW) along with its conservation partners in the comprehensive conservation of wildlife for the state.

As the smallest state in the nation, Rhode Island still supports almost 900 vertebrate wildlife species and an estimated 20,000 invertebrates spanning the scenic coastline of Narragansett Bay to the upland forests typical of the New England region. Included in this incredible natural diversity are 23 mammal species, 129 bird species, 21 reptile and amphibian species, 34 fish species and 157 invertebrate species that Rhode Island DEM DFW has identified as in greatest conservation need (GCN). These 364 GCN species are supported throughout the state in 64 different types of key habitats. This Comprehensive Wildlife Conservation Strategy (CWCS) process identified threats to these important species and habitats, and identified habitat loss and degradation from human population growth with its associated impacts as high on the long list of threats. This plan outlines a series of actions prescribed for the next decade to address these threats and to effectively conserve Rhode Island's important wildlife resources.

The CWCS planning process began with an exhaustive inventory of existing natural resource information, programs and stakeholders. This unprecedented broad and inclusive approach was taken to compile and represent information on the status of wildlife conservation in the state and the diversity of public and private stakeholders. It included review of other programs and efforts in the state, region and nation. Information on the full array of wildlife was researched, solicited and compiled. This information is presented herein as a summary of the status of wildlife and its habitat in the state, and as the foundation for identifying species of greatest conservation need and their key habitats.

A wide array of stakeholders participated in the development of the process as well as the resulting lists of wildlife species and habitats, threats and conservation actions. Extensive input was provided by natural resource staff throughout the RI DEM DFW. The resulting process engaged a broader network of individuals and entities and sparked increased communication, coordination and integration. Close coordination with the Teaming With Wildlife (TWW) and International Association of Fish and Wildlife Agencies (IAFWA) Committees as well as local, state, regional, and national conservation partners was maintained in order to capitalize on advancements and encourage integration and future coordination through the implementation of this SWG CWCS. Coordination cut across traditional program divisions to encourage integrated natural resource priority setting to result in mutually beneficial efficiency and economy

of scale. It fostered the broader "system" approach that identified and addressed wildlife species in broader habitat associations and more holistic assemblages representing biotic communities for more effective conservation.

The resulting product (this ten year strategic plan) provides the vision and direction for effective and efficient wildlife conservation in Rhode Island, including collaboration with the conservation community and citizens alike for the next decade. It is designed to respond and adapt to current needs and to be evaluated at regular intervals in order to provide the most appropriate and effective conservation for wildlife in greatest need of conservation in Rhode Island.

Rhode Island CWCS Element Guide

The RI DEM DFW has prepared this guide to Rhode Island's CWCS for the National Advisory Acceptance Team (NAAT) and others to readily find sections that address each of the eight required elements.

Rhode Island's CWCS consists of the main body of text and a series of technical appendices that provide more detailed information and supporting documentation. The main body of the CWCS has eight chapters, each of which focuses on one of the eight elements (in numerical order). Thus, Chapter 1 directly addresses Element 1 and its subelements, Chapter 2 addresses Element 2, and so on. The interconnectedness of the elements allows for each element to also be indirectly addressed in other chapters, and the table below highlights these linkages by listing all of the locations where each subelement is substantially addressed. Figures, tables and appendices are labeled throughout the document with the first number referring to the corresponding chapter and the second number or letter to the sequential order as the figure, table or appendix is introduced in the text. For example, Table 3.4 is the fourth table in Chapter 3 and Appendix 1c is the third appendix supporting Chapter 1.

The Rhode Island CWCS and its supporting appendices are available through the RI DEM DFW website (<http://www.dem.ri.gov/programs/bnatres/fishwild/swgindex.htm>) as Adobe PDF files. Detailed information about each of the GCN species, key habitats, threats, research needs and conservation actions is also available in the RI DEM DFW CWCS dataset and summarized on the RI DEM DFW website for the CWCS, which provided the public the opportunity to submit comments as well as to find specific information on the status, ranking and associations between individual GCN species and habitat.

NAAT Guidance	CWCS Section	Pages	Table or Figure	Pages
Element 1: Information on the distribution and abundance of species of wildlife, including low and declining populations as the state deems appropriate, that are indicative of the diversity and health of the state's wildlife:				
A. The Strategy indicates sources of information (e.g., literature, data bases, agencies, individuals) on wildlife abundance and distribution consulted during the planning process.	Chapter 1	4 – 42	Table 7.2	283
	Bibliography	313 – 353		
	Appendix 1a	A 2 –12		
	Appendix 5	A 528 - 574		
	Appendix 7a	A 575 - 580		

NAAT Guidance	CWCS Section	Pages	Table or Figure	Pages
	Appendix 8a	A 587 -589		
B. The Strategy includes information about both abundance and distribution for species in all major groups to the extent that data are available. There are plans for acquiring information about species for which adequate abundance and/or distribution information is unavailable.	Chapter 1	4 – 42	Figure 1.1	8
	Appendix 1b	A 13- 62	Figure 1.2	10
	Appendix 1c	A 63 - 74	Figure 1.3	11
			Figure 1.4	13
			Figure 1.5	14
			Figure 1.6	15
			Figure 1.7	17
			Figure 1.8	22
			Figure 1.9	23
			Figure 1.10	39
			Table 1.1	4
			Table 1.5	28
			Table 1.8	38
			Table 2.12	75
C. The Strategy identifies low and declining populations to the extent data are available.	Chapter 1	4 – 42	Table 1.5	28
	Appendix 1b	A 13 – 62		
	Appendix 1c	A 63 - 74		
D. All major groups of wildlife have been considered or an explanation is provided as to why they were not (e.g., including reference to implemented marine fisheries management plans). The state may indicate whether these groups are to be included in a future Strategy revision.	Chapter 1	4 – 42	Table 1.8	38
	Appendix 1a	A 2 – 12		
	Appendix 1b	A 13 - 62		

NAAT Guidance	CWCS Section	Pages	Table or Figure	Pages
E. The Strategy describes the process used to select the species in greatest need of conservation. The quantity of information in the Strategy is determined by the state with input from its partners, based on what is available to the state.	Chapter 1	4 – 42	Table 1.9	40
	Appendix 1b	A 13 - 62	Table 1.10	42
	Appendix 1c	A 63 - 74		
Element 2: Descriptions of locations and relative condition of key habitats and community types essential to conservation of species identified in the 1 st element:				
A. The Strategy provides a reasonable explanation for the level of detail provided; if insufficient, the Strategy identifies the types of future actions that will be taken to obtain the information.	Chapter 2	43 – 75	Table 2.4	61
	Chapter 4	98 – 261	Table 2.6	65
	Appendix 2a	A 75 – 82	Table 2.8	68
	Appendix 2b	A 83 - 104	Table 2.9	68
	Appendix 3	A 105 - 194	Table 2.11	72
B. Key habitats and their relative conditions are described in enough detail such that the state can determine where (i.e., in which regions, watersheds, or landscapes within the state) and what conservation actions need to take place.			Table 4.1	132
	Chapter 2	43 – 75	Figure 2.4	49
	Chapter 4	98 - 261	Figure 2.5	50
	Appendix 2a	A 75 – 82	Figure 2.6	51
	Appendix 2b	A 83 – 104	Figure 2.9	59
	Appendix 3	A 105 - 194	Figure 2.10	62
			Figure 2.12	67
			Figure 3.1	79
			Figure 3.2	81
			Figure 3.3	82
			Figure 3.4	83
			Figure 3.5	85
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NAAT Guidance	CWCS Section	Pages	Table or Figure	Pages
			Table 2.1	54
			Table 2.3	58
			Table 2.4	61
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			Table 2.6	65
			Table 2.7	65
			Table 2.8	68
			Table 2.9	68
			Table 2.10	69
			Table 2.11	72
Element 3: Descriptions of problems which may adversely affect species identified in the 1 st element or their habitats, and priority research and survey efforts needed to identify factors which may assist in restoration and improved conservation of these species and habitats:				
A. The Strategy indicates sources of information (e.g., literature, databases, agencies, or individuals) used to determine the problems or threats.	Chapter 3	76 – 97	Figure 3.1	79
	Chapter 4	98 – 261	Figure 3.2	81
	Appendix 1a	A 2 – 12	Figure 3.3	82
	Appendix 3	A 105 – 194	Figure 3.4	83
	Appendix 4	A 105 – 527	Figure 3.5	85
	Appendix 5	A 528 – 574	Table 1.5	28
			Table 2.1	54
			Table 2.4	61
			Table 2.5	63
			Table 2.6	65
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NAAT Guidance	CWCS Section	Pages	Table or Figure	Pages
			Table 2.7	65
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			Table 3.1	77
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			Table 3.3	87
			Table 3.4	88
			Table 3.5	89
			Table 3.6	91
			Table 4.1	132
			Table 5.2	268
B. The threats/problems are described in sufficient detail to develop focused conservation actions (for example, “increased highway mortalities” or “point source pollution” rather than generic descriptions such as “development” or “poor water quality”).	Chapter 3	76 – 97	Table 3.1	77
	Chapter 4	98 – 261	Table 3.4	88
	Appendix 3	A 105 - 194	Table 3.5	89
			Table 3.6	91
C. The Strategy considers threats/problems, regardless of their origins (local, state, regional, national and international), where relevant to the state’s species and habitats.	Chapter 3	76 – 97	Table 3.1	77
	Chapter 4	98 – 261	Table 3.4	88
	Appendix 3	A 105 - 194	Table 3.5	89
			Table 3.6	91
<i>continued on next page...</i>			Figure 3.1	79

NAAT Guidance	CWCS Section	Pages	Table or Figure	Pages
			Figure 3.2	81
			Figure 3.3	82
			Figure 3.4	83
			Figure 3.5	85
D. If available information is insufficient to describe threats/problems, research and survey efforts are identified to obtain needed information.	Chapter 3	76 – 97	Table 1.8	38
	Chapter 4	98 – 261	Table 5.2	268
	Appendix 3	A 105 – 194		
	Appendix 4	A 195 – 527		
E. The priority research and survey needs, and resulting products, are described sufficiently to allow for the development of research and survey projects after the Strategy is approved.	Chapter 3	76 – 97		
	Chapter 4	98 – 261		
	Appendix 3	A 105 – 194		
	Appendix 4	A 195 – 527		
Element 4: Descriptions of conservation actions determined to be necessary to conserve the identified species and habitats and priorities for implementing such actions:				
A. The Strategy identifies how conservation actions address identified threats to species of greatest conservation need and their habitats.	Chapter 4	98 – 261	Figure 3.6	91
	Appendix 3	A 105 – 194	Figure 4.1	100
	Appendix 4	A 195 – 527		
B. The Strategy describes conservation actions sufficiently to guide implementation of those actions through the development and execution of specific projects and programs.	Chapter 4	98 – 261		
	Appendix 4	A 195 – 527		

NAAT Guidance	CWCS Section	Pages	Table or Figure	Pages
C. The Strategy links conservation actions to objectives and indicators that will facilitate monitoring and performance measurement of those conservation actions (outlined in Element #5).	Chapter 4 Chapter 5 Appendix 4	98 – 261 262 – 276 A 195 – 527		
D. The Strategy describes conservation actions (where relevant to the state's species and habitats) that could be addressed by Federal agencies or regional, national or international partners and shared with other states.	Chapter 4 Chapter 7 Appendix 4 Appendix 7a	98 – 261 281 – 307 A 195 – 527 A 575 - 580	Table 7.3 Table 7.4	285 295
E. If available information is insufficient to describe needed conservation actions, the Strategy identifies research or survey needs for obtaining information to develop specific conservation actions.	Chapter 4 Appendix 4	98 – 261 A 195 – 527	Table 1.8 Table 5.2	38 268
F. The Strategy identifies the relative priority of conservation actions.	Chapter 4 Appendix 4	98 – 261 A 195 – 527		
Element 5: Descriptions of the proposed plans for monitoring species identified in the 1 st element and their habitats, for monitoring the effectiveness of the conservation actions proposed in the 4 th element, and for adapting these conservation actions to respond appropriately to new information or changing conditions:				
A. The Strategy describes plans for monitoring species identified in Element #1, and their habitats.	Chapter 5 Chapter 4 Appendix 5	262 – 276 98 – 261 A 528 – 574	Table 5.1	264
B. The Strategy describes how the outcomes of the conservation actions will be monitored.	Chapter 5 Chapter 4 Appendix 4	262 – 276 98 – 261 A 195 – 527	Table 5.1 Table 5.3	264 273

NAAT Guidance	CWCS Section	Pages	Table or Figure	Pages
C. If monitoring is not identified for a species or species group, the Strategy explains why it is not appropriate, necessary or possible.	Chapter 5	262 – 276	Table 5.2	268
D. Monitoring is to be accomplished at one of several levels including individual species, guilds, or natural communities.	Chapter 5 Chapter 4 Appendix 4 Appendix 5	262 – 276 98 – 261 A 195 – 527 A 528 – 574		
E. The monitoring utilizes or builds on existing monitoring and survey systems or explains how information will be obtained to determine the effectiveness of conservation actions.	Chapter 5 Appendix 5	262 – 276 A 528 – 574	Table 5.1 Table 5.2 Table 5.3	264 268 285
F. The monitoring considers the appropriate geographic scale to evaluate the status of species or species groups and the effectiveness of conservation actions.	Chapter 5 Chapter 4 Appendix 4 Appendix 5	262 – 276 98 – 261 A 195 – 527 A 528 – 574		
G. The Strategy is adaptive in that it allows for evaluating conservation actions and implementing new actions accordingly.	Chapter 5 Chapter 6	262 – 276 277 - 280	Table 5.3	273
Element 6: Descriptions of procedures to review the Strategy at intervals not to exceed 10 years:				
A. The state describes the process that will be used to review the Strategy within the next 10 years.	Chapter 6	277 - 280	Table 6.1	278

Element 7: Descriptions of the plans for coordinating, to the extent feasible, the development, implementation, review, and revision of the Strategy with federal, state, and local agencies and Indian tribes that manage significant land and water areas within the state or administer programs that significantly affect the conservation of identified species and habitats:				
A. The state describes the extent of its coordination with and efforts to involve Federal, state and local agencies, and Indian Tribes in the development of its Strategy.	Chapter 7	281 – 307	Table 7.1	282
	Appendix 7a	A 575-580	Table 7.2	283
	Appendix 7b	A 581 – 582	Figure 7.2	291
	Appendix 8a	A 587 – 589		
	Appendix 8b	A 590 – 591		
	Appendix 8c	A 592 – 596		
B. The state describes its continued coordination with these agencies and tribes in the implementation, review and revision of its Strategy.	Chapter 4	98 – 261	Table 6.1	278
	Chapter 6	277 – 280		
	Chapter 7	281 – 307		
	Appendix 4	A 195 – 527		
	Appendix 7a	A 575 – 580		
	Appendix 7b	A 581 – 582		
	Appendix 8b	A 590 – 591		
Element 8: Descriptions of the necessary public participation in the development, revision, and implementation of the Plan:				
A. The state describes the extent of its efforts to involve the public in the development of its Strategy.	Chapter 8	308 – 313		
	Chapter 4	98 – 261		
	Appendix 8a	A 587 – 589		
	Appendix 8b	A 590 – 591		
	Appendix 8c	A 592 – 596		

B. The state describes its continued public involvement in the implementation and revision of its Strategy.	Chapter 8	308 – 313		
	Chapter 4	98 – 261		
	Appendix 8b	A 590 – 591		

The process followed to develop the CWCS proceeded through each of the eight required elements and incorporated the guidance provided by the IAFWA and NAAT.

EXAMPLE: Least Tern

The least tern, for example, was identified as a GCN species following an evaluation of its status, abundance and distribution in the state, and existing conservation efforts that have identified it as a high priority species. RI DEM DFW staff, a Scientific Review Team and other partners assessed the abundance and distribution of fauna in Rhode Island, identifying those species in greatest conservation need (GCN) based on available scientific information (Element 1). The least terns found in Rhode Island are state threatened, globally ranked as G4, and state ranked as S2B, S2N. Furthermore, the North American Waterbird Conservation Plan classifies the least tern as High Priority, the Northeast Association of Fish and Wildlife Administrators as a regional Species of Concern, the USFWS as a Bird of Conservation Concern, and the South Atlantic Migratory Bird Initiative as a priority species.

The least tern nests within two areas that were identified as key habitats – *Littoral Zone* and *Predator Free Islands* (Element 2). These habitats are restricted to coastal areas and as such are relatively rare in Rhode Island (Element 2). The Littoral Zone key habitat was found to be in compromised condition, while Predator Free Islands are in also threatened and in compromised condition. Rhode Island's least tern habitat is threatened by habitat loss and fragmentation resulting from residential and waterfront development and associated infrastructure; plant succession of barren or sparsely vegetated nesting habitat; and animal predation of nests (Element 3).

Priority monitoring needs were then determined and include identifying breeding sites and non-breeding concentration areas, identifying threats to the species and its habitat(s), and monitoring nesting productivity (Element 3). Anticipated products of fulfilling these monitoring needs include data to fill information gaps to assess the status and/or condition of least terns, inclusion in and/or expansion of this species in the RI DEM DFW GCN species dataset and/or other RI DEM datasets, and the creation of new GIS coverages (Element 5). This data will also contribute to regional and national conservation efforts in which Rhode Island is a partner, such as the Breeding Bird Survey, Atlantic Coast Joint Venture, North American Waterbird Conservation Plan and North American Bird Conservation Initiative (Element 7).

Next, conservation actions to address the threats above were determined. Several priority conservation actions (Element 4) were identified to improve the conservation of least

terns and their coastal habitats: (1) address habitat fragmentation through the identification of appropriate conservation partners, developing partnerships with private landowners, developing a liaison with towns and other partners, and conducting outreach to appropriate State Parks; (2) address habitat loss by identifying key unprotected parcels in focal areas, facilitating their acquisition or protection through easements, and coordinating with other state and regional conservation programs; (3) address the threat of plant succession by identifying parcels in need of management and managing those parcels as required; and (4) address the threat of excessive animal predation through predator control and intervention where appropriate.

By monitoring the implementation and degree of success of these conservation actions (Element 5), RI DEM DFW and its partners will be able to quantify the performance measures for each – the number of partnerships formed and cooperative projects undertaken, the number of acres of habitat protected or restored, and the number of predators removed. The RI DEM DFW CWCS dataset will capture the current information on each of these species and will be used to track and adaptively assess, monitor and manage these species and their habitats, recording any changes to status and condition (Elements 5, 6). The adaptive management approach will allow RI DEM DFW to not only quantify these performance measures, but also compare the results of the species monitoring to infer whether the conservation actions are improving the number of least tern nests and/or nest productivity each year. If the status and condition of breeding least terns shows no significant improvement, then the conservation actions can be modified to intensify habitat protection measures, or target key areas and cooperative projects with partners if funds limit the expansion of the conservation measures (Elements 1, 3, 5 and 7). In this way, a feedback loop between monitoring, conservation actions and management objectives will be maintained (Elements 1-5).

Partners and stakeholders participated in workshops and meetings and were consulted to develop the GCN and key habitat lists as well as conservation actions. They were involved both in the development and review of these lists (Element 7). Following its proposal as a GCN species, the public was invited to provide comments (as with all GCN species and key habitats, threats and conservation actions) through workshops, newsletters and through the RI DEM DFW website (Element 8).

Information on the selection of GCN species (not just the least tern), key habitats, conservation actions and more are summarized throughout the CWCS and its appendices. References to more detailed sources of information and species accounts are provided in the Literature Cited as well as Appendices.

Acknowledgments: The RI DEM DFW thanks the many states that exchanged information in this CWCS effort to coordinate regionally and nationally. We greatly appreciate the support and recommendations of countless contributors and reviewers within RI DEM and its conservation partners in the state, USFWS, IAFWA, and the Regional and National Advisory Acceptance Team.

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Photos for deciduous forest, evergreen forest, sparsely vegetated, river and streams, lakes and ponds, and predator free islands were provided by Christopher Raithel. Photos for pitch pine, early successional, emergent wetland, and shrub wetland were provided by Richard Enser. Photos of mixed forest, intertidal, subtidal, and urban habitats were provided by Jason Osenkowski. Photo of agricultural habitat was provided by Richard Sutton. Photo of forested wetland was provided by Caren Caljouw.

Introduction

For more than a decade, the Teaming With Wildlife (TWW) Committee of the International Association of Fish and Wildlife Agencies (IAFWA), composed of the states and their governmental and nongovernmental partners in conservation, has encouraged Congressional support for new sources of Federal funding to complement state wildlife conservation programs. This support came in the form of substantial annual appropriations to states under the Wildlife Conservation and Restoration Program (WCRP) and State Wildlife Grant program (SWG) in Fiscal Years 2001, 2002, and 2003. Under the new federal WCRP and SWG programs, Congress provided an historic opportunity for the state fish and wildlife agencies and their partners to design and implement a comprehensive vision for the conservation of America's wildlife. Under SWG (FY02), each state, Territory, and the District of Columbia must complete a Comprehensive Wildlife Conservation Strategy (CWCS) by October 1, 2005. This CWCS will also meet the obligation under WCRP (FY01) to produce a Wildlife Conservation Strategy.

Rhode Island's Comprehensive Wildlife Conservation Strategy represents the results of an inclusive approach to compile and present the best available current information on the status of wildlife conservation in the state while involving the diversity of Rhode Island's public and private stakeholders. It is through this tool that we have the opportunity to inform conservation partners and the greater public how to best use the funding available to ensure that common species remain common. Specific components are presented in order to meet legal obligations under the State Wildlife Grants federal program that provides funding and guidance for this effort through the U.S. Fish and Wildlife Service (USFWS), Office of Federal Aid.

The purpose of this document is to provide direction and coordination of wildlife conservation efforts in Rhode Island for the next decade. The overall goal is to identify those species in greatest need of conservation and their associated key habitats, and to describe the actions necessary to prevent their populations from declining. This is also a chance to prevent additional species from becoming threatened or endangered and to plan into the future. As an integral part of the process, RI DEM DFW will ensure long-term implementation and conservation of these species. This plan is the first opportunity of its kind and will be a significant step forward as RI DEM DFW continues to conserve Rhode Island's wildlife diversity for generations to come.

The Conservation Actions identified in this CWCS will be an essential foundation for the future of wildlife conservation as well as a stimulus for federal, state, local public and private conservation partners to think strategically about their individual and coordinated roles in prioritizing wildlife conservation efforts. Numerous conservation plans addressing the needs of individual or regional habitats, species or threats have been developed, however none of them take a statewide, comprehensive perspective that includes all of Rhode Island's wildlife diversity and key habitats in a systems approach to long term conservation. The development of the CWCS at the state level is the critical first step toward defining the capabilities and needs of RI DEM DFW and its partners in

accomplishing wildlife conservation goals. This CWCS also identifies the measures that will be used to evaluate the results achieved and the threats and needs that remain for effective wildlife conservation in Rhode Island. The CWCS process presents an opportunity for the RI DEM DFW to provide effective and visionary leadership in wildlife conservation. Strategic implementation with the new funds, periodic review, and resulting adaptive management make this document a long-term tool for wildlife conservation.

Congress identified eight required elements in the WCRP and SWG legislation. During the development process, the TWW Committee provided more specific guiding principles that included criteria to help states define the scope and focus of their plans. The U.S. Fish and Wildlife Service's National Advisory Acceptance Team (USFWS-NAAT) also provided guidance on basic information needed during the strategy review and evaluation process.

The Eight Required Elements

Congress identified eight required elements to be addressed in each state's Comprehensive Wildlife Conservation Strategy. Congress also directed that the strategies identify and focus on "species in Greatest Conservation Need," yet address the "full array of wildlife" and wildlife-related issues. The strategies must provide and make use of:

- (1) Information on the distribution and abundance of species of wildlife, including low and declining populations as the State fish and wildlife agency deems appropriate, that are indicative of the diversity and health of the State's wildlife; and,
- (2) Descriptions of locations and relative condition of key habitats and community types essential to conservation of species identified in (1); and,
- (3) Descriptions of problems which may adversely affect species identified in (1) or their habitats, and priority research and survey efforts needed to identify factors which may assist in restoration and improved conservation of these species and habitats; and,
- (4) Descriptions of conservation actions proposed to conserve the identified species and habitats and priorities for implementing such actions; and,
- (5) Proposed plans for monitoring species identified in (1) and their habitats, for monitoring the effectiveness of the conservation actions proposed in (4), and for adapting these conservation actions to respond appropriately to new information or changing conditions; and,
- (6) Descriptions of procedures to review the strategy at intervals not to exceed ten years; and,
- (7) Plans for coordinating the development, implementation, review, and revision of the plan with Federal, State, and local agencies and Indian tribes that manage significant land

and water areas within the State or administer programs that significantly affect the conservation of identified species and habitats.

(8) Congress also affirmed through this legislation that broad public participation is an essential element of the development and implementation of these plans, the projects that are carried out while these plans are developed, and the species in greatest need of conservation that Congress has indicated such programs and projects are intended to emphasize.

The intent of this document, therefore, is two fold. The first goal is to meet the required eight elements of the SWG program in order for Rhode Island to be eligible to receive SWG funding for this long overdue and critically important conservation work. Therefore the document has been organized and presented in the context of these eight elements, which correspond to the eight chapters.

The second goal is to provide a functional and foundational strategy for comprehensive wildlife conservation in the state to guide RI DEM DFW and its conservation partners for the next decade. This document identifies the spectrum of needed wildlife diversity conservation efforts and calls for coordinated implementation at multiple scales and levels. It provides the best available information on those wildlife species and their habitats in most need of conservation in hopes that partners and stakeholders at all levels will use and incorporate these targets and tasks into their ongoing efforts across the state.

Chapter 1: Rhode Island's Wildlife

Rhode Island's wildlife is remarkably diverse considering that it is the smallest state in the nation and supports the second highest human population density. From the highlands in the northwest to the open waters of the Atlantic Ocean, Rhode Island has thousands of resident and migratory aquatic and terrestrial faunal species. Hosting almost 100 natural vegetative community types, the state's land and waterscapes support a spectrum from rare and endangered species to the most common and abundant. This chapter addresses Element 1 by describing the full array of Rhode Island's fish and wildlife and summarizing the best available information and sources of species abundance and distribution status. For additional information on species status, please see Appendices 1a-c.

Table 1.1 Wildlife Diversity of Rhode Island- Species Richness by Taxa.

Taxa	Species found in RI	State-listed	Federally-listed	S1 & S2 Ranked	S3 Ranked	G1 & G2 Ranked	GCN Species
Mammals	91	12	8	8	3	1	23
Birds	427	58	4	75	28	0	129
Reptiles and Amphibians	46	13 [†]	4	9	3	2	21
Fish	306	2	1	7	8	0	34
Invertebrates (estimated 20,000+)	396+	56	1	56	17	1	157
Total	870+	71	18	155	59	4	364

[†] As listed in RI DEM (2001k)

Key: S1 Rank = Critically imperiled in the state
 S2 Rank = Imperiled in the state
 S3 Rank = Vulnerable to extirpation or extinction in the state
 Species ranked S4 Rank = Apparently Secure, S5 Rank = Secure or unknown (for invertebrates) are not shown, but a listing of the full array of known wildlife can be found in Appendix 1b and 1c.
 G1 Rank = Critically imperiled across its entire range (i.e., globally)
 G2 Rank = Imperiled across its entire range (i.e., globally)

Invertebrates far outnumber other animal groups and demonstrate high biotic diversity in Rhode Island, with many thousands of species and representatives found in habitats across the state (RI DEM 2004c). Birds are the most diverse vertebrate taxonomic group in the state with over 400 species, and contain the highest number of state-listed species. Over 300 species of freshwater and saltwater fish have been recorded in the state's waters, while 91 mammals, 29 reptiles and 19 amphibians are distributed throughout a variety of habitat types. Table 1.1 summarizes Rhode Island's wildlife diversity along with standardized status ranks that indicate abundance and distributions status. Each of these taxonomic groups, along with the best available information on their status and distribution, is discussed further in the following sections. This chapter is intended as a summary overview of Rhode Island's wildlife and provides appropriate references to more specific information on these species groups in existing literature. It is the intent of this document to compile, evaluate and present summary status information and best sources for this information, rather than to repeat

existing detailed accounts of each species that have been prepared by RI DEM's many local, state, regional, and national partners programs.

RI DEM DFW and its partners maintain datasets of the state's fish and wildlife species and their distribution and abundance. Appendix 1b presents a checklist of Rhode Island's vertebrates and those invertebrates for which information is available (Rhode Island's full array of wildlife). This appendix represents the RI DEM DFW dataset of the vertebrate species and their status in the state. The vertebrate dataset represents the best available summary of information on abundance, distribution, and status of wildlife species for Rhode Island, including those with low and declining populations. RI DEM DFW or its partners do not have a comprehensive list of invertebrate species, as many are yet to be documented or studied in the state. Appendix 1c presents those species in Rhode Island that have been determined to be of Greatest Conservation Need.

Wildlife Resource Value and Public Use

Rhode Island's fish and wildlife resources provide a varied and renewable source of economic value and quality of life to the state and nation. Migrating and wintering waterfowl, neo-tropical migrants, butterflies, dragonflies, fish, and rare plants attract residents and eco-tourists to five US Fish and Wildlife Service wildlife refuges, 24 State Management Areas, and ten Audubon Society of Rhode Island wildlife refuges for wildlife observation opportunities. Rhode Island's State Comprehensive Outdoor Recreation Plan (SCORP) identifies those State Management Areas that provide fishing and hunting opportunities" (RI DEM 2003n).

In 2001, there were ~399,000 residents and non-residents who participated in wildlife-associated recreation in Rhode Island, spending \$288 million on fishing, hunting and wildlife watching (US DOI 2001). Three-quarters of these participants reported wildlife watching as one of their activities (generating ~\$170 million), while 45% fished and 2% hunted (generating ~ \$111 million) (US DOI 2001).

USFWS estimates that 193,000 people enjoy birdwatching in Rhode Island (US DOI 2001). Most (76%) of these birdwatchers are residents of Rhode Island, while the rest are visitors from throughout the Northeast and the rest of the nation (US DOI 2001). Over 98,000 participants traveled away from home to watch or photograph wildlife in Rhode Island (US DOI 2001). An estimated 237,000 state residents observe, feed and/or photograph wildlife from home. According to the most recent survey, these wildlife watchers spent almost \$22 million in Rhode Island and \$16 million outside of the state on their activities in 2001 (US DOI 2001).

The state's coastal areas host nearly two million visitors annually (RI DEM 2003n). Rhode Island's parks and management areas draw six million visitors each year, generating \$1.7 billion in revenues to the state's economy (RI DEM 2003n). In a survey of visitor preferences, most people rated protecting Narragansett Bay, protecting watersheds, providing state beaches and state parks, and providing natural habitats for wildlife and plants as very

important and as RI DEM's top five priorities (RI DEM 2003n). Approximately 37% of the state's population reports enjoying wildlife-associated recreation (US DOI 2001). The tourism industry is worth an estimated \$8.4 billion to Rhode Island's economy every year (RI DEM 2003n).

Eleven thousand hunters (residents and non-residents) spent nearly \$118 million in 2001 (US DOI 2001). The RI DEM DFW administers annual hunting programs for deer, wild turkey, small game and furbearers (e.g., rabbit, squirrel, fox, coyote, beaver), upland and migratory game birds (e.g., American woodcock, pheasant, quail, ruffed grouse) and waterfowl. In the 2004-05 hunting season, deer hunters purchased over 17,000 permits and harvested over 2,600 deer in Rhode Island (RI DEM 2005a), and ~700 permitted hunters harvested 207 wild turkey (RI DEM 2005b).

Rhode Island has a rich heritage in the marine fishing, boating and shipping industries. Point Judith, Rhode Island, is consistently one of the top ten commercial fishing ports in the nation in terms of annual economic landings. Today, commercial fisheries landings are worth \$70-80 million annually, harvesting approximately 120 million pounds of saltwater fish, crustaceans and mollusks. Lobster, squids, and quahogs are the top three fisheries of economic value for Rhode Island. Valliere and Murphy (2001) analyzed the issues of commercial fishing licenses in Rhode Island over the span of a decade and discovered that RI DEM DFW issued 1,000 less in 2000-01 from a peak of 5,686 in 1992.

Recreational fishing is also an economic revenue source for the state, with over \$13 million spent by 46,000 anglers on freshwater fishing in 2001 (US DOI 2001). Black bass and trout are the top two fish sought by freshwater sportsmen in Rhode Island (US DOI 2001). The state stocks several streams, rivers, and lakes with fish such as trout and largemouth bass, and maintains 46 fishing and boating access sites to manage and enhance freshwater fishing opportunities throughout the state. In addition, an estimated 321,000 saltwater anglers contribute \$100 million to the Rhode Island economy annually; the majority of these anglers are non-residents of Rhode Island, with more out-of-state fishermen coming to the state every year (Valliere and Murphy 2001). Striped bass, bluefish and flatfish are the top fish species caught by saltwater anglers (US DOI 2001). Twenty-two state-owned saltwater fishing and boating access sites allow residents and visitors to enjoy recreational fishing in Rhode Island's marine waters.

Wildlife is part of the culture of Rhode Island and wildlife recreation is a cornerstone of its conservation ethic and natural resource management. Whether fishing, hunting, watching wildlife, or feeding backyard birds, Rhode Islanders derive many hours of enjoyment from wildlife-related recreation. Rhode Island's wildlife and natural habitats contribute on many levels to the quality of life experienced by residents and visitors alike. More than half a century ago, Aldo Leopold characterized the value of wildlife to society: "Some have attempted to justify wildlife conservation in terms of meat, others in terms of personal pleasure, others in terms of cash, still others in the interest of science, education, agriculture, art, public health, and even military preparedness. But few have so far clearly realized and expressed the whole truth; namely that all these things are but factors in a broad social value, and that wildlife is a social asset" (Leopold 1953).

Efforts to estimate the true value of wildlife, as with most natural resources, have met with limited success and significant information gaps and research needs remain (Costanza et al. 1997, De Groot 1994, Pimental et al. 1997, Wilson and Carpenter 1999, and World Bank 1995). It is likewise impossible to put a precise dollar value on forests that replenish oxygen and cleanse the air, wetlands that clear toxic elements from the water and absorb runoff, or wildlife species that control agricultural pests, disperse seed, recycle nutrients, or pollinate plants. In many ways the role they play in our lives would have to be considered priceless.

Mammals

Rhode Island hosts 91 different species of mammals, at least 79 of which are indigenous or native to the state (August et al. 2001). August et al. (2001) provides the best available information on the state's mammal species, while Nawojchik (2000) and Valliere (2003) describe the state's marine mammals. A few mammal species have recently established or reestablished breeding populations in the state (i.e., Virginia opossum (*Didelphis virginiana*), coyote (*Canis latrans*), fisher (*Martes pennanti*), beaver (*Castor canadensis*)), while others have been introduced with the aid of humans (e.g., house mouse (*Mus musculus*), feral dog (*Canis lupus familiaris*) and cat (*Felis silvestris*), black (*Rattus rattus*) and Norway rats (*Rattus norvegicus*) (August et al. 2001). Sightings of black bears (*Ursus americanus*) have become more common in Rhode Island as bear populations in neighboring Connecticut and Massachusetts continue to grow, however the breeding status of bears in Rhode Island is still unknown. Twelve mammals are listed by Rhode Island as endangered, threatened or species of concern, and eight of these are also federally listed (Table 1.1). These listed species include the Indiana bat (*Myotis sodalis*), smoky shrew (*Sorex fumeus*), and several species of whales.

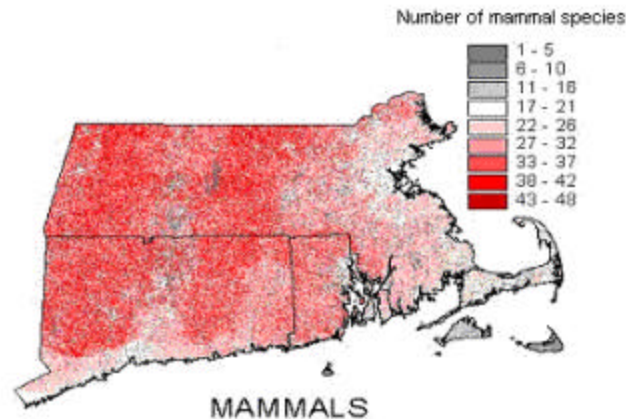
Some of Rhode Island's mammals are cosmopolitan and can be found in several different habitat types (Figure 1.1). Others are specialists that prefer one habitat type and have been more susceptible to threats from development, deforestation, and other habitat conversions. Forest maturation processes have changed the compositional structure and age class of the forest, so that small mammals such as the New England cottontail no longer can find suitable habitats (RI DEM 2003f). Historically, hunting and trapping caused the decline of certain mammal populations, but in recent decades most of these species (e.g., American beaver) have recovered. Chapter 3 discusses general threats and Chapter 4 discusses threats to individual species and habitats in detail.

The RI DEM DFW and its partners monitor the abundance and distribution of several mammal populations in the state. Prudence Island once supported the densest population of white-tailed deer (*Odocoileus virginianus*) in all of New England (Gibbs et al. 1995). Species for which hunting and trapping programs are allowed, such as coyote, beaver, fisher, and white-tailed deer, are monitored through RI DEM DFW management programs. These programs include setting hunting and trapping seasons, bag limits, and access restrictions through permits. Data on harvest of hunted and trapped species are collected annually: e.g., deer harvest information is available from 1977 to the present. In areas where a species

(such as deer) have become overabundant, RI DEM DFW coordinates with local communities to control populations and respond to nuisance complaints as needed.

RI DEM DFW maintains a database of small mammal records (e.g., moles, mice, shrews, voles) dating back to 2001, recording relevant biological parameters such as species, sex, size, weight, location, habitat, and method of capture for each animal.

Figure 1.1 Mammals Species Richness and Distribution in Southern New England (Source: SNE GAP Zuckerberg et al. 2004)



Marine mammal abundance and distribution data are collected by RI DEM DFW, the University of Rhode Island, the Mystic Aquarium in eastern Connecticut, and other partners. These data are limited, however, and generally reflect sightings and strandings of deceased or injured animals. The Mystic Aquarium documented 28 individual strandings of four species of pinnipeds in Rhode Island between 1979 and 2000, and 19 individual strandings of six species of cetaceans on Block Island from 1983 to 2000 (Nawojchik 2000). A management plan for marine mammals in Rhode Island (Valliere 2003) presents the best available information on the status of this group as well as threats and action for conservation. Save the Bay, a non-governmental organization (NGO), and the Narragansett Bay National Estuarine Research Reserve have monitored seal populations as part of their Bay Watchers program since 1993 (Berounsky 2002). RI DEM DFW also collects data on aquatic furbearer populations such as beaver and river otter (*Lontra canadensis*). Beaver populations are monitored in the major watersheds of the Blackstone, Pawcatuck (2001-02) Quinebaug, Hunt, and Pawtuxet Rivers (2003). Otter latrines have been surveyed statewide since 1999. In addition, mink (*Mustela vison*) have been collected by RI DEM DFW throughout the state since 1999 for a cooperative study with the U.S. Environmental Protection Agency of environmental contaminants.

The Block Island meadow vole (*Microtus pennsylvanicus provectus*), a subspecies of the more common meadow vole (*Microtus pennsylvanicus*), is endemic to Block Island (USFWS 2002a) and is found in idle agricultural fields or hay fields on the island. Due to its limited distribution, this vole is imperiled both in Rhode Island and globally and has been selected as a GCN species for this CWCS (Table 1.2). Block Island is known for hosting a variety of rare and endangered species and has been designated one of The Nature Conservancy's "Last

Great Places” for its ecological value (Gibbs et al. 1995). RI DEM DFW and its partners have preserved approximately 20% of the island for conservation, protecting habitat for the endemic Block Island meadow vole and other rare species.

While ample information exists on the location and status of certain mammals in Rhode Island (e.g., game species), data are limited on other species. Distribution data are insufficient to accurately map many mammal species' occurrence, and collection of status and life history information has been recognized as a research need. Additional information is needed for some smaller mammal species, particularly bats (*Chiroptera*), New England cottontail (*Sylvilagus transitionalis*), and common water shrew (*Sorex palustris*) in order to fully understand current abundance and distribution in Rhode Island and develop appropriate targeted management activities (NEES & WDTC in press).

Of the total mammal diversity in the state, 23 species have been determined to be of Greatest Conservation Need. Table 1.2 identifies GCN mammal species for Rhode Island. The process of identifying GCN species is discussed at the end of this chapter and Appendix 1c lists all GCN species, along with their abundance and distribution status, including low and declining populations.

Table 1.2 GCN Mammals of Rhode Island

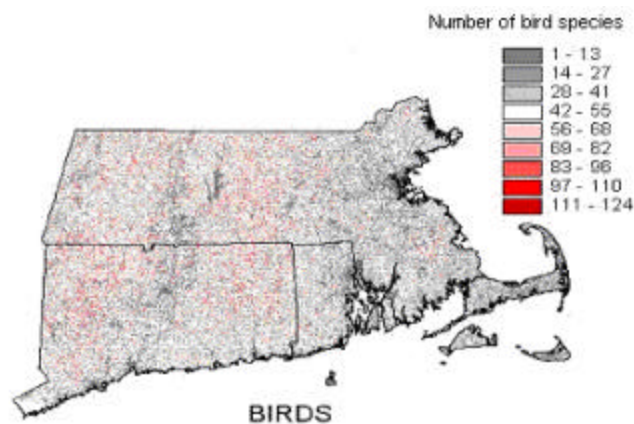
GCN MAMMALS (total 23)	
Common Name	Scientific Name
black bear	<i>Ursus americanus</i>
Block Island meadow vole	<i>Microtus pennsylvanicus Provectus</i>
blue whale	<i>Balaenoptera musculus</i>
bobcat	<i>Lynx rufus</i>
common water shrew	<i>Sorex palustris</i>
eastern pipistrelle	<i>Pipistrellus subflavus</i>
eastern red bat	<i>Lasiurus borealis</i>
eastern small-footed myotis	<i>Myotis leibii</i>
fin whale	<i>Balaenoptera physalus</i>
hoary bat	<i>Lasiurus cinereus</i>
humpback whale	<i>Megaptera novaeangliae</i>
Indiana bat	<i>Myotis sodalist</i>
little brown myotis	<i>Myotis lucifugus</i>
minke whale	<i>Balaenoptera acutorostrata</i>
New England cottontail	<i>Sylvilagus transitionalis</i>
North Atlantic right whale	<i>Eubalaena glacialis</i>
northern long-eared bat	<i>Myotis septentrionalis</i>
porcupine	<i>Erethizon dorsatum</i>
sei whale	<i>Balaenoptera borealis</i>
silver-haired bat	<i>Lasionycteris noctivagans</i>
smoky shrew	<i>Sorex fumeus</i>
southern bog lemming	<i>Synaptomys cooperi</i>
sperm whale	<i>Physeter macrocephalus</i>

Birds

An estimated 427 species of birds are presently known to occur regularly in Rhode Island and another 68 species have been observed as accidental occurrences (Table 1.1). At least 173 of these birds breed in the state and 150 are regular migrants that pass through the state seasonally (August et al. 2001). Abundance and distribution of birds in Southern New England is shown in Figure 1.2. Conway (1992), August et al. (2001), Rhode Island Ornithological Club (2002) and Rosenberg (2004) provide the best available information on Rhode Island's birds, while Enser (2002) describes the state's breeding birds and MANEM (2004) the state's waterbirds. Miller (1999) describes Canada warbler (*Wilsonia canadensis*) and northern waterthrush (*Seiurus noveboracensis*) populations and habitat in Rhode Island swamps.

Six birds are historically extirpated as breeding species in Rhode Island, including the Henslow's sparrow (*Ammodramus henslowii*), vesper sparrow (*Pooecetes gramineus*), golden-winged warbler (*Vermivora chrysoptera*), cliff swallow (*Hirundo pyrrhonota*), roseate tern (*Sterna dougallii*), and sharp-shinned hawk (*Accipiter striatus*) (August et al. 2001). Other species [e.g., Eskimo curlew (*Numenius borealis*)] have never nested in Rhode Island but have disappeared as passage migrants. Some of the extirpated nesters have also disappeared as migrants (e.g., Henslow's sparrow, golden-winged warbler). Forty-three species that breed in Rhode Island are considered rare in their abundance; in contrast only 30 species are considered common in their abundance (August et al. 2001). Fifty-eight birds are currently listed by the state as endangered, threatened, or species of concern, more than any other taxonomic group.

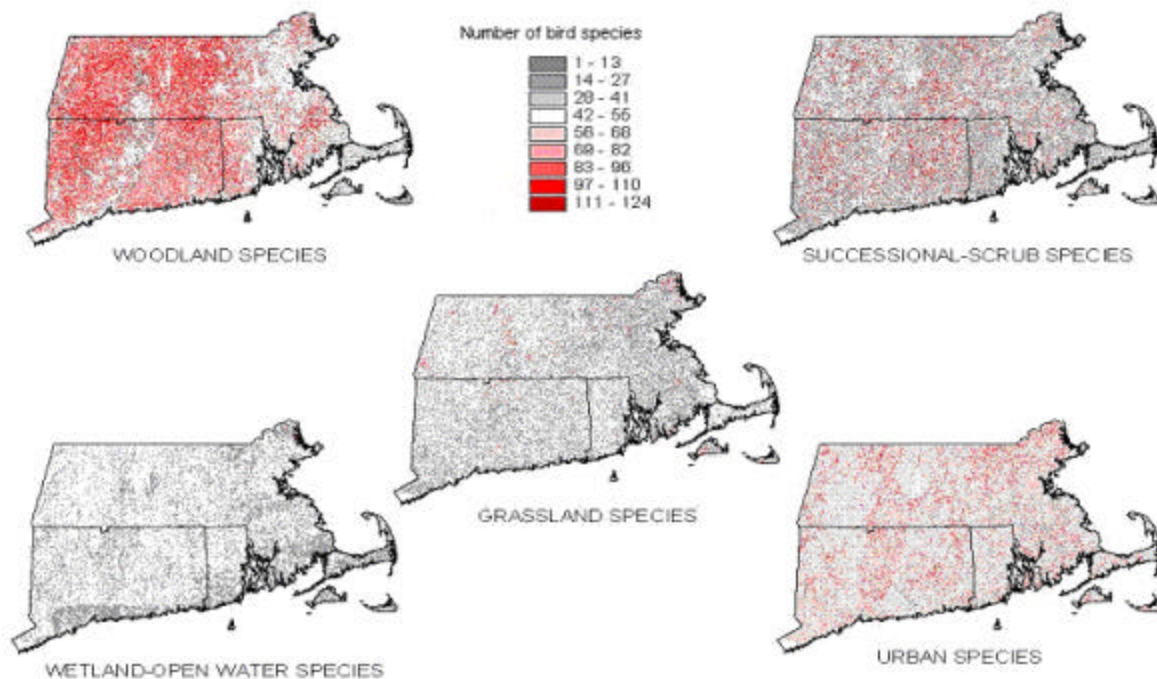
Figure 1.2 Bird Species Richness and Distribution in Southern New England (SNE GAP Zuckerberg et al. 2004)



Landbirds that rely upon grassland and shrubland habitats appear to be the most at risk nationally. Abundance and distribution of various bird guilds are shown in Figure 1.3. The National Audubon Society's 2004 State of the Birds report found that 85% of the nation's grassland bird populations are declining (Butcher 2004). Over one-third of the 47 native grassland bird species found in the U.S. are on the Audubon WatchList (species of moderate or high concern) due to their rarity, population declines, and/or threats to their survival (Butcher 2004). Nineteen of twenty-seven species analyzed by the National Audubon

Society were found to be suffering from significant population declines. The short-eared owl (*Asio flammeus*), for example, has shown a 69% population decline from 1966 to 2003 (Butcher 2004). Partners in Flight (PIF) has chosen the upland sandpiper (*Bartramia longicauda*), grasshopper sparrow (*Ammodramus savannarum*), and bobolink (*Dolichonyx oryzivorus*) as priority species for grassland habitats in Southern New England due to their population declines and loss of habitat (Dettmers and Rosenberg 2000; Rosenberg 2004); all of these species have been selected as GCN species for Rhode Island as well (Appendix 1c). The upland sandpiper is state-listed as endangered and the grasshopper sparrow is state-listed as threatened in Rhode Island. Although population estimates for the first three of these four species are unavailable for Rhode Island, PIF has recommended doubling the state's populations of the short-eared owl and grasshopper sparrow (Rosenberg 2004). There are an estimated 130 breeding bobolink in Rhode Island, and PIF has set a target population of 200 individuals as the state's contribution to the continental recovery of the species (Rosenberg 2004).

Figure 1.3 Species Richness for Common Bird Habitat Guilds (SNE GAP Zuckerberg et al. 2004)



Shrubland birds are also at risk nationally, with 50 of 78 species assessed showing population declines. The northern bobwhite (*Colinus virginianus*), which breeds in Rhode Island, has shown a population decline of two-thirds since 1966 and “has mostly vanished from the northeastern states” (Butcher 2004). One-third of the 107 shrubland bird species were ranked by Audubon as of moderate or high concern (Butcher 2004). PIF has selected nine bird species that rely upon shrubland or early successional habitats in Southern New England as priority species in Rhode Island: northern bobwhite, American woodcock (*Scolopax minor*), willow flycatcher (*Empidonax traillii*), eastern kingbird (*Tyrannus tyrannus*), brown thrasher (*Toxostoma rufum*), blue-winged warbler (*Vermivora pinus*), prairie warbler (*Dendroica*

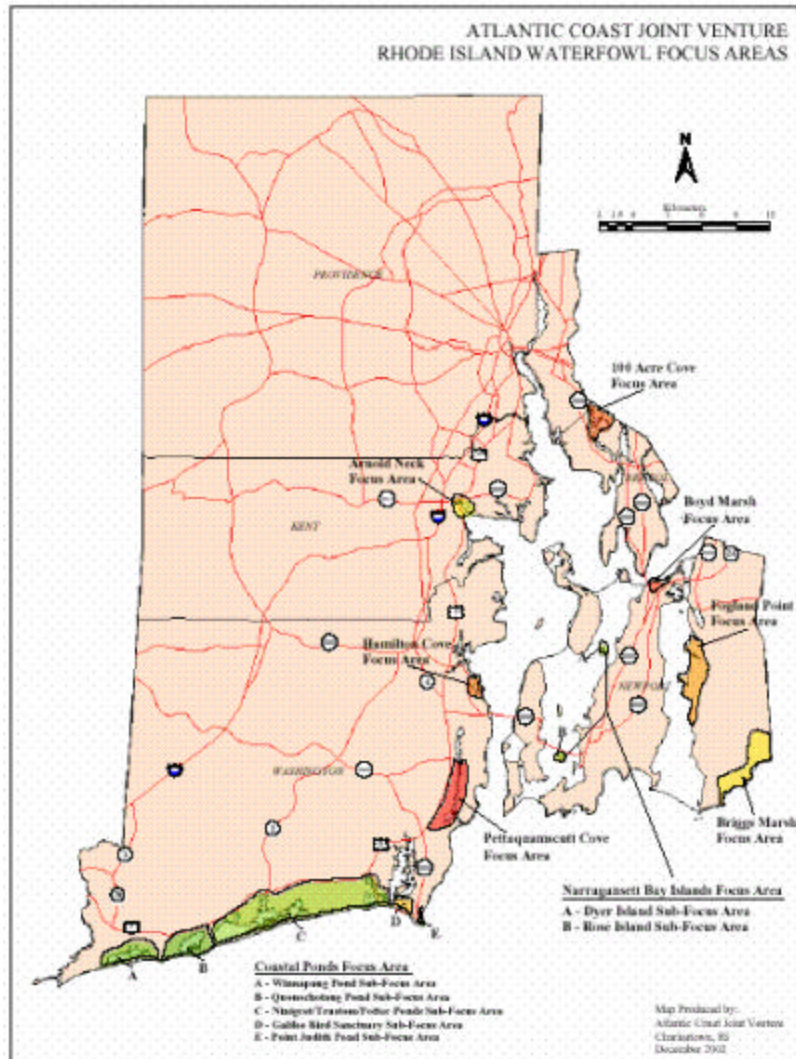
discolor), eastern towhee (*Pipilo erythrophthalmus*), and field sparrow (*Spizella pusilla*) (Rosenberg 2004). All nine of these birds have been selected as GCN species for the Rhode Island CWCS (Table 1.3, Appendix 1c). Partners in Flight recommends increasing the populations for each of these species in Rhode Island, with specific target populations provided in Rosenberg (2004).

The decline of early successional forest, particularly in the eastern U.S., has contributed to population declines in dozens of bird species (Butcher 2004, USGS 1995). Of the 232 species found in the U.S., approximately 19% of them are listed by Audubon as of moderate or high concern (Butcher 2004). The cerulean warbler (*Dendroica cerulea*), a GCN species which breeds in Rhode Island, is listed as state-threatened and has a current population of less than one quarter of its historic population (Butcher 2004). The American woodcock (*Scolopax minor*) is another early successional forest species with population declines (averaging 1.9% per year in the Northeast) due to loss of habitat. The American Woodcock Management Plan provides more detailed information on status and addresses the conservation needs of this valuable game bird in the Northeast (USFWS 1996a). PIF has identified 18 woodland or forest birds as priority species for Southern New England that occur in Rhode Island, including the cerulean warbler (Rosenberg 2004). Only one of these, the rusty blackbird (*Euphagus carolinus*), a PIF priority species, has not been selected as a GCN species but is a migrant in the state (Appendix 1b; August et al. 2001). PIF has set population objectives to increase the populations of half of these woodland birds including: black-billed cuckoo (*Coccyzus erythrophthalmus*), whip-poor-will (*Caprimulgus vociferus*), northern flicker (*Colaptes auratus*), wood thrush (*Hylocichla mustelina*), cerulean warbler, Canada warbler (*Wilsonia canadensis*), rose-breasted grosbeak (*Pheucticus ludovicianus*), rusty blackbird, and Baltimore oriole (*Icterus galbula*). In addition, PIF has set population objectives to maintain the current statewide populations of the other half (broad-winged hawk (*Buteo platypterus*), Acadian flycatcher (*Empidonax virens*), great crested flycatcher (*Myiarchus crinitus*), yellow-throated vireo (*Vireo flavifrons*), blackburnian warbler (*Dendroica fusca*), black-and-white warbler (*Mniotilta varia*), worm-eating warbler (*Helmitheros vermivorus*), Louisiana waterthrush (*Seiurus motacilla*), and scarlet tanager (*Piranga olivacea*)) (Rosenberg 2004).

In 2004, RI DEM DFW developed an upland habitat conservation plan that recognized and documented the decline of early successional habitats of shrubland, seedling/sapling forest, and old fields. This plan listed 24 avian species dependant on these habitats. Included on this list are ruffed grouse (Schroeder et al. 2004), American woodcock, prairie warbler and field sparrows. This plan is designed to guide habitat management and conservation in Rhode Island.

In urban habitats, 20 of 43 species analyzed by Butcher (2004) have declining populations but only 2.2% of the 45 species found in urban areas are on the Audubon WatchList. The chimney swift (*Chaetura pelagica*), which has adapted to urban habitats, is a GCN species that has shown a 44% population decline nationally since 1966 (Butcher 2004). The chimney swift is a PIF priority species for urban/suburban habitats in Southern New England, with a target objective of increasing the Rhode Island statewide population from an estimated 5,800 to 8,700 birds (Dettmers and Rosenberg 2000, Rosenberg 2004).

Figure 1.4 ACJV- Rhode Island Waterfowl Focus Areas (Source: ACJV Plan 2004)

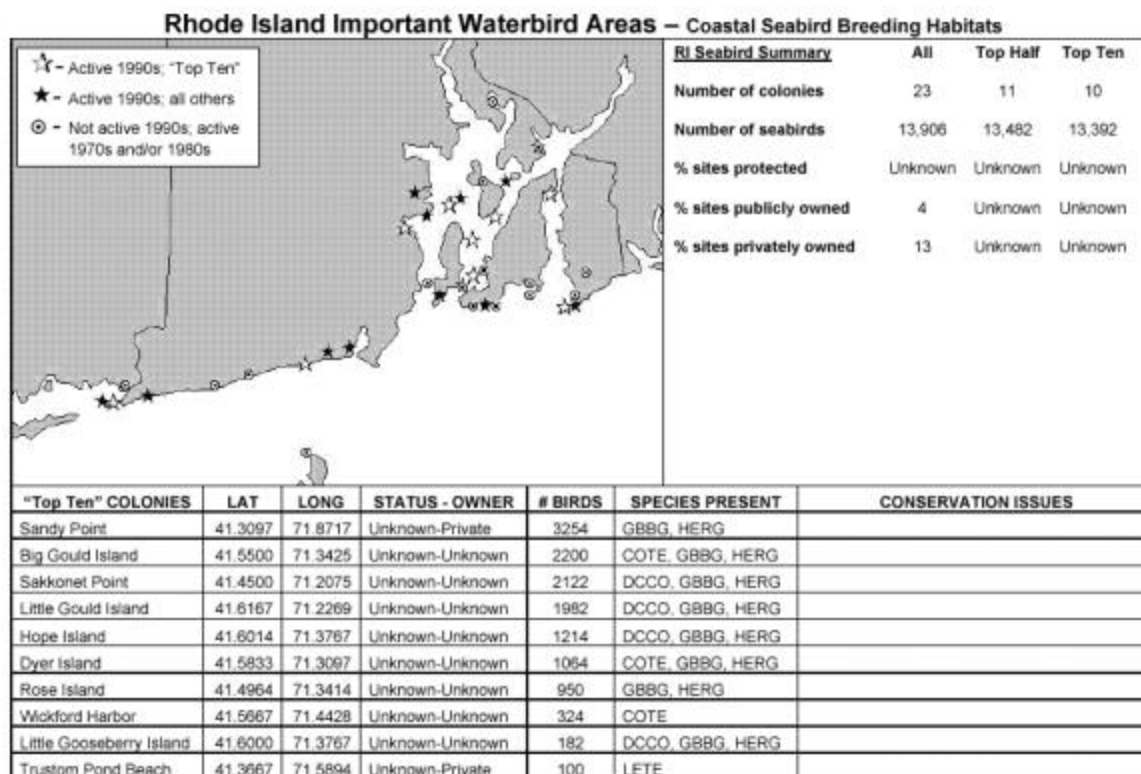


Waterbirds are found throughout Rhode Island's lakes, ponds, rivers, estuaries and marine waters. High concentrations of migrating waterbirds attract thousands of birdwatchers during peak migration periods to areas such as Block Island (Gibbs et al. 1995). Greater scaup (*Aythya marila*), for instance, are common in Narragansett Bay during the winter (August et al. 2001), although there is concern for their continental status. Nationally, 20% of the country's 268 species of waterbirds are classified as moderate or high concern by Audubon; 67 of the 106 species analyzed in their 2004 State of the Birds report are showing population increases, despite a decline of roughly half the nation's freshwater wetlands since 1780 (Butcher 2004).

According to the U.S. Shorebird Conservation Plan, almost half of the 72 species reviewed are exhibiting apparent or significant population declines (Brown et al. 2001). The federally-threatened piping plover (*Charadrius melodus*), on the other hand, breeds along the state's southern beaches but is considered rare due to its limited population and distribution (August

et al. 2001). Only two species show an apparent or significant population increase, while the remaining 38 birds have apparently stable or unknown population status. In general, Brown et al. (2001) conclude that there is insufficient information available to accurately assess the status of most, if not all, shorebird populations in North America and that monitoring and research to obtain this information are some of the highest priorities for conserving this guild of waterbirds.

Figure 1.5 MANEM – Rhode Island Important Waterbird Areas for Coastal Seabirds (Source: MANEM 2004)

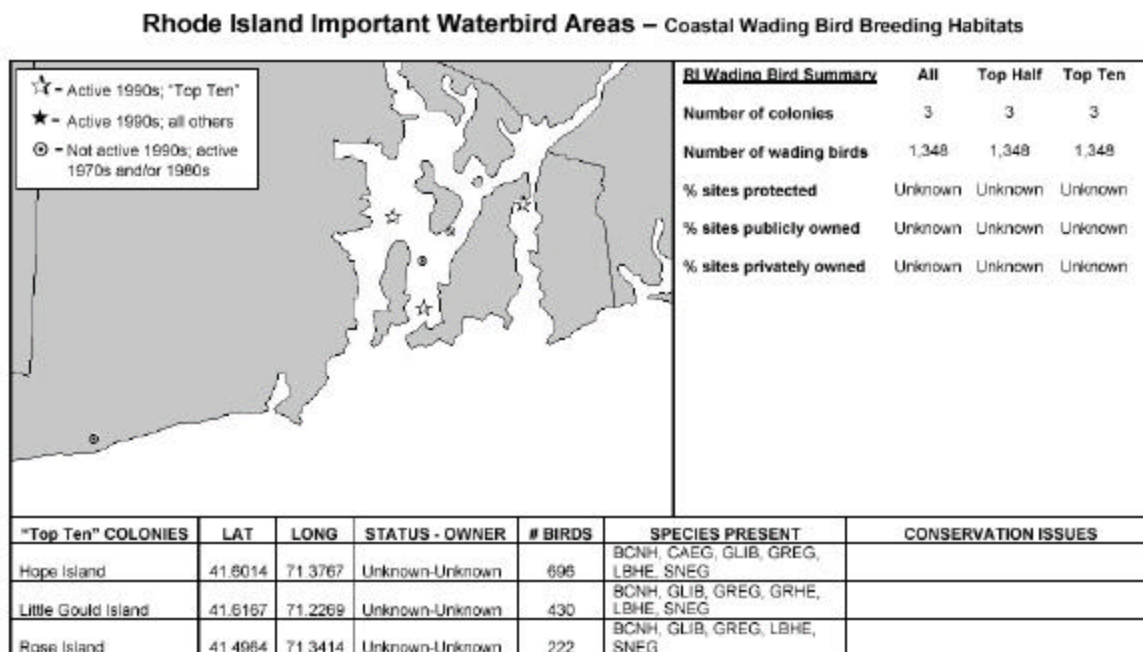


The North American Waterbird Conservation Plan assessed the abundance and distribution of 210 waterbird species in North America and found that one-third of colonial nesting waterbirds are at risk of serious population declines, eleven pelagic seabirds are imperiled, 36 pelagic and coastal seabirds are of high conservation concern, and seven wading birds are of high conservation concern (Kushlan et al. 2002). Only 17% of 166 colonial waterbird species are exhibiting apparent or biologically significant population increases, while another 15% are lacking information to estimate population trends (Kushlan et al. 2002). Non-breeding population data are generally unavailable for most colonial waterbirds and regions, and thus an expanded population survey program is a research need for this avian guild (Kushlan et al. 2002).

The population status of waterfowl, on the other hand, is better understood since many species are harvested each year. In 2005, the breeding duck population in the Northeast was 1% less than the long-term average (USFWS 2005b). The breeding population of mallards

was 6% lower than the long-term average for the Northeast in 2003 (USFWS 2005b). Wood duck populations are exhibiting a long-term (1966-2004) and short-term population (1985-2004) increase in the Atlantic flyway (USFWS 1999a, 2003a, 2005b). The abundance of blue-winged teal (*Anas discors*), a GCN species, was 2% higher nationally than the long-term average in 2005 (USFWS 2005ba). Green-winged teal (*Anas crecca*), another GCN species, showed a 16% higher breeding population than the long-term average in 2005 in the U.S. and Canada (USFWS 2005b). Canada geese (*Branta canadensis*) are extensively monitored as well, with the Atlantic Flyway Resident Population increasing at a rate of 1% a year over the last decade (USFWS 2005b). Atlantic brant (*Branta bernicla*), which overwinter in Rhode Island, have shown an average 3% wintering population increase over the last decade and have a stable long-term population trend (USFWS 1999a, 2003a). Most species of sea ducks, however, are suffering from population declines (USFWS 1999a). The abundance of American black duck (*Anas rubripes*) has declined in eastern North America over the last 40 years (USFWS 1999a). The status of scaup (greater and lesser scaup) is also declining (USFWS 1999a). With these few exceptions, duck and goose populations are generally stable or increasing in North America.

Figure 1.6 MANEM – Rhode Island Important Waterbird Areas for Coastal Wading Birds (Source: MANEM 2004)



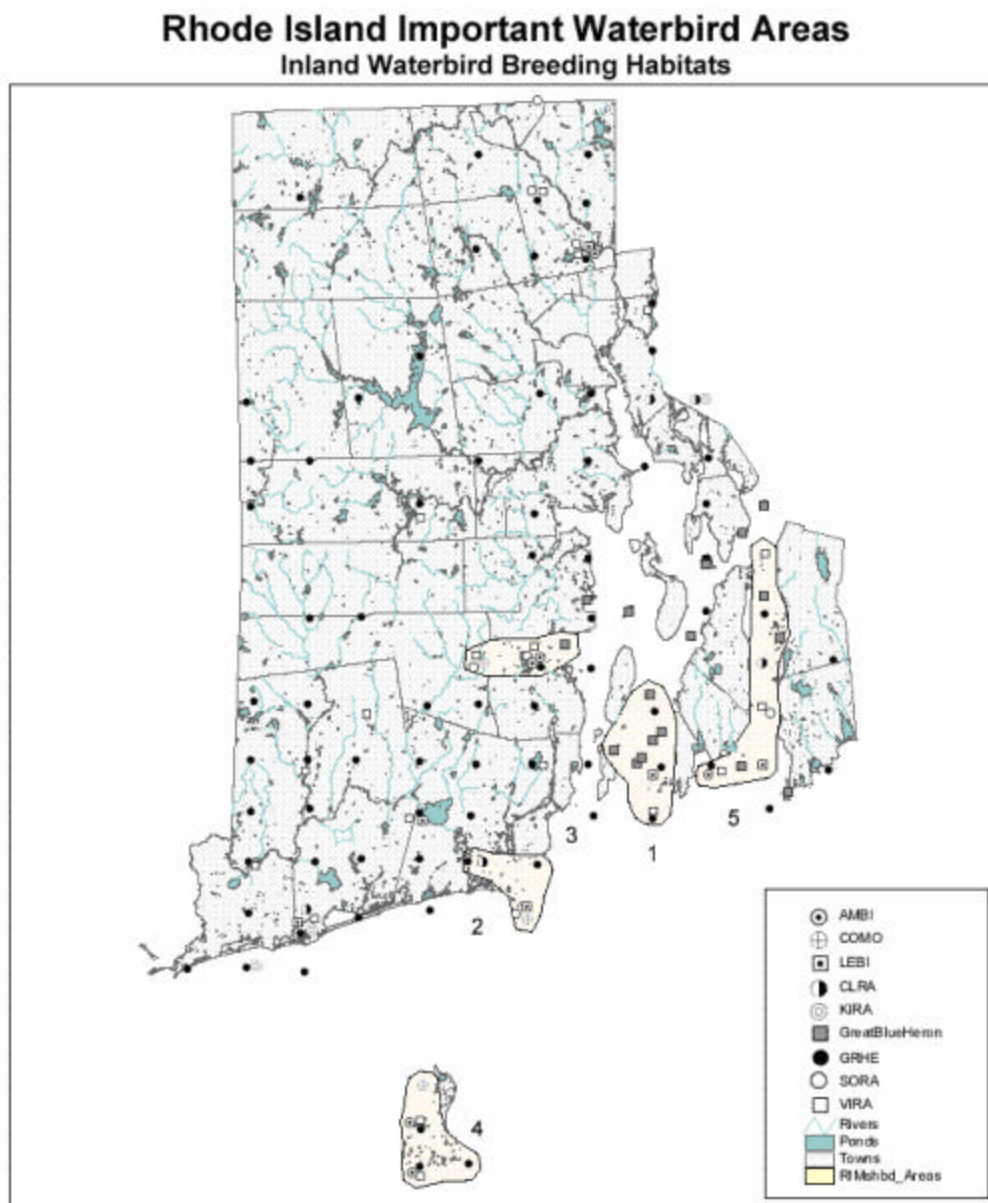
Some individual bird species have received national and regional attention for conservation. The status of the federally threatened piping plover and federally endangered roseate tern, for example, are addressed by existing recovery plans (USFWS 1996b; USFWS 1998). Distribution and population status information has been compiled for these species by the USFWS at their refuges in southern Rhode Island with recommendations for conservation actions (USFWS 2000). Partners in Flight has published a North American Landbird Conservation Plan (Rich et al. 2004) as well as a regional bird conservation plan for Southern New England (Dettmers and Rosenberg 2000). These plans identify a variety of

conservation actions for particular habitats (e.g., grassland, freshwater wetlands) and target landbird species. Similarly, the U.S. Shorebird Conservation Plan and the Northern Atlantic Regional Shorebird Plan assessed the conservation needs of shorebirds, prioritized species for conservation, and outlined specific conservation actions to maintain and improve the status of shorebirds and their habitats (Brown et al. 2001; Clark and Niles 2000). The North American Waterbird Conservation Plan has prepared the same information for waterbirds and their habitat (Kushlan et al. 2002). The Northeast Endangered Species and Wildlife Diversity Technical Committee (NEES & WDTC in press) has prepared species accounts and needed conservation actions for regional species of concern, including 23 birds. Data from all of these plans have been incorporated into this CWCS where relevant, their specific conservation actions are incorporated by reference, and the relevant collaborators are identified as partners for implementing Rhode Island's CWCS conservation actions where applicable.

Several organizations have delineated specific areas in Rhode Island as important for avian species (Figures 1.4-1.7). The Atlantic Coast Joint Venture, a partnership of government agencies and conservation partners, has designated nine Waterfowl Focus Areas in Rhode Island where the conservation of waterfowl is particularly important; these areas include 100 Acre Cove – Warren/Palmer River, Arnold Neck, Boyd Marsh, Hamilton Cove, two islands in Narragansett Bay, Fogland Point, Briggs Marsh, Pettaquamscutt Cove, and several coastal ponds along the southern coast (Figure 1.4). The Mid-Atlantic/New England Maritime Regional Working Group for Waterbirds (MANEM) is a regional partnership working to conserve waterbirds in the Northeast, and they have identified Important Waterbird Areas for seabirds (Figure 1.5), wading birds (Figure 1.6) and marshbirds (Figure 1.7) in Rhode Island. The Northern Atlantic Shorebird Plan has highlighted the coastal marshes, beaches and the uplands of Block Island as regionally significant habitat for shorebirds in Rhode Island (Clark and Niles 2000).

Numerous species of upland game birds and waterfowl are open for hunting in Rhode Island, including the American woodcock, ruffed grouse, wild turkey, Canada goose, and several species of ducks, and some of which are stocked. The RI DEM DFW monitors the current status of gamebirds to allow sustainable populations in the state. Information about gamebird abundance and distribution is maintained in several databases, including breeding birds Canada geese and waterfowl. Waterfowl breeding bird plots are surveyed annually during the second week in May. In addition, a mid-winter aerial survey is conducted annually during the first week in January.

Figure 1.7 MANEM – Rhode Island Important Waterbird Areas for Inland Marshbirds (Source: MANEM 2004)



ID	AREA_NAME	AMBI	COMO	CLRA	GBHE	GRHE	KIRA	LEBI	VIRA	SORA	TOTAL	Status	Conservation Issues
1	Narragansett Bay	0	0	0	6	3	0	1	1	0	11		
2	Pt Judith Pond - Block Is. Sound	0	1	1	0	2	0	1	0	1	6		
3	Belleville Pond	1	1	0	1	1	0	1	2	2	9		
4	Block Island	2	1	0	0	3	0	0	2	0	8		
5	Sakonnet River	1	0	1	3	2	0	1	3	1	12		

Major Rivers & Streams dataset produced by Rhode Island Department of Environmental Management-GIS Program, Ponds dataset from University of Rhode Island Department of Natural Resources Science-Environmental Data Center, Towns from Rhode Island Department of Administration-Planning-RIGIS (<http://www.edc.uri.edu/rigis/>). Great Blue Heron coverage from Gould, M. and L. Gould. 1992. Wildlife. In Habitat Inventory/Resource Mapping for Narragansett Bay and Associated Coastline. Narragansett Bay Project, Providence, RI.

A number of state, regional, and national programs are or have historically been implemented to measure and track bird populations. Effort expended on monitoring bird populations in Rhode Island vastly exceeds the sum of all other animal survey work. Three Christmas Bird Count (CBC) surveys are presently run consistently in Rhode Island. This program, coordinated by the National Audubon Society, provides consistent data on wintering bird populations. The Breeding Bird Survey (BBS), coordinated by the U.S. Fish and Wildlife Service, is another continent-wide program designed to monitor nesting species. BBS routes were run consistently in the past, but only the route on Block Island is presently done because of resource limitations. Within the RI DEM DFW, the E-1 project has traditionally been responsible for monitoring certain vulnerable avian populations. This project has provided some baseline data on species of marsh, grassland, raptorial and forest birds; much of these data were incorporated in the Rhode Island Breeding Bird Atlas (Enser 1992). Despite recent work in qualifying many populations of Rhode Island nesting avifauna, the scope of work is much higher than the existing resource base, so that many datasets are outdated or cannot be maintained annually. Annual surveys are presently conducted on colonial nesting birds (egrets, gulls, terns) and piping plover. No other birds can be tracked this closely with existing resources. There are also urgent data management needs in this category of inventory. Much of the data collected historically exists in hard copy formats only, and so there is a great need to develop geo-referenced datasets and other electronic formats.

The RI DEM DFW has monitored avian populations at the Galilee Bird Sanctuary following a salt marsh restoration project (1992-1997), as has the University of Rhode Island (1991-1999). The Audubon Society of Rhode Island periodically conducts bird population surveys (e.g., Birdathon Survey) and has partnered with the University of Rhode Island (URI) to monitor fall migration of birds at the Kingston Wildlife Research Station (1958-1994, 1998-present). The USFWS has also partnered with URI to monitor bird breeding productivity and population dynamics at their coastal National Wildlife Refuges (1991-2000). The Jamestown Land Trust has monitored breeding and migratory birds in Jamestown (1985) and the Norman Bird Sanctuary has monitored grassland-nesting birds at their sanctuary since 1995 (Berounsky 2002). In addition, BioBlitz events sponsored by the Rhode Island Natural History Survey (RINHS) and others have provided snapshots of avian diversity in specific locations. However, distribution data are insufficient to accurately map all bird species' occurrence, and collection of status and life history information has been recognized as a research need.

Of the total bird diversity in the state, 129 species have been determined to be of Greatest Conservation Need. Table 1.3 identifies GCN bird species for Rhode Island. The process of identifying GCN species is discussed at the end of this chapter and Appendix 1c lists all GCN species, along with their abundance and distribution status, including low and declining populations.

Table 1.3 GCN Birds of Rhode Island

GCN BIRDS (total 129)	
Common name	Scientific name
Acadian flycatcher	<i>Empidonax virescens</i>
American bittern	<i>Botaurus lentiginosus</i>
American black duck	<i>Anas rubripes</i>
American kestrel	<i>Falco sparverius</i>
American oystercatcher	<i>Haematopus palliatus</i>
American woodcock	<i>Scolopax minor</i>
bald eagle	<i>Haliaeetus leucocephalus</i>
Baltimore oriole	<i>Icterus galbula</i>
bank swallow	<i>Riparia riparia</i>
barn owl	<i>Tyto alba</i>
barred owl	<i>Strix varia</i>
belted kingfisher	<i>Ceryle alcyon</i>
black skimmer	<i>Rynchops niger</i>
black-and-white warbler	<i>Mniotilta varia</i>
black-bellied plover	<i>Pluvialis squatarola</i>
black-billed cuckoo	<i>Coccyzus erythrophthalmus</i>
blackburnian warbler	<i>Dendroica fusca</i>
black-crowned night heron	<i>Nycticorax nycticorax</i>
black-throated blue warbler	<i>Dendroica caerulescens</i>
black-throated green warbler	<i>Dendroica virens</i>
blue-headed vireo	<i>Vireo solitarius</i>
blue-winged teal	<i>Anas discors</i>
blue-winged warbler	<i>Vermivora pinus</i>
bobolink	<i>Dolichonyx oryzivorus</i>
broad-winged hawk	<i>Buteo platypterus</i>
brown creeper	<i>Certhia americana</i>
brown thrasher	<i>Toxostoma rufum</i>
Canada warbler	<i>Wilsonia canadensis</i>
cattle egret	<i>Bubulcus ibis</i>
cerulean warbler	<i>Dendroica cerulea</i>
chestnut-sided warbler	<i>Dendroica pensylvanica</i>
chimney swift	<i>Chaetura pelagica</i>
clapper rail	<i>Rallus longirostris</i>
cliff swallow	<i>Petrochelidon pyrrhonota</i>
common moorhen	<i>Gallinula chloropus</i>
common nighthawk	<i>Chordeiles minor</i>
common tern	<i>Sterna hirundo</i>
common yellowthroat	<i>Geothlypis trichas</i>
double-crested cormorant	<i>Phalacrocorax auritus</i>
dunlin	<i>Calidris alpina</i>
eastern kingbird	<i>Tyrannus tyrannus</i>

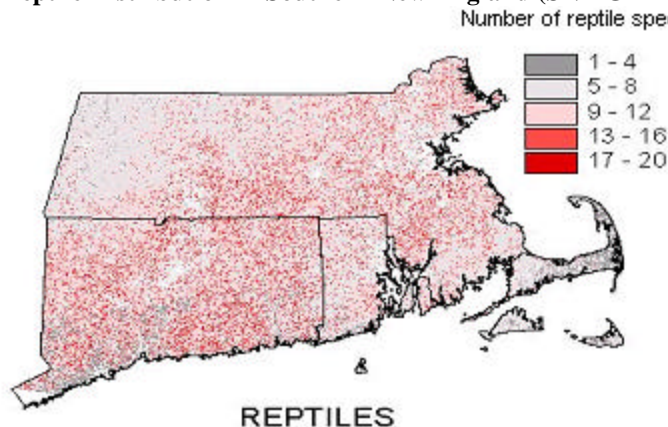
eastern meadowlark	<i>Sturnella magna</i>
eastern towhee	<i>Pipilo erythrophthalmus</i>
field sparrow	<i>Spizella pusilla</i>
gadwall	<i>Anas strepera</i>
glossy ibis	<i>Plegadis falcinellus</i>
golden-crowned kinglet	<i>Regulus satrapa</i>
grasshopper sparrow	<i>Ammodramus savannarum</i>
gray catbird	<i>Dumetella carolinensis</i>
great black-backed gull	<i>Larus marinus</i>
great blue heron	<i>Ardea herodias</i>
great crested flycatcher	<i>Myiarchus crinitus</i>
great egret	<i>Ardea alba</i>
greater yellowlegs	<i>Tringa melanoleuca</i>
green-winged teal	<i>Anas crecca</i>
hairy woodpecker	<i>Picoides villosus</i>
harlequin duck	<i>Histrionicus histrionicus</i>
hermit thrush	<i>Catharus guttatus</i>
herring gull	<i>Larus argentatus</i>
hooded warbler	<i>Wilsonia citrina</i>
horned lark	<i>Eremophila alpestris</i>
indigo bunting	<i>Passerina cyanea</i>
king rail	<i>Rallus elegans</i>
least bittern	<i>Ixobrychus exilis</i>
least flycatcher	<i>Empidonax minimus</i>
least sandpiper	<i>Calidris minutilla</i>
least tern	<i>Sterna antillarum</i>
lesser yellowlegs	<i>Tringa flavipes</i>
little blue heron	<i>Egretta caerulea</i>
long-eared owl	<i>Asio otus</i>
Louisiana waterthrush	<i>Seiurus motacilla</i>
marsh wren	<i>Cistothorus palustris</i>
Nashville warbler	<i>Vermivora ruficapilla</i>
northern bobwhite	<i>Colinus virginianus</i>
northern flicker	<i>Colaptes auratus</i>
northern goshawk	<i>Accipiter gentilis</i>
northern harrier	<i>Circus cyaneus</i>
northern parula	<i>Parula americana</i>
northern waterthrush	<i>Seiurus noveboracensis</i>
orchard oriole	<i>Icterus spurius</i>
osprey	<i>Pandion haliaetus</i>
ovenbird	<i>Seiurus aurocapillus</i>
pectoral sandpiper	<i>Calidris melanotos</i>
peregrine falcon	<i>Falco peregrinus</i>
pied-billed grebe	<i>Podilymbus podiceps</i>
pileated woodpecker	<i>Dryocopus pileatus</i>

piping plover	<i>Charadrius melodus</i>
prairie warbler	<i>Dendroica discolor</i>
prothonotary warbler	<i>Protonotaria citrea</i>
purple finch	<i>Carpodacus purpureus</i>
purple martin	<i>Progne subis</i>
purple sandpiper	<i>Calidris maritima</i>
red knot	<i>Calidris canutus</i>
red-breasted nuthatch	<i>Sitta canadensis</i>
ring-necked pheasant	<i>Phasianus colchicus</i>
roseate tern	<i>Sterna dougallii</i>
rose-breasted grosbeak	<i>Pheucticus ludovicianus</i>
ruddy turnstone	<i>Arenaria interpres</i>
ruffed grouse	<i>Bonasa umbellus</i>
saltmarsh sharp-tailed sparrow	<i>Ammodramus caudacutus</i>
sanderling	<i>Calidris alba</i>
savannah sparrow	<i>Passerculus sandwichensis</i>
scarlet tanager	<i>Piranga olivacea</i>
seaside sparrow	<i>Ammodramus maritimus</i>
semipalmated plover	<i>Charadrius semipalmatus</i>
semipalmated sandpiper	<i>Calidris pusilla</i>
sharp-shinned hawk	<i>Accipiter striatus</i>
short-billed dowitcher	<i>Limnodromus griseus</i>
short-eared owl	<i>Asio flammeus</i>
snowy egret	<i>Egretta thula</i>
solitary sandpiper	<i>Tringa solitaria</i>
sora	<i>Porzana carolina</i>
spotted sandpiper	<i>Actitis macularia</i>
upland sandpiper	<i>Bartramia longicauda</i>
whimbrel	<i>Numenius phaeopus</i>
whip-poor-will	<i>Caprimulgus vociferus</i>
white-rumped sandpiper	<i>Calidris fuscicollis</i>
willet	<i>Catoptrophorus semipalmatus</i>
willow flycatcher	<i>Empidonax traillii</i>
Wilson's snipe	<i>Gallinago delicata</i>
winter wren	<i>Troglodytes troglodytes</i>
wood thrush	<i>Hylocichla mustelina</i>
worm-eating warbler	<i>Helmitheros vermivorus</i>
yellow warbler	<i>Dendroica petechia</i>
yellow-billed cuckoo	<i>Coccyzus americanus</i>
yellow-breasted chat	<i>Icteria virens</i>
yellow-crowned night heron	<i>Nyctanassa violacea</i>
yellow-rumped warbler	<i>Dendroica coronata</i>
yellow-throated vireo	<i>Vireo flavifrons</i>

Reptiles and Amphibians (Herpetofauna)

Of the 46 reptile and amphibian species found in Rhode Island, seven are listed by the state as endangered, threatened or species of concern and another four are federally-listed (Table 1.1). August et al. (2001) and RI DEM (2003x) summarize the best available information on the state's herpetofauna; Nawojchik (2000) and Valliere (2003) provide information on sea turtles found in Rhode Island. Global evidence documents widespread and local declines in reptile and amphibian populations and a need to identify the specific causes and impacts of this decline (Gibbons et al. 2000, LaRoe et al. 1995, USGS 1995). There is a recognized national and regional need for advocacy focused on conservation of amphibians and reptiles and the use of an ecosystem approach to incorporate species protection into existing management plans (NEES & WDTC, in press, PARC 1999). An estimated 35% of amphibians that are dependent on aquatic habitats are rare or imperiled nationally (TNC 1996, Abell et al. 2000). LaRoe et al. (1995) found that 45% of the nation's turtle species are in need of conservation action, with many species experiencing significant population and distribution declines over the last century. Moreover, vernal pools – the habitat for many amphibian and some reptile species – are declining in the Northeast (Calhoun and Klemens 2002).

Figure 1.8 Predicted Reptile Distribution in Southern New England (SNE GAP Zuckerberg et al. 2004)



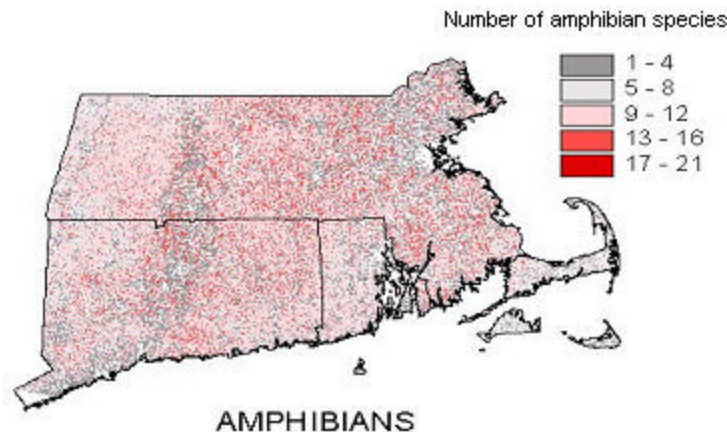
Regionally, the Northeast Endangered Species and Wildlife Diversity Technical Committee (in press) have identified 27 reptiles and amphibians as regional species of concern. The eastern box turtle (*Terrapene carolina*), a GCN species, is one species of regional concern. Although this species is thought to be in decline, surveys are needed to confirm its abundance and distribution. The eastern hognose snake (*Heterodon platirhinos*) and the eastern ribbon snake (*Thamnophis sauritus*) are both regional species of concern and also species of concern in Rhode Island, but accurate population assessments are needed to determine their status. Both have been identified as GCN species for Rhode Island. The eastern spadefoot toad (*Scaphiopus holbrookii*), a state-threatened species, is facing population declines and loss of habitat in the Northeast and may be extirpated from the state; ranked as critically imperiled (S1) in Rhode Island, this amphibian has also been selected as a GCN species. The northern leopard frog (*Rana pipiens*), another GCN species and state

species of concern, is also a regional species of concern that is exhibiting population declines in the Northeast but is considered common elsewhere in the U.S. (NEES & WDTC in press).

In Rhode Island, there is relatively good abundance and distribution data for amphibians and reptiles (Raithel, unpublished) but data are not digitized so GIS maps are not available. Although outdated and coarse scale, GAP has predicted distribution of reptiles (Figure 1.8) and amphibians (Figure 1.9) in Rhode Island as part of SNE GAP. Six reptiles are considered rare, ten species are classified as common and one (the timber rattlesnake (*Crotalus horridus*)) is extirpated (August et al. 2001, RI DEM 2001k). Similarly, four amphibians are categorized as rare and nine as common (August et al. 2001). Five reptiles are ranked as protected by the RI DEM DFW, which prohibits the possession of these species at any time without a permit; these species are the spotted turtle (*Clemmys guttata*), wood turtle (*Clemmys insculpta*), northern diamondback terrapin (*Malaclemys t. Terrapin*), Eastern box turtle, and timber rattlesnake (RI DEM 2001k).

The federally-listed reptiles are sea turtles that visit Rhode Island's estuarine and marine waters during the warmer months. As more information about distribution, abundance, migratory movements and population characteristics are collected, coordinated work with USFWS, NMFS and other partners to implement those existing actions identified in the species' Federal Recovery Plans appropriate for Rhode Island's waters will be enhanced (NMFS and USFWS, 1991a, 1991b, 1992, 1993; USFWS and NMFS 1992). The Mystic Aquarium has documented 20 leatherback sea turtle strandings on Block Island between 1983 and 2000 (Nawojchik 2000).

Figure 1.9 Predicted Amphibian Distribution in Southern New England (SNE GAP Zuckerberg et al. 2004)



The bog turtle is also federally listed, but its recovery plan lacks accurate historical data on the species' presence in Rhode Island and does not include the state in its known range (USFWS 2001a). The Barrington Land Conservation Trust has monitored populations of the diamondback terrapin near Barrington since 1990. Researchers at URI have one of the nation's longest monitoring programs of breeding amphibians in the same location, a pond on the Alton Jones Campus; monitoring data are available from 1970-78 and 1990-2000. The Norman Bird Sanctuary has monitored amphibians at the Sanctuary since 1995. In addition,

BioBlitz events sponsored by the Rhode Island Natural History Survey (RINHS) and others have provided snapshots of reptile and amphibian diversity in specific locations.

Of the total herpetofauna diversity in the state, almost half (21 species) have been determined to be of Greatest Conservation Need. Table 1.4 identifies GCN herpetofauna species for Rhode Island, of which nine are amphibian species and 12 are reptile species. The process of identifying GCN species is discussed at the end of this chapter and Appendix 1c lists all GCN species, along with their abundance and distribution status, including low and declining populations.

Table 1.4 GCN Herpetofauna of Rhode Island

GCN HERPETOFAUNA (total 21)	
Common Name	Scientific Name
Amphibians (9)	
dusky salamander	<i>Desmognathus fuscus</i>
eastern newt	<i>Notophthalmus viridescens</i>
eastern spadefoot toad	<i>Scaphiopus holbrookii</i>
four-toed salamander	<i>Hemidactylium scutatum</i>
fowler's toad	<i>Bufo fowleri</i>
marbled salamander	<i>Ambystoma opacum</i>
northern leopard frog	<i>Rana pipiens</i>
spring salamander	<i>Gyrinophilus porphyriticus</i>
wood frog	<i>Rana sylvatica</i>
Reptiles (12)	
Atlantic green turtle	<i>Chelonia mydas mydas</i>
Atlantic hawksbill turtle	<i>Eretmochelys imbricate</i>
black rat snake	<i>Elaphe obsoleta</i>
diamondback terrapin	<i>Malaclemys terrapin</i>
eastern box turtle	<i>Terrapene Carolina</i>
eastern hognose snake	<i>Heterodon platirhinos</i>
eastern ribbon snake	<i>Thamnophis sauritus</i>
Kemp's ridley sea turtle	<i>Lepidochelys kempii</i>
leatherback turtle	<i>Dermochelys coriacea</i>
loggerhead turtle	<i>Caretta caretta</i>
spotted turtle	<i>Clemmys guttata</i>
wood turtle	<i>Clemmys insculpta</i>

Fish

Over 300 fish have been observed in Rhode Island's freshwater and marine habitats (Table 1.1). August et al. (2001) details the state's freshwater and finfish, and Martinez (1994), Weiss (1995), Pollock (1997), Massie (1998), Gilbert and Williams (2002), and Froese and Pauly (2005) also provide information on the state's saltwater fish species. Valliere and Murphy (2001), Lazar and Lake (2001), Gibson (2001), and RI DEM (2002k, 2004k) describe the status of the state's marine stocks, and Clayton et al. (1978) describes the fishes of coastal Massachusetts, most of which are also found in Rhode Island's coastal waters. Libby (2004) provides the best available information on the freshwater fish of the state. This DEM DFW report presents the results of a ten-year stream survey and presents distribution and abundance information for each species occurrence at the sample sites across the state. These results are not yet digitized but include distribution maps for each individual species.

Only two fish are currently listed by the state as endangered, threatened or species of concern – the American brook lamprey (*Lampetra appendix*) and Atlantic sturgeon (*Acipenser oxyrinchus*) are both listed as species of special concern. An estimated 37% of the North America's freshwater fish species are at risk of extinction and 27 species have already gone extinct in the last century (Miller et al. 1989, and TNC 1996, as cited in Abell et al. 2000). Freshwater taxa are receiving more attention as several sources argue they are more threatened than terrestrial species (Neves 1992, Allan and Flecker 1993, Williams et al. 1993, and McAllister et al. 1997, as cited in Abell et al. 2000). Abell et al. (2000) found that nearly every freshwater aquatic system in North America is impacted by some degree of degradation.

The majority of Rhode Island's fish diversity consists of saltwater species. This diversity attracts both commercial and recreational fishermen alike. Direct dockside value of commercial landings has fluctuated widely over the last ten years between a high of \$86 million in 1999 and a low of \$69 million in 2003. Landings of ground fish, shellfish and lobster provide the mainstay of the industry. The total value of the industry, however, when all economic factors are compiled, is estimated to be in excess of \$500 million (RI Seafood Council 2003). In addition, an average annual number of 300,000 recreational anglers spend in excess of \$150 million and land approximately 4.5 million pounds of finfish (e.g., striped bass, summer flounder, bluefish, black sea bass, scup and tautog). While there is evidence of stock rebuilding in some fisheries, four out of ten of the state's most valuable species remain overfished (lobster, quahog, winter flounder and bluefish). Rhode Island has exclusive management control for those species that spend their entire lives in state waters: the Atlantic States Marine Fisheries Commission manages coastal (0 – 3 miles) inshore migratory species, and the New England Fisheries Management Council and /or the Mid-Atlantic Fisheries Management Council maintains jurisdiction from 3 – 200 miles off the coast.

RI DEM DFW and NMFS manage the populations of fish species. Table 1.5 lists the current status of key species found in Rhode Island's marine and estuarine waters. Most of the saltwater and estuarine fishery resources found in the state's waters are exhibiting population declines, while others are highly migratory and population data are limited. GCN species

such as Atlantic salmon (*Salmo salar*), monkfish (*Lophius americanus*), and windowpane flounder (*Scophthalmus aquosus*) are classified as overfished by RI DEM DFW and/or NMFS (NMFS 2002, 2003; Valliere and Murphy 2001). The state of Rhode Island has recently completed a lengthy review of its fisheries management and licensing program, identifying several potential conservation actions to improve protection of the state's fisheries (Gibson 2001, RI DEM 2002k, Valliere and Murphy 2001).

In addition, the New England Fishery Management Council (NEFMC) has developed Fishery Management Plans (FMP) for Atlantic herring (*Clupea harengus*), Atlantic salmon, Atlantic sea scallop, monkfish (*Lophius americanus*), red crab (*Chaceon quinquedens*), skates (e.g., barndoor skate, thorny skate), spiny dogfish (*Squalus acanthias*), and multispecies plans for 15 species of groundfish (e.g., yellowtail flounder, American plaice) and silver, red and offshore hake (FMPs are available online at <http://www.nefmc.org/>). The Mid-Atlantic Fishery Management Council (MAFMC) has FMPs for Atlantic mackerel, squid and butterfish; bluefish; spiny dogfish (joint with the NEFMC); summer flounder, scup and black sea bass; surf clam and ocean quahog; and tilefish (available online at <http://www.mafmc.org/mid-atlantic/fmp/fmp.htm>). The Atlantic States Marine Fisheries Commission (ASMFC) manages 22 species or groups of species for conservation, and has approved Interstate FMPs for several of them (e.g., horseshoe crab (*Limulus polyphemus*), striped bass (*Morone saxatilis*); available online at <http://www.asmfc.org/>). All of these regional FMPs assess the abundance and distribution for each species and describe conservation measures to address any threats to the fish stocks, which may include fishing closure areas or quotas. For example, the FMP for the anadromous Atlantic salmon prohibits the possession or incidental bycatch of any Atlantic salmon in federal waters due to its status as a federally-endangered species with wild populations remaining only in Maine (NEFMC 2003b).

According to RI DEM DFW and NMFS, the fisheries resource of Narragansett Bay and Rhode Island Sound is in transition. Demersal fish populations are in decline while pelagic species populations are increasing. Crab and lobster survey results have shown population increases while quahogs have declined. This community restructuring is coincident to overfishing of demersal finfish, a long-term increase in water temperature, and predator-prey interactions (RI DEM 2003f). In addition to managing marine fisheries resources in Rhode Island, the RI DEM DFW manages freshwater fisheries. Freshwater fish populations are declining nationally, but the Northeast has the fewest number of species at risk (LaRoe et al. 1995). Alterations to river habitats are the leading cause of declining freshwater populations of fish, herpetofauna and invertebrates (USGS 1995). RI DEM DFW, Freshwater Fisheries staff recently completed a 10-year survey of streams in Rhode Island that documented species status and distribution information (Libby 2004). As a result of this survey, the locations of each species have been plotted on maps, in addition to an evaluation of the physical and chemical characteristics of the location. Between 1993 and 2002, 32 species of freshwater fish were caught during the surveys, 21 are native and 11 were identified as introduced. Ten anadromous and one catadromous species were also collected. Two among Rhode Island's freshwater and anadromous fish species are considered imperiled - the Atlantic and shortnose sturgeons (LaRoe et al. 1995, Williams et al. 1989). Rhode Island has classified seven freshwater fish as imperiled in the state (S1 or S2): American brook lamprey

(*Lampetra appendix*), American shad (*Alosa sapidissima*), Atlantic salmon, blueback herring (*Alosa aestivalis*), rainbow smelt (*Osmerus mordax*), shortnose sturgeon, and possibly the spottail shiner (*Notropis hudsonius*). Spottail shiners are generally found in the larger river basins of the northeast and during Libby's 10-year DEM DFW Stream Survey (2004), some were reported from the Ashaway River, a tributary of the Pawcatuck. Only the American brook lamprey and rainbow smelt are freshwater residents in inland waters, however. The American brook lamprey is a state and regional species of concern and a GCN species; population surveys are needed in order to fully determine its status (NEES & WDTC in press).

Freshwater fishing is a popular pastime in Rhode Island. The state operates fish stocking programs for trout, largemouth bass and several anadromous species. These stocking programs maintain fish population levels in selected Rhode Island rivers and lakes and restore anadromous fish distribution to areas that have become restricted due to dams and other obstructions. The state's Trout Conservation Stamp Program, which requires fishermen targeting trout, salmon and char in state waters to purchase a conservation stamp, funds the conservation and enhancement of these species in Rhode Island (Valliere and Murphy 2001).

The presence of over 520 dams on Rhode Island rivers and streams has reduced the historic range of several fish species, particularly the anadromous species that migrate into freshwater for spawning. The Narragansett watershed (8-digit Hydrologic Catalog Unit (HUC)) is the most threatened of the state's watersheds in terms of surface waters impounded by dams (EPA 2002). Restoration of these migratory routes is underway in many locations through dam removal and the construction of fish ladders. Abundance and distribution of adult American shad and river herring are monitored at fish ladders annually by RI DEM DFW.

Monitoring data for Rhode Island's fisheries is widespread but concentrates on species that are commercially or recreationally valuable. The RI DEM DFW has monitoring databases for recreationally important finfish stocks in coastal waters (1979-present): the aforementioned adult American shad and river herring at various fish ladders, juvenile American shad and river herring (1986-present), finfish in coastal ponds (1993-present), juvenile finfish (1986-present), pelagic gamefish targeted by the gillnet fishery (2000 – present), and largemouth bass in several ponds (RI DEM unpublished). The state and its partners (e.g., EPA, USGS) also conduct fish pathology and community sampling analyses as part of water quality monitoring programs. Individual conservation projects such as the salt marsh restoration project at the state-owned Galilee Bird Sanctuary have provided monitoring data on fish and other wildlife from 1992 to 1997. The Rhode Island Sea Grant program monitored larval fish and zooplankton in Narragansett Bay from 1999 to 2002. URI also monitored winter flounder (and shellfish) populations in three coastal ponds recently (1999-2003).

Table 1.5 Condition of Fishery Stocks in Rhode Island Marine and Estuarine Waters

Species		Status						
Common Name	Scientific Name	Increasing	Stable	Declining	Overfishing Occurring	Overfished	Approaching Overfished	GCN Species
American eel	<i>Anguilla rostrata</i>			X	Unk	Unk	Unk	X
American lobster ***	<i>Homarus americanus</i>			X	Yes	Yes	N/A	X
American plaice	<i>Hippoglossoides platessoides</i>		X		Yes	No	No	No
Atlantic herring	<i>Clupea harengus</i>	X			No	No	No	No
Atlantic menhaden	<i>Brevoortia tyrannus</i>		X	X (expected)	No	No	No	X
Atlantic salmon	<i>Salmo salar</i>			X	No	Yes	N/A	X
Atlantic sea scallop ***	<i>Placopecten magellanicus</i>	X			Yes	No	No	X
Atlantic sturgeon	<i>Acipenser oxyrhynchus</i>			X	Overexploited			X
barndoor skate	<i>Dipterus laevis</i>	X				Yes	N/A	No
bay anchovy	<i>Anchoa mitchilli</i>			X	Unk	Unk	Unk	No
bay scallop ***	<i>Argopecten irradians</i>		X		Unk	Unk	Unk	No
black sea bass	<i>Centropristis striata</i>			X	Yes	Yes	N/A	No
blue crab ***	<i>Callinectes sapidus</i>		X		Unk	Unk	Unk	X
blueback herring	<i>Alosa aestivalis</i>			X	No	No	No	X
bluefish	<i>Pomatomus saltatrix</i>			X	Yes	Yes	N/A	No
butterfish	<i>Peprilus triacanthus</i>			X	No	No	No	No
hickory shad	<i>Alosa mediocris</i>	Unknown			Unk	Unk	Unk	No
hogchoker	<i>Trinectes maculatus</i>			X	Unk	Unk	Unk	X
horseshoe crab ***	<i>Limulus polyphemus</i>			X	Unk	Yes	Unk	X
illex (short fin) squid ***	<i>Illex illecebrosus</i>			X	No	Unk	No	No
loligo (long finned) squid ***	<i>Loligo pealeii</i>			X	Yes	No	Yes	X
Atlantic mackerel	<i>Scomber scombrus</i>	X			No	No	No	No
Monkfish	<i>Lophius americanus</i>	X	X		Yes	Yes	N/A	X

RHODE ISLAND'S COMPREHENSIVE WILDLIFE CONSERVATION STRATEGY

Species		Status						
Common Name	Scientific Name	Increasing	Stable	Declining	Overfishing Occurring	Overfished	Approaching Overfished	GCN Species
		(northern)						
Mummichog	<i>Fundulus heteroclitus</i>				Unk	Unk	Unk	No
ocean quahog ***	<i>Arctica islandica</i>			X	No	No	No	No
oyster ***	<i>Crassostrea virginica</i>		X		Unk	Unk	Unk	No
oyster toadfish	<i>Opsanus tau</i>			X	Unk	Unk	Unk	X
quahogs (narr. bay) ***	<i>Mercenaria mercenaria</i>			X	Yes (in Narr. Bay)	N/A	N/A	X
red crab ***	<i>Chaceon quinquedens</i>	Unknown			Unk	Unk	Unk	No
Scup	<i>Stenotomus chrysops</i>	X			Yes	Yes	N/A	No
sea robin (3 spp. – armored, northern, striped)	<i>Peristedion miniatum</i> <i>Prionotus carolinus</i> <i>Prionotus evolans</i>			X	Unk	Unk	Unk	No
shortnose sturgeon	<i>Acipenser brevirostrum</i>			X	Overexploited			X
silver hake (whiting)	<i>Merluccius bilinearis</i>			X	Yes (in 1999)	Yes	N/A	No
smooth skate	<i>Malacoraja senta</i>	X				Yes	N/A	No
soft-shelled clam ***	<i>Mya arenaria</i>			X	Unk	Unk	Unk	No
spiny dogfish	<i>Squalus acanthias</i>			X	Yes	Yes	N/A	No
striped bass	<i>Morone saxatilis</i>	X			No	No	No	No
summer flounder	<i>Paralichthys dentatus</i>	X			Yes	Yes	N/A	No
surf clam ***	<i>Spisula solidissima</i>			X	No	No	No	No
Tautog	<i>Tautoga onitis</i>	X			Yes	Yes	N/A	No
thorny skate	<i>Amblyraja radiata</i>			X		Yes	N/A	No
tilefish	<i>Lopholatilus chamaeleonticeps</i>		X		Yes	Yes	N/A	No
weakfish	<i>Cynoscion regalis</i>	X			No	No	N/A	X
windowpane flounder	<i>Scophthalmus aquosus</i>			X	Yes	Yes	Yes	X
winter flounder	<i>Pseudopleuronectes americanus</i>	X (for SNE stock)		X (in Narr. Bay)	No (for SNE stock)	No	N/A	X
winter skate	<i>Leucoraja ocellata</i>	X				Yes	N/A	No

RHODE ISLAND'S COMPREHENSIVE WILDLIFE CONSERVATION STRATEGY

Species		Status						
Common Name	Scientific Name	Increasing	Stable	Declining	Overfishing Occurring	Overfished	Approaching Overfished	GCN Species
witch flounder	<i>Glyptocephalus cynoglossus</i>	X				No		No
yellowtail	<i>Seriola lalandei</i>	Unknown			Yes	Yes	N/A	No
yellowtail flounder	<i>Limanda ferruginea</i>	X			Yes (in 1998)	Yes	N/A	No

Highly Migratory Species		Status						
Common Name	Scientific Name	Increasing	Stable	Declining	Overfishing Occurring	Overfished	Approaching Overfished	GCN Species
Atlantic sharpnose shark	<i>Rhizoprionodon terraenovae</i>	Unknown			No	No	No	No
bigeye tuna	<i>Thunnus obesus</i>	Unknown			Yes	Yes	N/A	No
blacktip shark	<i>Carcharhinus limbatus</i>	X			No	No	N/A	No
blue marlin	<i>Makaira nigricans</i>	Unknown			Yes	Yes	N/A	No
blue shark	<i>Prionace glauca</i>	Unknown			Unk	Unk	Unk	No
Atlantic bluefin tuna	<i>Thunnus thynnus</i>	Unknown			Yes	Yes	N/A	No
nurse shark	<i>Ginglymostoma cirratum</i>	Unknown			Unk	Unk	Unk	No
porbeagle	<i>Lamna nasus</i>	Unknown			Unk	Unk	Unk	No
sandbar shark	<i>Carcharhinus plumbeus</i>	Unknown			Yes	No	N/A	No
shortfin mako shark	<i>Isurus oxyrinchus</i>	Unknown			Unk	Unk	Unk	No
silky shark	<i>Carcharhinus falciformis</i>	Unknown			Yes	Yes	N/A	No
spinner shark	<i>Carcharhinus brevipinna</i>	Unknown			Yes	Yes	N/A	No
swordfish	<i>Xiphias gladius</i>	Unknown			Yes	Yes	N/A	No
white marlin	<i>Tetrapturus albidus</i>	Unknown			Yes	Yes	N/A	No
yellowfin tuna	<i>Thunnus albacares</i>	Unknown			No	No	No	No

*** Invertebrate species.

N/A = Not applicable

SNE = Southern New England

Unk = Unknown

Data Sources: Friedland (2000), Gibson (2001), Kocik (2000), NEFMC (2003a-h), Nitschke (2000), NMFS (2002, 2003), RI DEM (2002k), USGS (1995), Valliere and Murphy (2001)

Of the total fish diversity in the state, 34 species have been determined to be of Greatest Conservation Need. Distribution data are insufficient to accurately map most of these fish species' occurrence, and collection of status and life history information has been recognized as a research need. Table 1.6 identifies GCN fish species for Rhode Island. The process of identifying GCN species is discussed at the end of this chapter and Appendix 1c lists all GCN species, along with their abundance and distribution status, including low and declining populations.

Table 1.6 GCN Fish of Rhode Island

GCN FISH (total 34)	
Common Name	Scientific Name
alewife	<i>Alosa pseudoharengus</i>
American brook lamprey	<i>Lampetra appendix</i>
American eel	<i>Anguilla rostrata</i>
American goosfish (monkfish)	<i>Lophius americanus</i>
American sand lance	<i>Ammodytes americanus</i>
American shad	<i>Alosa sapidissima</i>
Atlantic menhaden	<i>Brevoortia tyrannus</i>
Atlantic salmon	<i>Salmo salar</i>
Atlantic sturgeon	<i>Acipenser oxyrhynchus</i>
Atlantic tomcod	<i>Microgadus tomcod</i>
banded sunfish	<i>Enneacanthus obesus</i>
blacknose dace	<i>Rhinichthys atratulus</i>
blueback herring	<i>Alosa aestivalis</i>
bridle shiner	<i>Notropis bifrenatus</i>
brook trout	<i>Salvelinus fontinalis</i>
common shiner	<i>Luxilus cornutus</i>
creek chubsucker	<i>Erimyzon oblongus</i>
cunner	<i>Tautoglabrus adspersus</i>
hogchoker	<i>Trinectes maculatus</i>
lined seahorse	<i>Hippocampus erectus</i>
longnose dace	<i>Rhinichthys cataractae</i>
northern kingfish	<i>Menticirrhus saxatilis</i>
oyster toadfish	<i>Opsanus tau</i>
rainbow smelt	<i>Osmerus mordax</i>
redbreast sunfish	<i>Lepomis auritus</i>
sea raven	<i>Hemitripterus americanus</i>
shortnose sturgeon	<i>Acipenser brevirostrum</i>
skates sp	<i>Raja spp.</i>
smooth dogfish	<i>Mustelus canis</i>
spotfin killifish	<i>Fundulus luciae</i>
spottail shiner	<i>Notropis hudsonius</i>
weakfish	<i>Cynoscion regalis</i>
windowpane	<i>Scophthalmus aquosus</i>
winter flounder	<i>Pseudopleuronectes americanus</i>

Invertebrates

Rhode Island and its offshore waters are home to literally thousands of invertebrate species. Tidal pools along rocky portions of the coast contain miniature aquariums of invertebrates, from sea anemones to coralline algae and barnacles (Gibbs et al. 1995). Almost 400 individual invertebrate species (terrestrial and fresh water) are presently tracked in the Rhode Island Natural Heritage Database, with 56 of those species listed by the state as endangered, threatened or species of concern (Table 1.1). This represents a small fraction of the world's invertebrate fauna, however. Insects, for instance, are the most diverse faunal group and often serve as environmental indicators; there are over 163,000 species of insects in the U.S. and Canada, including 14,000 moths and butterflies (Lepidoptera). Despite this incredible diversity, or perhaps because of it, little is known about the majority of these species and nearly half of them remain undescribed (LaRoe et al. 1995). Pavulaan and Rhode Island Nongame Wildlife Program (1994) provides the best available information on Rhode Island's butterflies, Sikes (2004) on the state's beetles, Carpenter (2000) on the odonata of Block Island, Mello (2000) on the macrolepidoptera of Block Island, and Raithel and Hartenstine (in press) on the freshwater mussels of the state. Burgess (2002) samples the aquatic benthic invertebrates of the Wood-Pawcatuck watershed. Martinez (1994), Weiss (1995), Pollock (1997), and Massie (1998) provided information on Rhode Island's marine invertebrate species.

Invertebrates are underrepresented in national endangered species conservation. As a result, many scientists call for an ecosystem-level approach to providing conservation for endangered invertebrates while collecting needed information about the diversity, abundance and distribution of these species. Eventually, population data would allow species-based actions to be incorporated into management plans to protect specific endangered species (Hoffman Black et al. 2001). At present, however, distribution and abundance data are insufficient to accurately map most invertebrate species' occurrence, and collection of status and life history information has been recognized as a research need.

Rhode Island supports thousands of invertebrate species, but full inventories are not readily available. Over 2,000 species of beetles are found in the state (Sikes 2000, 2004), including several that are federally and/or state-listed. Mello (2000) found that 271 species of macrolepidoptera (larger moths) occur on Block Island alone, contributing to the island's high ecological significance. Many butterflies rely upon specific host plants and are declining as their required habitat declines (LaRoe et al. 1995).

The aquatic insects of the state rely upon healthy riparian habitats throughout their life histories, and these species can serve as barometers of environmental health along rivers and streams. The forthcoming *Rhode Island Odonata Atlas* should provide more demographic information on many of these species, facilitating their management; so far, at least 130 odonate species have been documented in Rhode Island, including 31 species on Block Island (Carpenter 2000).

Rhode Island supports a diverse beetle fauna (Coleopterans). Some species, such as the endangered tiger beetles, are highly specialized to specific habitats and historically were found in only a few locations in the state (USFWS 1993a, 1994). The northeastern tiger beetle (*Cicindela dorsalis dorsalis*) has been extirpated from Rhode Island, but the USFWS Recovery Plan for the species identifies five historic sites (Napatree Point, Block Island, Narragansett Pier, Roger Williams Park, and Newport) where the species could be reintroduced (USFWS 1994). Several other species of tiger beetles, although not considered endangered species by the USFWS, are nevertheless declining regionally. The only known population of the clay banks tiger beetle (*Cicindela limbalis*) in southern New England, another GCN species, is found on the clay bluffs of Block Island (Sikes 2000). The pine barrens tiger beetle (*Cicindela formosa*) is also a habitat specialist (and a GCN species), with a distribution limited to inland dune/sand barren and pitch pine/scrub oak barren habitats. The American burying beetle ([*Nicrophorus americanus*](#)) is federally-endangered, critically-imperiled (S1) in the state, and a GCN species. Once widespread, this carrion beetle is now limited to only a few known natural locations in Rhode Island (Block Island), certain western states and has been reintroduced in Massachusetts (USFWS 1991).

Aquatic invertebrates can also be habitat specialists with limited distributions and declining abundances. Nationally and regionally, many freshwater mussel species are in danger of extinction (Williams et. al. 2003). An estimated 67% of freshwater mussel species and 65% of freshwater crayfish are rare or imperiled nationally (Abell et al. 2000, TNC 1996). Of the 297 freshwater mussel species found in the U.S., almost 72% have become endangered, threatened or species of concern in the last 50 years (LaRoe et al. 1995). Ten species of freshwater mussels have become extinct in North America within the last century (Miller et al. 1989, and TNC 1996, as cited in Abell et al. 2000). Four of Rhode Island's dozen native freshwater mussel species are state-listed due to their rarity (RI DEM 2001k) and half of the species are considered imperiled (LaRoe et al. 1995). The freshwater mussels have been the subject of recent survey work (Raithel and Hartenstine, in press) but more work on this beleaguered fauna is desirable. Past survey work concentrated only on finding populations; no populations have been adequately quantified and adequate baseline data on which to base future faunal changes do not exist. Therefore, more survey and long-term monitoring research is needed to track the status of these freshwater mussel species. Baseline population status and life history information is needed to establish effective conservation actions for the brook floater (*Alasmidonta varicosa*), eastern pond mussel (*Ligumia nasuta*), and tidewater mucket (*Leptodea ochracea*), all of which have been selected as GCN species (NEES & WDTC in press).

A variety of invertebrates have periodically or continuously been monitored in Rhode Island. Virginia Brown has recently completed a five-year survey program to inventory the odonates (dragonflies and damselflies) of Rhode Island in preparation of the Rhode Island Odonata Atlas. The Audubon Society of Rhode Island surveyed butterflies at their Powder Mill Ledges Wildlife Refuge in 2003 and 2004. The EPA monitored populations of the estuarine amphipod (*Ampelisca abdita*) in the Narrow River from 1996 to 2000.

Marine invertebrates of commercial or recreational harvest interest, such as lobsters, clams, and oysters, are collaboratively managed by RI DEM divisions to maintain healthy, sustainable populations. The state maintains faunal databases on macroinvertebrate populations in over 45 rivers and streams (1992-present), lobster populations in Narragansett Bay (1991-present), and lobster larval settlement (1990-present). The condition of shellfish and their habitat have been monitored by RI DEM DFW and its partners for water quality (1946-present), disease (1998-2001), lobster shell disease in Dutch Harbor (1997-2001), and bacteria sources (1976-present).

Researchers with URI have monitored benthic infauna in Narragansett Bay (1999-present), phytoplankton diversity near Fox Island (1950s-present), and shellfish populations and metal tissue loads in three coastal ponds (1999-2003). The Woods Hole Oceanographic Institute Sea Grant in Massachusetts has surveyed intertidal crabs on rocky shores near Bristol (1998-2001). Rhode Island Sea Grant, NMFS and CMER tagged lobsters in a survey program from 1994-2003. Save The Bay, a non-governmental organization (NGO), and the Narragansett Bay National Estuarine Research Reserve have monitored horseshoe crab populations (including spawning data) as part of their Bay Watchers program since 1993 (Berounsky 2002).

Individual conservation projects such as the salt marsh restoration project at the state-owned Galilee Bird Sanctuary have provided monitoring data on fish and other wildlife from 1992 to 1997. NOAA/NMFS monitored lobster, oyster, bay scallop and finfish restoration projects in Rhode Island waters from 2000 to 2004 including the North Cape project where cultivated populations could influence the native populations. Bioinvasive (invertebrate) species have been monitored in marine waters by RI DEM DFW and its partners since 2000, and by USDA/APHIS in terrestrial habitats since 1982.

Of the total invertebrate diversity in the state, 157 species have been determined to be of Greatest Conservation Need. Table 1.7 identifies GCN invertebrate species for Rhode Island. The process of identifying GCN species is discussed at the end of this chapter and Appendix 1c lists all GCN species, along with their abundance and distribution status, including low and declining populations.

Table 1.7 GCN Invertebrates of Rhode Island

GCN INVERTS (total 157)	
Common Name	Scientific Name
a buck moth	<i>Hemileuca maia</i>
a diving beetle	<i>Cybister fimbriolatus</i>
a dung beetle	<i>Copris fricator</i>
a dung beetle	<i>Dichotomius carolinus</i>
a flea beetle	<i>Phyllotreta chalybeipennis</i>
a ground beetle	<i>Bembidion confusum</i>
a ground beetle	<i>Bembidion semicinctum</i>
a ground beetle	<i>Carabus serratus</i>
a ground beetle	<i>Carabus sylvosus</i>
a ground beetle	<i>Carabus vinctus</i>

a ground beetle	<i>Omophron tessellatum</i>
a hisster beetle	<i>Hister arcuatus</i>
a noctuid moth	<i>Aplectoides condita</i>
a noctuid moth	<i>Metaxaglaea violacea</i>
a noctuid moth	<i>Zale submediana</i>
a silphid beetle	<i>Thanatophilus lapponicus</i>
a tiger beetle	<i>Cicindela tranquebarica</i>
Acadian hairstreak	<i>Satyrium acadicum</i>
alewife floater	<i>Anodonta implicata</i>
American burying beetle	<i>Nicrophorus americanus</i>
American rubyspot	<i>Hetaerina americana</i>
an arctiid moth	<i>Grammia speciosa</i>
arrow clubtail	<i>Stylurus spiniceps</i>
arrowhead spiketail	<i>Cordulegaster obliqua</i>
backwater bluet	<i>Enallagma weewa</i>
Baltimore	<i>Euphydryas phaeton</i>
barrens chaetaglaea	<i>Chaetaglaea tremula</i>
barrens tiger beetle	<i>Cicindela patruela</i>
barrens xylotype	<i>Xylotype capax</i>
bay shrimp	<i>Crangon septemspinosa</i>
Benjamin's abagrotis	<i>Abagrotis crumbi benjamini</i>
blue crab	<i>Callinectes sapidus</i>
blue mussel	<i>Mytilus edulis</i>
blueberry sallow	<i>Apharetra dentata</i>
bog copper	<i>Lycaena epixanthe</i>
broad-winged skipper	<i>Poanes viator</i>
bronze copper	<i>Lycaena hyllus</i>
brook floater	<i>Alasmidonta varicosa</i>
brook snaketail	<i>Ophiogomphus aspersus</i>
brown elfin	<i>Callophrys augustinus</i>
clay banks tiger beetle	<i>Cicindela limbalis</i>
club tunicate	<i>Styela clava</i>
coastal swamp metarranthis	<i>Metarranthis pilosaria</i>
columbine duskywing	<i>Erynnis lucilius</i>
comet darner	<i>Anax longipes</i>
common sanddragon	<i>Progomphus obscurus</i>
coppery emerald	<i>Somatochlora georgiana</i>
crimson-ringed whiteface	<i>Leucorrhinia glacialis</i>
deep sea scallop	<i>Placopecten magellanicus</i>
delta-spotted spiketail	<i>Cordulegaster diastatops</i>
dusted skipper	<i>Atrytonopsis hianna</i>
eastern pearlshell	<i>Margaritifera margaritifera</i>
eastern pine elfin	<i>Callophrys niphon</i>
eastern pond mussel	<i>Ligumia nasuta</i>
Edwards' hairstreak	<i>Satyrium edwardsii</i>

fiddler crabs	<i>Uca spp.</i>
frosted elfin	<i>Callophrys irus</i>
golden star tunicate	<i>Botryllus schlosseri</i>
green crab	<i>Carcinus maenas</i>
harvester	<i>Fenisea tarquinius</i>
Henry's elfin	<i>Callophrys henrici</i>
Hessel's hairstreak	<i>Callophrys hesseli</i>
hickory hairstreak	<i>Satyrium caryaevorum</i>
hoary elfin	<i>Callophrys polios</i>
horseshoe crab	<i>Limulus polyhemus</i>
lampmussel	<i>Lampsilis radiata</i>
lobster	<i>Homarus americanus</i>
long finned squid	<i>Loligo pealeii</i>
lyre-tipped spreadwing	<i>Lestes unguiculatus</i>
Maine snaketail	<i>Ophiogomphus mainensis</i>
Mantis shrimp	<i>Squilla empusa</i>
meadow fritillary	<i>Boloria bellona</i>
mulberry wing	<i>Poanes massasoit</i>
mustached clubtail	<i>Gomphus adelphus</i>
noctuid moth	<i>Lithophane baileyi</i>
northeastern beach tiger beetle	<i>Cicindela dorsalis</i>
northern hairstreak	<i>Fixsenia favonius ontario</i>
northern pearly eye	<i>Enodia anthedon</i>
olive hairstreak	<i>Callophrys gryneus</i>
orange sheath tunicate	<i>Botrylloides diegensis</i>
pale green pinion moth	<i>Lithophane viridipallens</i>
persius duskywing	<i>Erynnis persius</i>
pine barrens bluet	<i>Enallagma recurvatum</i>
pine barrens nepytia	<i>Nepytia sp 1</i>
pine barrens tiger beetle	<i>Cicindela formosa</i>
pine barrens zale	<i>Zale sp 1</i>
pitcher plant borer	<i>Papaipema appassionate</i>
purple tiger beetle	<i>Cicindela purpurea</i>
quahog	<i>Mercenaria mercenaria</i>
red-bellied tiger beetle	<i>Cicindela rufiventris</i>
regal fritillary	<i>Speyeria idalia</i>
ringed boghaunter	<i>Williamsonia lintneri</i>
rock crab	<i>Cancer irroaiatus</i>
salt marsh tiger beetle	<i>Cicindela marginata</i>
scarlet bluet	<i>Enallagma pictum</i>
sea grapes	<i>Molgula manhattensis</i>
sea star	<i>Asterias spp.</i>
sea vase	<i>Ciona intestinalis</i>
seabeach tiger beetle	<i>Cicindela hirticollis</i>
sleepy duskywing	<i>Erynnis brizo</i>

southern pygmy clubtail	<i>Lanthus vernalis</i>
southern sprite	<i>Nehalennia integricollis</i>
spatterdock darner	<i>Aeshna mutata</i>
spider crabs	<i>Libinia spp.</i>
spine-crowned clubtail	<i>Gomphus abbreviatus</i>
sponge beds	<i>Family porferia</i>
squawfoot	<i>Strophitus undulatus</i>
taper-tailed darner	<i>Gomphaeschna antilope</i>
thaxter's pinon moth	<i>Lithophane thaxteri</i>
tidewater mucket	<i>Leptodea ochracea</i>
triangle floater	<i>Alasmidonta undulata</i>
twin-spotted spiketail	<i>Cordulegaster maculata</i>
whelk	<i>Busycon spp.</i>
white m hairstreak	<i>Parrhasius m-album</i>
zebra clubtail	<i>Stylurus scudderi</i>
	<i>Agonum darlingtoni</i>
	<i>Alobates morio</i>
	<i>Amara chalcea</i>
	<i>Anaedes brunneus</i>
	<i>Brachinus cyanipennis</i>
	<i>Calathus ingratus</i>
	<i>Calosoma wilcox</i>
	<i>Canthon pilularius</i>
	<i>Canthon vigilans</i>
	<i>Coccinella novemnotata</i>
	<i>Cotalpa lanigera</i>
	<i>Desmocerus palliatus</i>
	<i>Geospinus incrassatus</i>
	<i>Scaphinotus elevatus</i>
	<i>Strategus antaeus</i>
	<i>Argyrostromis anilis</i>
	<i>Capis curvata</i>
	<i>Catocala antinympha</i>
	<i>Catocala muliercula</i>
	<i>Cepphis decoloraria</i>
	<i>Conservula anodonta</i>
	<i>Crymodes burgessi</i>
	<i>Cycnia inopinatus</i>
	<i>Darapsa versicolor</i>
	<i>Exyra fax</i>
	<i>Fagitana littera</i>
	<i>Faronata rubripennis</i>
	<i>Homophoberia cristata</i>
	<i>Iodopepla u-album</i>
	<i>Macrochilo louisiana</i>

	<i>Meropleon diversicolor</i>
	<i>Oligia minuscula</i>
	<i>Orosagrotis perpolita</i>
	<i>Plagodis kuetzingi</i>
	<i>Psaphida thaxterianus</i>
	<i>Scopula purata</i>
	<i>Sideridis maryx</i>
	<i>Thysanopyga intractata</i>
	<i>Zale curema</i>
	<i>Zanclognatha martha</i>
	<i>Apldium spp.</i>
	<i>Ascidiella aspersa</i>

Research and Survey Needs

Population estimates for many GCN species, especially invertebrates, are unavailable and are an identified research need for Rhode Island. Many of these species are exhibiting national population declines, and population surveys in Rhode Island are necessary to identify opportunities for conserving and recovering these species locally. Table 1.8 lists species that have been identified as needing population surveys to provide abundance and distribution data. Where available, the data source identifying the species as requiring population surveys is noted; if no source is listed, the data source is the RI DEM.

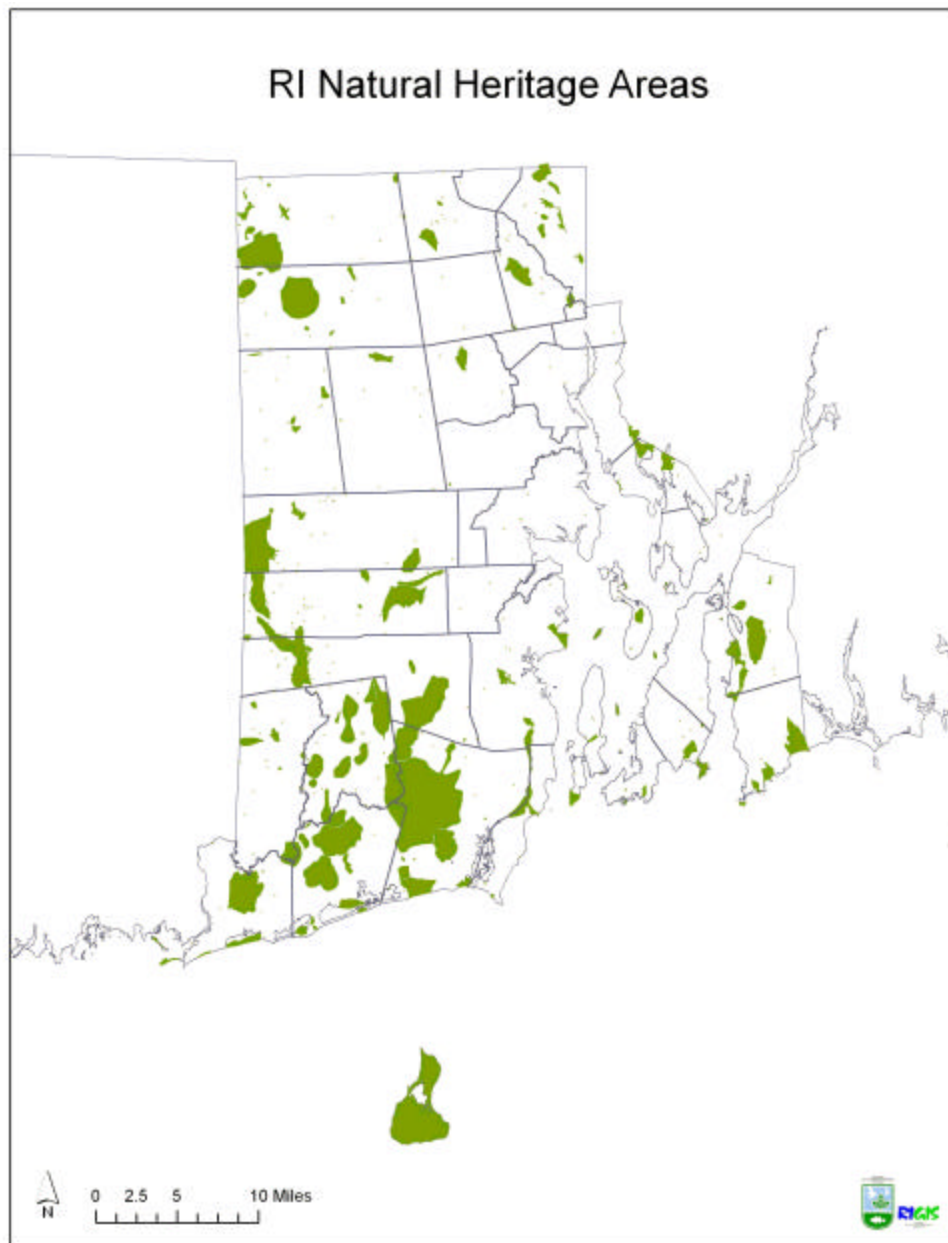
Table 1.8 Species or groups in need of population surveys to determine their abundance and distribution in Rhode Island

Mammals	Birds	Fish
hoary bat ¹	upland sandpiper ²	American brook lamprey ¹
New England cottontail ¹	short-eared owl ²	Atlantic sturgeon ¹
water shrew ¹	grasshopper sparrow ²	bridle shiner ¹
	American woodcock ²	
Herpetofauna	black-billed cuckoo ²	Invertebrates
eastern box turtle ¹	whip-poor-will ²	brook floater ¹
eastern hognose snake ¹	Acadian flycatcher ²	eastern pond mussel ¹
eastern ribbon snake ¹	blackburnian warbler ²	tidewater mucket ¹
eastern spadefoot ¹	cerulean warbler ²	butterflies ⁶
northern leopard frog ¹	Louisiana waterthrush ²	
	shorebirds ³	
	sea ducks ⁴	
	non-breeding colonial	
	waterbirds ⁵	

¹ Northeast Endangered Species and Wildlife Diversity Technical Committee (in press); ² Rosenberg (2004); ³ Brown et al. (2001); ⁴ USFWS (1999); ⁵ Kushlan et al. (2002); ⁶ LaRoe et al. (1995)

In addition to these population surveys, there is also a need to survey for areas of concentration of some species. The National Audubon Society, for instance, has an Important Bird Area (IBA) program that identifies and designates locations that are critically important to congregations of individual or groups of avian species. Rhode Island is one of the few states that does not have an active IBA program –although American Bird Conservancy identifies the Block Island National Wildlife Refuge as an important bird area. Another survey need may be to identify Rhode Island waters that may qualify for designation as a federal Marine Protected Area (MPA). RI DEM Natural Heritage Program published a rare species list and identified critical habitats for these rare species (Figure 1.10).

Figure 1.10 Critical Habitats for Rhode Island's Rare Species (Source: RI DEM NHP)



Identifying Species of Greatest Conservation Need (GCN)

The process for identification of Species of Greatest Conservation Need (GCN) involved research and compilation of the best available quantitative and qualitative information from RI DEM staff, internal and external experts and stakeholders. Once the full array of wildlife species and checklists were assembled and reviewed, together with the TWW IAFWA guidance and partner program priorities lists, a RI DEM DFW CWCS dataset was created to capture and organize the most current species status information for analysis (Appendix 1b). Sources of information are listed previously in this chapter for each taxon as well as in Appendices 1a-e. RI DEM DFW, NHP and RINHS data as well as August et al. (2001) were the primary sources of information on the wide spectrum of Rhode Island's biota. Other specific datasets and references were used for individual taxa and have been referenced above in the appropriate taxa sections.

Table 1.9 Criteria for Selecting Species of Greatest Conservation Need

TWW Committee's State Wildlife Grants Work Group (IAFWA Guidance) Criteria for GCN:

- Endangered, threatened and candidate species (federal or state)
- Imperiled species (Globally rare)
- Declining species
- Endemic species
- Disjunct species
- Vulnerable species
- Species with small, localized "at-risk" populations
- Species with limited dispersal
- Species with fragmented or isolated populations
- Species of special, or conservation, concern
- Focal species
(keystone species, wide-ranging species, species with specific needs)
- Indicator species
- "Responsibility" species
(i.e., species that have their center of range within a state)
- Concentration areas
(e.g., migratory stopover sites, bat roosts / maternity sites)

RI DEM DFW's CWCS Technical and Scientific Teams, including internal and external experts most knowledgeable of the status of these taxa in Rhode Island, reviewed the dataset using the selection criteria in Table 1.9 for consideration as GCN species. If a species met any one of these criteria it was considered eligible for GCN status. The Technical Team developed recommendations utilizing the criteria listed below as well as the best available scientific quantitative and qualitative information. The more criteria met, along with expert recommendation, the stronger consideration was given to a species. GCN species were not ranked and an inclusive approach was taken, following the intent of the SWG program to "keep common species common". Special efforts were made to determine those species thought to be focal or indicators for a guild or group of

species. This was particularly true with marine species, as their mobility and use of multiple habitats facilitated identification of “focal primary and secondary species” to target. In this way, conservation actions developed for these focal species also provided for the diverse suite of other marine species also utilizing these habitats.

The following list of species groups was developed from this guidance, and taxa lists were further refined with input from staff and stakeholder experts to produce an inclusive GCN list for each taxa covering mammals, birds, reptiles and amphibians, fish and invertebrates. The overlap of species priorities among partner programs (USFWS, USFS, TNC, NHP, NatureServe, PIF, PARC, AFS, etc.), stakeholders, experts and agencies alike indicated significant agreement on most groups of wildlife to be considered as GCN.

Special Status Species

- Federally-listed threatened and endangered animals
- State-listed threatened and endangered animals
- Wildlife species listed as In Need of Conservation
- Natural Heritage Program tracked and watchlist animal species
- NE wildlife species of regional conservation concern
- TNC ecoregional target species
- Responsibility species (those for which Rhode Island supports the core populations)
- Endemic species

Recognized Bird Priorities

- Partners in Flight and All Bird Conservation priority species
- USFWS migratory birds of management concern
- Colonial waterbirds
- Forest interior breeding birds
- Shrubland successional breeding birds
- Grassland breeding birds
- Shorebirds with significant migratory concentrations
- Marshland breeding birds

Other Terrestrial Species Groups

- Reptiles and amphibians at risk
- Bats at risk
- Small mammals at risk
- Invertebrates at risk

Aquatic Species Groups

- Aquatic invertebrates at risk
- Freshwater fish at risk
- American Fisheries Society species of concern
- Depleted anadromous fish
- Depleted marine invertebrates

○ Sensitive aquatic species

A resulting draft list of GCN species was developed by these teams after significant consultation and coordination efforts among experts and included those species groups meeting the criteria in Table 1.9 (TWW IAFWA guidance as well including partner program priorities). This list was posted on the website. A workshop was then conducted to solicit additional input and feedback on the GCN and key habitat lists. Stakeholder input was incorporated through the review of the Technical and Scientific Committees. The proposed GCN list was refined and again posted on the website for final review, then adopted as GCN targets for which habitat, threats and actions were identified during the remainder of this CWCS development. This summarizes the process used in Rhode Island to develop the GCN and key habitat lists for this CWCS. Additional information on the input process and stakeholder involvement can be found in Appendices 8a-c.

Table 1.10 summarizes the resulting list of species of Greatest Conservation Need identified for Rhode Island. The complete GCN species list is found in Appendix 1c. The summary breakdown of GCN species includes 24 mammals, 129 birds and 3 bird groups, 21 reptiles and amphibians, 31 fish (10 freshwater, 13 saltwater and 8 anadromous/catadromous), and 157 invertebrates. These were presented for each taxa in the previous sections. During this process, GCN species were also assigned to primary, secondary and tertiary habitats in the dataset and sorted by primary habitat for further analysis of threats and actions (presented in Chapter 4).

Table 1.10 Summary of Species of Greatest Conservation Need Identified for Rhode Island

Taxa	Full Array Species (Source: RI DEM NHP and DFW datasets 2005)	GCN Species (Source: RI DEM DFW dataset) 2005)
Mammals	91	23
Birds	427	129 species plus 3 groups
Reptiles and Amphibians	46	21
Fish	306	34
Invertebrates*	~396 terrestrial/freshwater ~439 marine	134 terrestrial/freshwater 23 marine
Total	~1705	364

*Estimated total species is ~20,000, but information is insufficient

Chapter 2: Rhode Island's Wildlife Habitat

The ecological health of Rhode Island's habitats influences the distribution and abundance of the state's wildlife. The state's varied physiography, climate, geology, soil types, topography, and watersheds support a range of vegetative communities that provide diverse habitats for its wildlife. Both landscape and waterscape diversity of the country's smallest state provide a complex ecological framework for Rhode Island's fish and wildlife diversity. This chapter describes the location and condition of Rhode Island's key habitats, addressing Element 2 and its subelements.

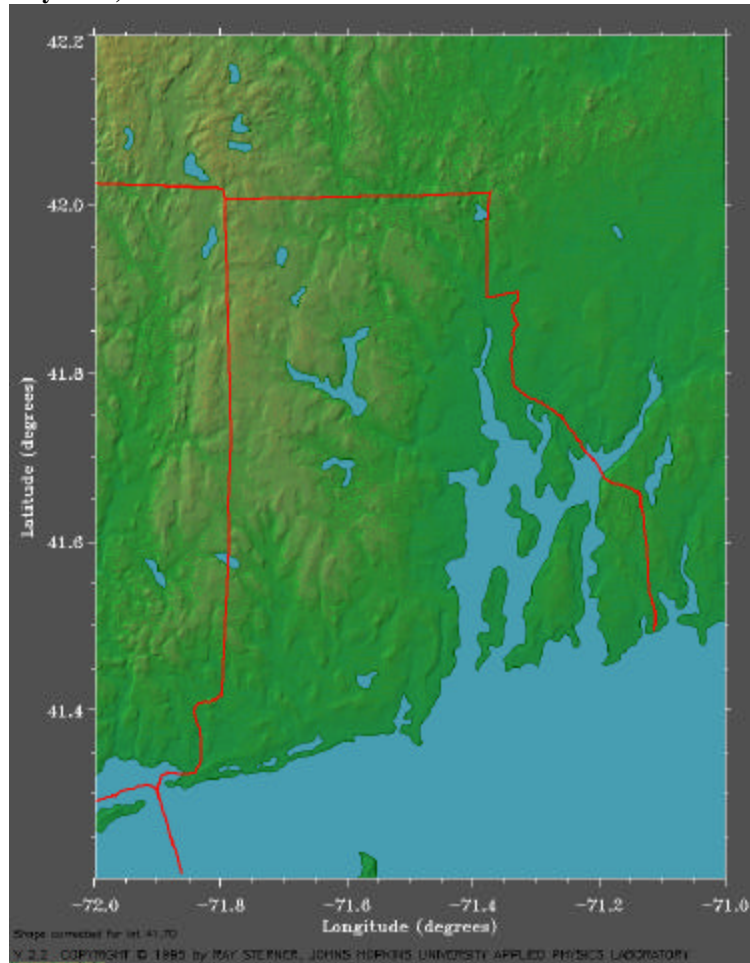
Rhode Island's Landscape

Despite its small size - only 1,054 square miles - Rhode Island's landscape provides a wealth of opportunities for fish and wildlife resources as well as for residents of and visitors to the state. Rhode Island has valued natural resource conservation, open space, and outdoor recreation opportunities for decades, writing and updating a State Comprehensive Outdoor Recreation Plan (SCORP) since 1965 (RI DEM 2003n). The seventh edition of this plan, issued in 2003, serves as a model for a CWCS plan in its longevity and effectiveness. From the barrier beaches and Block Island at the coast, to the extensive wetland systems of the pristine Wood-Pawcatuck River watershed, to the rolling forests of western Rhode Island, the state provides a variety of habitats for fish and wildlife resources. Western Rhode Island is largely rural in nature, while the region surrounding Narragansett Bay is increasingly urban. In fact, Rhode Island is the second most densely populated state in the country, not including the summer visitors who tour the attractive coastal areas. Development pressures on the remaining natural landscapes are on the rise, threatening the health of many of the state's ecosystems. The state has developed numerous conservation and management plans like the SCORP to protect the natural resources of the state, and this CWCS serves as a catalyst to coordinate the range of existing plans.

Physiography

Rhode Island's physiography, or topography, is predominantly classified as Seaboard Lowland (RI DEM 2003n). The northwestern portion of the state is characterized by hills and valleys rising between 500 and 800 feet above sea level, with the highest point in the state found at Jerimoth Hill (812 ft, or 247 m). Narragansett Bay and its tributaries dominate the eastern part of the state and a low-lying strip along the bay's western shore (Figure 2.1). The Atlantic Ocean and Block Island Sound form the southern border of the state. With 420 miles of resulting shoreline, the southern landscape is dominated by coastal lowlands that are generally less than 200 feet above sea level (RI DEM 2003n). Numerous islands are found within Narragansett Bay, and Block Island is a well-known landmark found off the southern coast between Rhode Island and Long Island, New York. 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 1995)



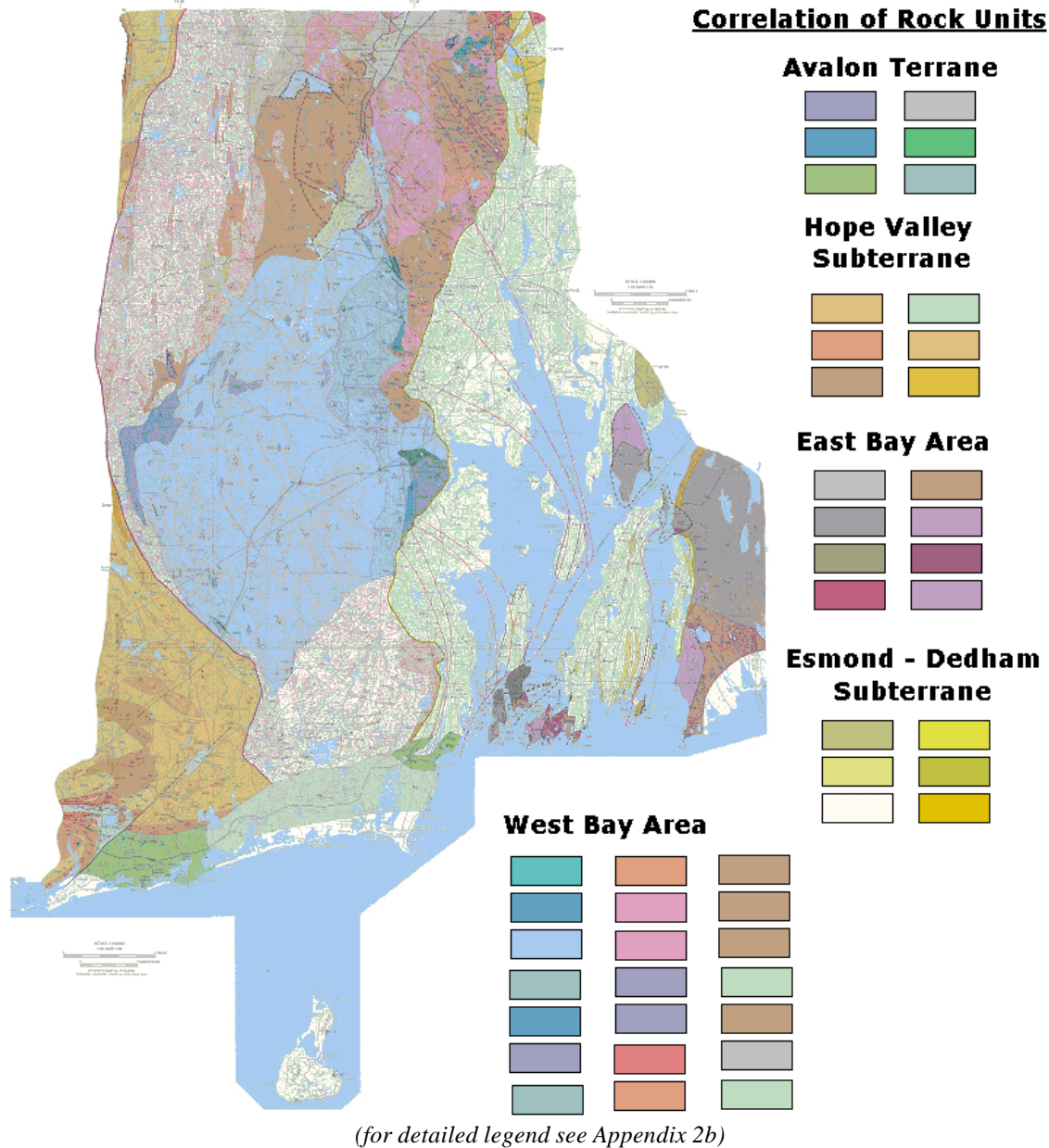
Geology

The geology of Rhode Island is varied and includes areas of highly dynamic barrier islands and spits along the southern coast to solid bedrock exposures. Rhode Island's topography has been influenced by its glacial history, which is also responsible for many of its landforms and soils. Fluctuating sea levels have alternately exposed and drowned estuaries and bays, which are the dominant features of Rhode Island's landscape and heritage.

The geologic history of the region includes two periods of mountain-building followed by extensive periods of erosion that wore the mountains down to their current lowland and gently rolling topography (Gibbs et al. 1995, Quinn 1997). The faults associated with Rhode Island's historic mountain-building phases are still present and occasionally rock the state with minor earthquakes. These faults are generally limited to the Narragansett Bay area. 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.

Figure 2.2 Geologic Map of Rhode Island (Source: Rhode Island Geological Survey)



Most of the state is underlain by igneous and metamorphic rocks that are 136 to over 570 million years old (Figure 2.2; Quinn 1997). This bedrock is typically seen in natural exposures along the coast, where glaciers and waves have exposed the underlying rocks (e.g., south of Narragansett, Mt. Hope, 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 surrounding Narragansett Bay (Gibbs et al. 1995, Quinn 1997). Near the Massachusetts state

line in northern Rhode Island, the only known occurrence in the world of cumberlandite, a very rare rock rich in iron and titanium, can be found exposed in Cumberland at Iron Mine Hill; cumberlandite is the official state rock of Rhode Island due to its rarity and its historical significance as a regional source of iron ore during the 18th century (Gibbs et al. 1995, Quinn 1997). The fine-grained granite found in Westerly is also well-known and is one of the global standards for the granite rock type (Quinn 1997).

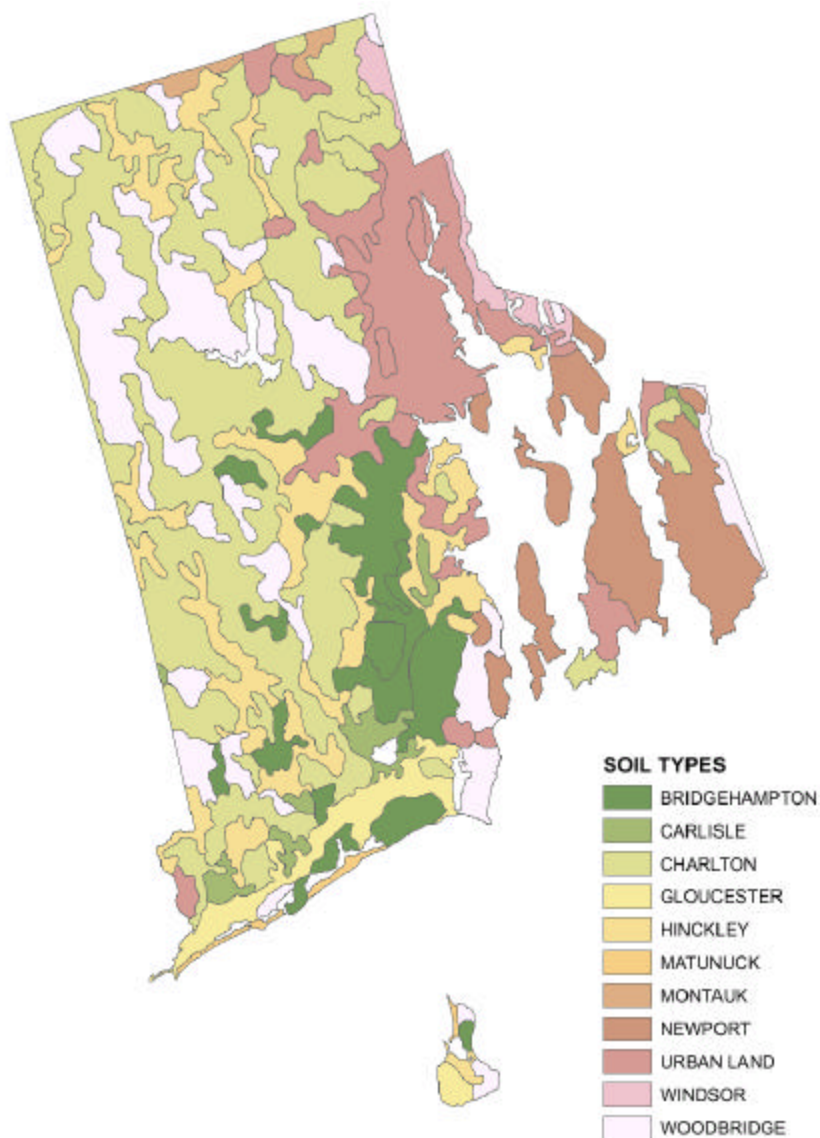
The entire state of Rhode Island was covered by glaciers in recent geologic time (as recently as 14,000 years ago). The glaciers and their subsequent melting helped to create Long Island, Long Island Sound and Narragansett Bay. East Passage and West Passage, for example, are channels modified by the glaciers. 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 can be seen in several of Rhode Island's forests and old stone walls (e.g. Lincoln Woods State Park). 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>.

The glacial history of Rhode Island is the predominant factor responsible for the state's present landscape and landforms (Gibbs et al. 1995). Besides carving coastal features and leaving behind huge boulders, the glaciers also built new landforms. The Charlestown Moraine, a ridge of sand and gravel, is found inland from the coast from Westerly to Narragansett and corresponds to similar landforms on Long Island (Gibbs et al. 1995, Quinn 1997). Wordens Pond and Great Swamp were created by alterations to surface drainage patterns resulting from the Charlestown Moraine, as is the irregular course of the Pawcatuck River (Quinn 1997). Drumlins, eskers and kettle holes are other landscape features created by the glaciers. Drumlins are streamlined hills of bedrock and/or glacial sediments that are oriented in the direction the glacier moved across the landscape. Eskers are sinuous ridges of glacial sand and gravel that formed underneath a melting glacier; North Burial Ground and Roger Williams Park in Providence both contain hills that are eskers. Kettle holes are depressions created when chunks of glacial ice were left behind, then melted to form lakes, ponds and wetlands (Quinn 1997, Gibbs et al. 1995). One such kettle hole is Scott Pond.

Since the glaciers left Rhode Island, the climate has warmed and sea level has risen several hundred feet and continues to rise at a millimeter or two a year. Long Island and Block Island Sounds were originally freshwater lakes, but with rising sea level have become sounds flooded by marine waters. Narragansett Bay was originally a series of inland river valleys but has become drowned with saltwater as well, forming an extensive network of estuaries that continue to expand with rising sea level (Gibbs et al. 1995, Quinn 1997). Shaped by its glacial and climatic history, Rhode Island's land and waterscapes create the ecological context for its fish and wildlife resources.

Soils

Figure 2.3 Soils Map of Rhode Island (Source: NRCS)



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 (Figure 2.3). The sandy loam soils are derived from glacial till and/or glaciofluvial parent material and are distributed on hills, drumlins, terraces, and outwash plains. These soils are moderately well-drained to well-drained and contain varying percentages 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, followed by complexes of soil in which two soil types are intermixed or found in close proximity. The sandy and silt loams form the basis for many of the state's Prime or Important Farmlands. Mucks, which are very poorly drained soils commonly 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; these include beach soils, dune (udipsamment) soils, peats (found in tidal marshes), and rock outcrops. Mucky sandy and/or silt loams are characteristic of Rhode Island's floodplain soils, are poorly to very poorly drained, and are 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>.

Climate

Rhode Island's climate is largely controlled by its proximity and exposure to the Atlantic Ocean, with coastal areas tending to have slightly moderated temperatures due to their proximity to it (Gibbs et al. 1995). Average precipitation in Rhode Island is approximately 43 inches annually, and the mean annual temperature is 49° F (NOAA 2004). January is the coldest month of the year (mean temperature of 29° F) and July the warmest month (mean temperature of 70° F). This annual variation creates distinct seasons that affect or influence migratory use of the state's land and waterscapes by a variety of fish and wildlife.

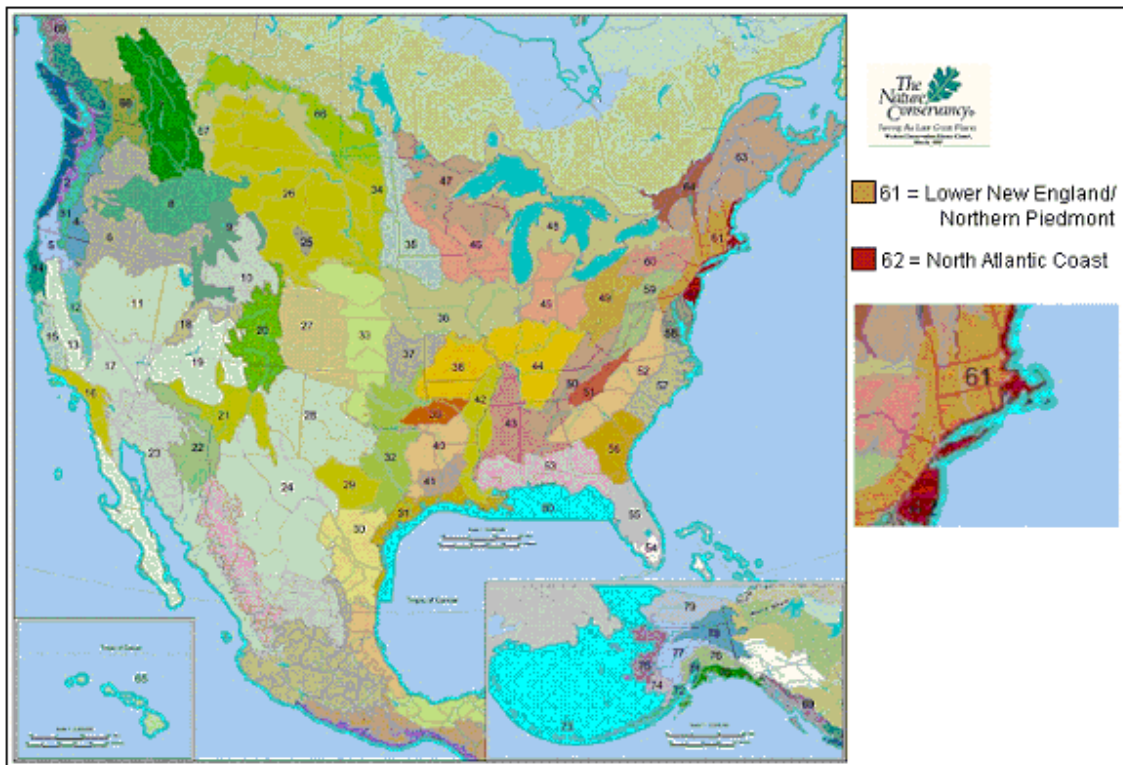
Precipitation is more uniform than temperature through the four seasons, with summer (June through August) slightly drier than the other three seasons (NOAA 2004). Overall, the state's weather is known for its frequent and dramatic changes, with temperatures capable of shifting 50 degrees in one week (Gibbs et al. 1995). Blizzards and hurricanes occasionally affect the state, as do tornadoes, ice storms, and flash floods.

Rhode Island has been growing warmer and wetter since 1895, with the 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 2004). Since greenhouse gases are one of the leading contributors to climate change, Rhode Island has studied the likely causes and effects of greenhouse gas emissions and climate change and subsequently prepared a Greenhouse Gas Action Plan for the state (Bailie et al. 2002, RI DEM 2002a, Lazarus and Smith 2004). The Greenhouse Gas Action Plan partially fulfills a regional commitment on the part of the state to reduce greenhouse gas emissions to 1990 levels by 2010 (RI DEM 2002a). Potential conservation actions to reduce greenhouse gas emissions, and thus minimize adverse impacts to the state's environment and economy, are identified in RI DEM (2002a); implementation strategies for the highest priority actions are under development. Continued and/or increased levels of support for the state's Urban/Suburban Forestry Program and Open Space Protection Program are two of the high priorities for addressing climate change in Rhode Island. Restoration of marginal agricultural lands to forest and wetland habitats has been identified as a lower priority conservation action (RI DEM 2002a).

Ecological Regions and Vegetation Classifications of Rhode Island's Landscape

Several Ecological classification systems have been applied to the Rhode Island landscape. These regional classifications place Rhode Island and its wildlife resources within a national setting. An ecosystem approach to conservation planning and implementation allows Rhode Island to participate in and benefit from regional and national conservation efforts with a variety of partner agencies and organizations.

Figure 2.4 TNC Ecoregions Map (Source: TNC)

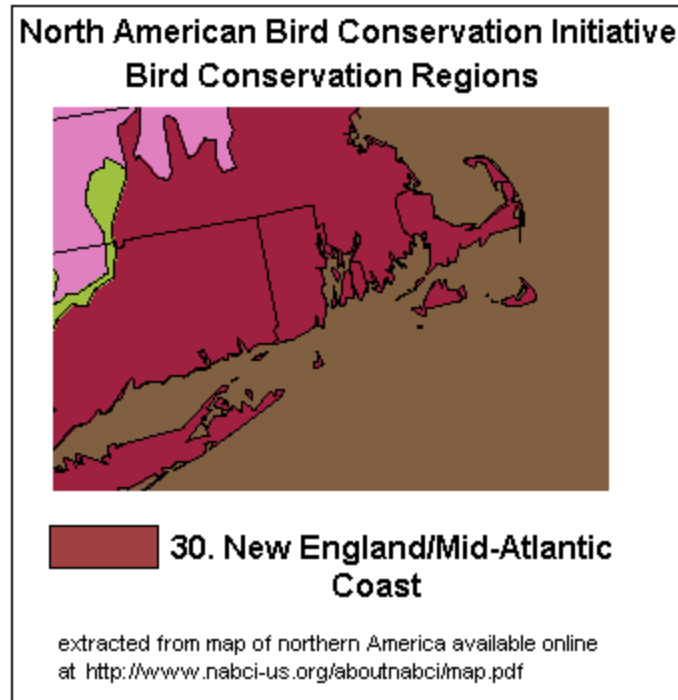


Rhode Island falls within one Ecoregional Province of the U.S. Forest Service classification system (McNab and Avers 1994, Bailey 1995, Rudis 1999). The entire state is within the Lower New England Section of the Eastern Broadleaf Forest (Oceanic) Province. The Lower New England Section is characterized by glacially-influenced landforms descending to coastal lowlands, forests dominated by northern hardwood, Appalachian oak, and northeastern oak-pine associations, and a faunal ecosystem that has been disturbed by human settlement. The latter has resulted in an ecological shift to a system that lacks large predators, suffers from an imbalance between plant resources and herbivores, and lacks large areas of early successional habitat (Rudis 1999).

The Nature Conservancy (TNC) also has undertaken an initiative to classify North America into ecoregions, adapting Bailey (1995) to incorporate concepts of conservation biology and ecology in order to develop meaningful biodiversity conservation plans for each ecoregion

(Groves et al. 2002). The northwestern portion of Rhode Island falls within TNC's Lower New England – Northern Piedmont Ecoregion (Figure 2.4), while the coastal areas are within the North Atlantic Coast Ecoregion. Characteristic species of flora and fauna and best examples of characteristic natural communities have been utilized to develop conservation priorities for each ecoregion. Conservation plans for both ecoregions have been drafted by TNC and describe the vegetative communities and biological resources of each (Sneddon et al. 1998, Beers and Davison 1999, Barbour et al. 2003).

Figure 2.5 North American Bird Conservation Initiative Bird Conservation Regions (BCR) (Source: NABCI)

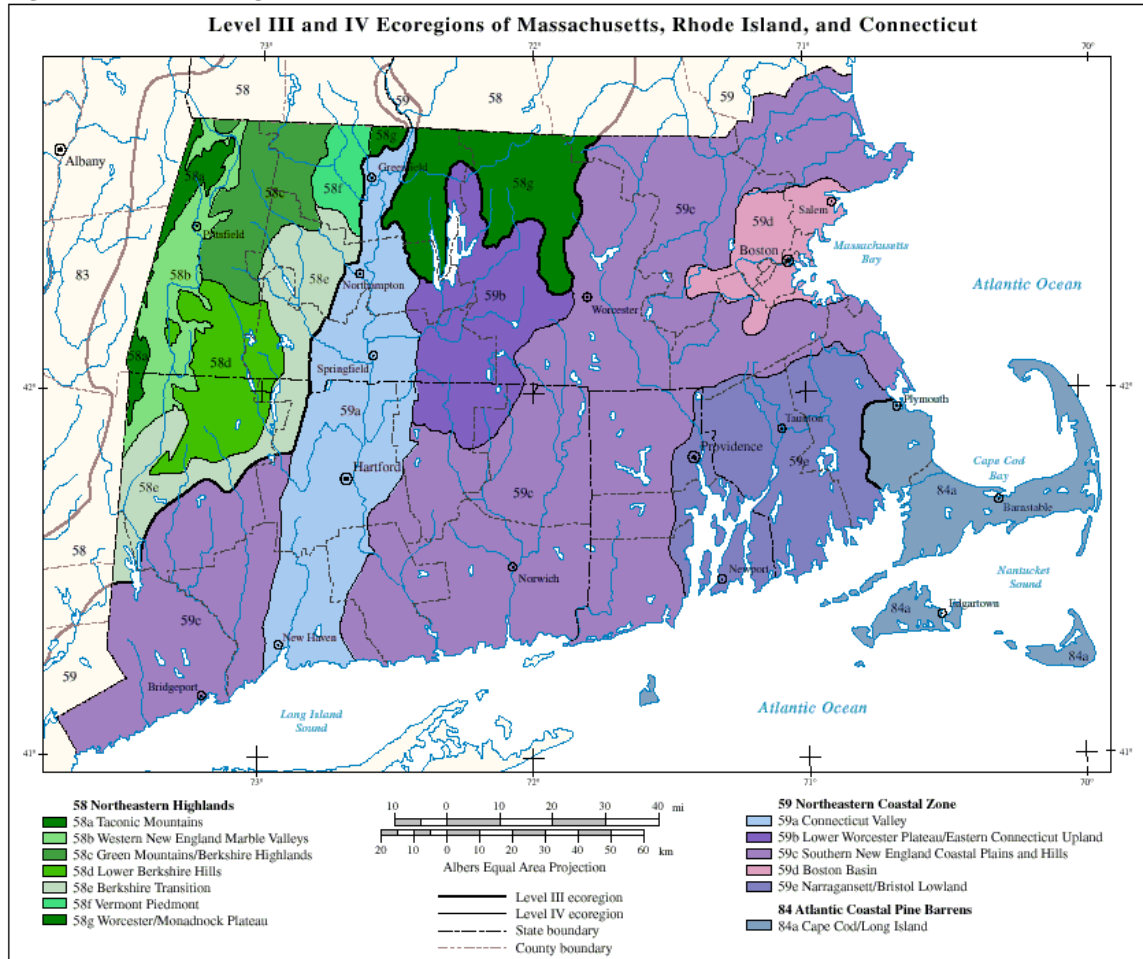


The North American Bird Conservation Initiative, in conjunction with Partners in Flight (PIF), has developed Bird Conservation Regions (BCR) based on the TNC Ecoregion System. Rhode Island falls within one BCR – the New England/ Mid-Atlantic Coast (BCR #30) (Figure 2.5). Rhode Island is within PIF's Southern New England Physiographic Area, or planning unit. There are three PIF Ecological Units that cover portions of Rhode Island – Narragansett/Bristol Lowland and Islands, Southern New England Coastal Lowland, and Southeast New England Coastal Hills and Plains (Dettmers and Rosenberg 2000). Avian target species have been identified by PIF for each Ecological Unit, and those species have been incorporated into Rhode Island's selection process for species in Greatest Conservation Need.

The Environmental Protection Agency (EPA) recently collaborated with the Massachusetts Department of Environmental Protection to draft ecoregion classifications for Massachusetts, Rhode Island and Connecticut (Figure 2.6). The EPA system utilizes a hierarchical system (denoted by Roman numerals), 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 Ecoregions (Block Island).

Figure 2.6 EPA Ecoregions for Massachusetts, Rhode Island, and Connecticut (Source: EPA)



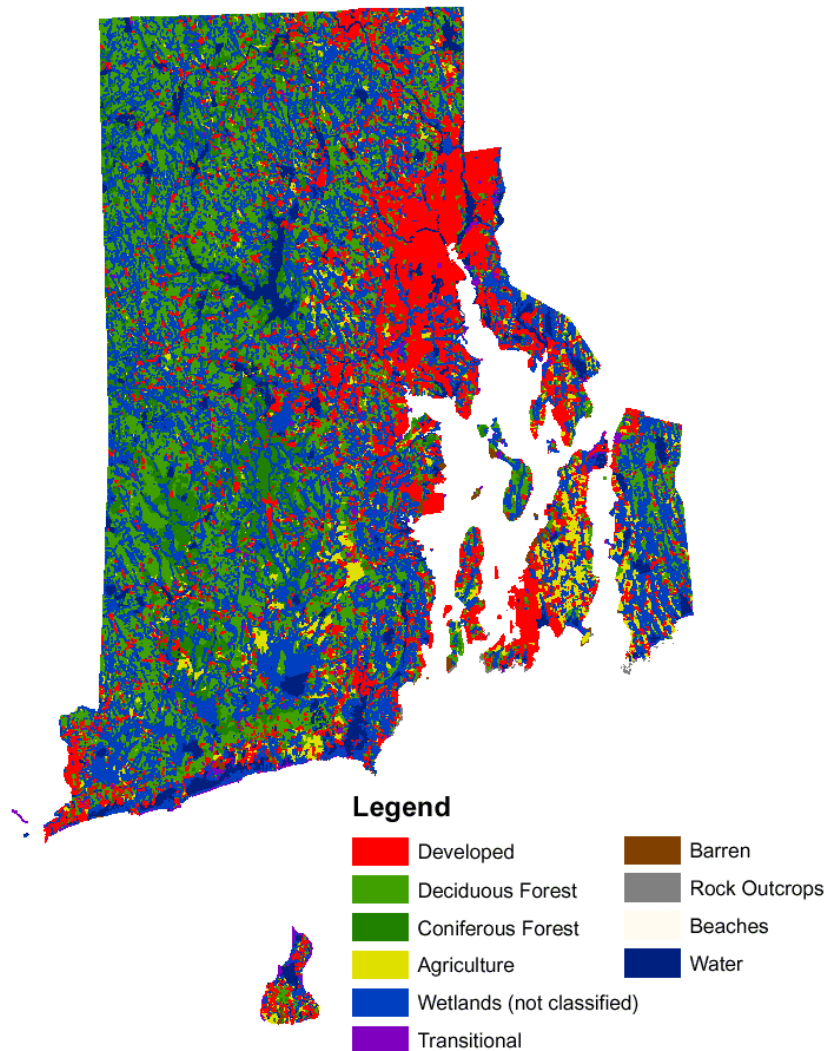
Finally, the World Wildlife Fund has divided North America into a series of terrestrial and freshwater ecoregions (Ricketts et al. 1999, Abell et al. 2000, respectively).

Abell et al. (2000) delineate Rhode Island as within the North Atlantic Ecoregion and the Temperate Coastal Rivers and Lakes Major Habitat Type. Based upon a Biological Distinctiveness Index (BDI) that utilized 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 described in Chapter 3.

Vegetation Classifications

A variety of vegetation community classification systems are applicable to Rhode Island's landscape. The use of these systems facilitates compilation of regional and national descriptions and inventory data (and geo-spatial data where available) for vegetative resources. For many wildlife species, especially amphibians, reptiles and invertebrates, the lack of distribution and abundance data requires the use of key habitats and associated vegetative communities as the best available scale for appropriate conservation planning and implementation.

Figure 2.7 Land Use/Land Cover Map of Rhode Island (Source: RIGIS)



The National Vegetation Classification Standard (NVCS) was accepted in 1997 as the standard vegetation classification system for federal agencies (FGDC 1997, <http://www.fgdc.gov/standards/documents/standards/vegetation/>). The NVCS system uses a hierarchy of 9 levels, first using 7 levels of physiognomic factors (such as climatic, environmental and structural characteristics) at the coarse scale and then two levels of

floristic factors (such as dominant and indicator species) to describe communities at the fine scale (FGDC 1997, Comer et al. 2003). The NVCS was maintained by The Nature Conservancy up until 1994 when NatureServe was created to take over TNC's role of coordinating and maintaining the NVCS and other databases for Natural Heritage programs across the U.S. NatureServe is a consortium of state natural resource agencies and other organizations involved in conservation of native flora, fauna and natural habitats, and supports a database system and distribution mechanism for natural heritage data in the U.S. (Comer et al. 2003, <http://www.natureserve.org>).

The Southern New England Gap Analysis Program (GAP) has recently mapped the vegetative communities of Massachusetts, Connecticut, and Rhode Island using the NVCS system to define terrestrial habitats (Zuckerberg et al. 2004). The Rhode Island Geographic Information System (RIGIS), a partnership managed by the University of Rhode Island's Environmental Data Center (URI EDC), has mapped the land use and land cover patterns in each of the state's watersheds, creating an interactive online Critical Resources Atlas that identifies a variety of natural resource features and threats (<http://www.edc.uri.edu/riatlas/>). The Critical Resources Atlas utilizes 14 types of land use, three types of forest cover (evergreen, deciduous and mixed), and two types of wetland (coastal and freshwater).

Locally, the RI DEM DFW and The Nature Conservancy have developed a Natural Communities of Rhode Island classification system (Enser and Lundgren 2005). This state-specific classification system utilizes six systems: marine, estuarine, riverine, lacustrine, palustrine, and terrestrial. Each of these six systems is further divided into subsystems (e.g. subtidal and intertidal for the marine system). The individual community types may be named after the dominant vegetation species, physiographic location or physiognomy of the vegetation. Based on this classification system, the CWCS process resulted in 64 community types for Rhode Island, which were used as a foundation to describe Rhode Island's key wildlife habitats.

Forested Land

Forest fragmentation (Figure 3.1) and succession resulting from land use change renders the habitat functionally unusable or unsuitable to the many species of wildlife that require large blocks of contiguous forest or early successional habitats. Sufficient local, regional and national research shows a continuing decline of large, contiguous, unfragmented forest (Vogelmann 1995, Wickham et al. 1999, Butler and Wharton 2002). More than 26,700 individuals and enterprises privately own 76% of Rhode Island's forestland. State, federal, and other public owners hold the remaining quarter of forested areas. Private and public water utilities own some of the largest forested tracts, while the number of owners with fewer than 50 acres of timberland has more than doubled since 1973. The majority (20,900) of the private forest landowners own fewer than 10 acres (Widmann 2002). The average privately-owned forest parcel declined from 26 acres in 1973 to 13 acres in 1993 (Butler and Wharton 2002). These small tracts are primarily new home sites and lead to forest fragmentation (Butler and Wharton 2002, Widmann 2002). The proportion of urban forest has increased from 1% to 5% from 1985 to 1998, encouraging RI DEM to formulate an Urban and

Community Forest Plan to manage this increasing trend (RI DEM 1999a, Butler and Wharton 2002). Dynamic change in Rhode Island's forest resource accentuates the importance of environmentally sound private forestland management as well as adequate public regulation and policy related to wildlife use of these habitats.

Trends in Rhode Island's forest distribution have been monitored by the U.S. Forest Service and RI DEM (Figure 2.8, 3.1, 3.2; Table 2.1). This monitoring indicates that Rhode Island's forests are maturing, with an increasing number of older trees and a decreasing number in seedling/sapling and young stands. From 1953 to 1998, the proportion of the state's forests that were sapling/seedling or nonstocked stands declined from 42% to 6%, significantly diminishing the amount of early successional habitat available for fish and wildlife resources. Meanwhile, tree size has increased, with the average volume of trees per acre tripling since 1953. Oak species dominate Rhode Island's forests, but the proportion of white pine is increasing while some oak species are declining. The increase in tree size and volume is greater than the annual loss to timber harvest and land use conversion, leading to an overall annual increase in the volume of timberland in Rhode Island even though the spatial extent of forest is declining (Widmann 2002). Land use conversion remains the largest threat to the state's forests, responsible for 83% of the annual forest removal, or roughly 6 acres per day (Widmann 2002, Butler and Wharton 2002).

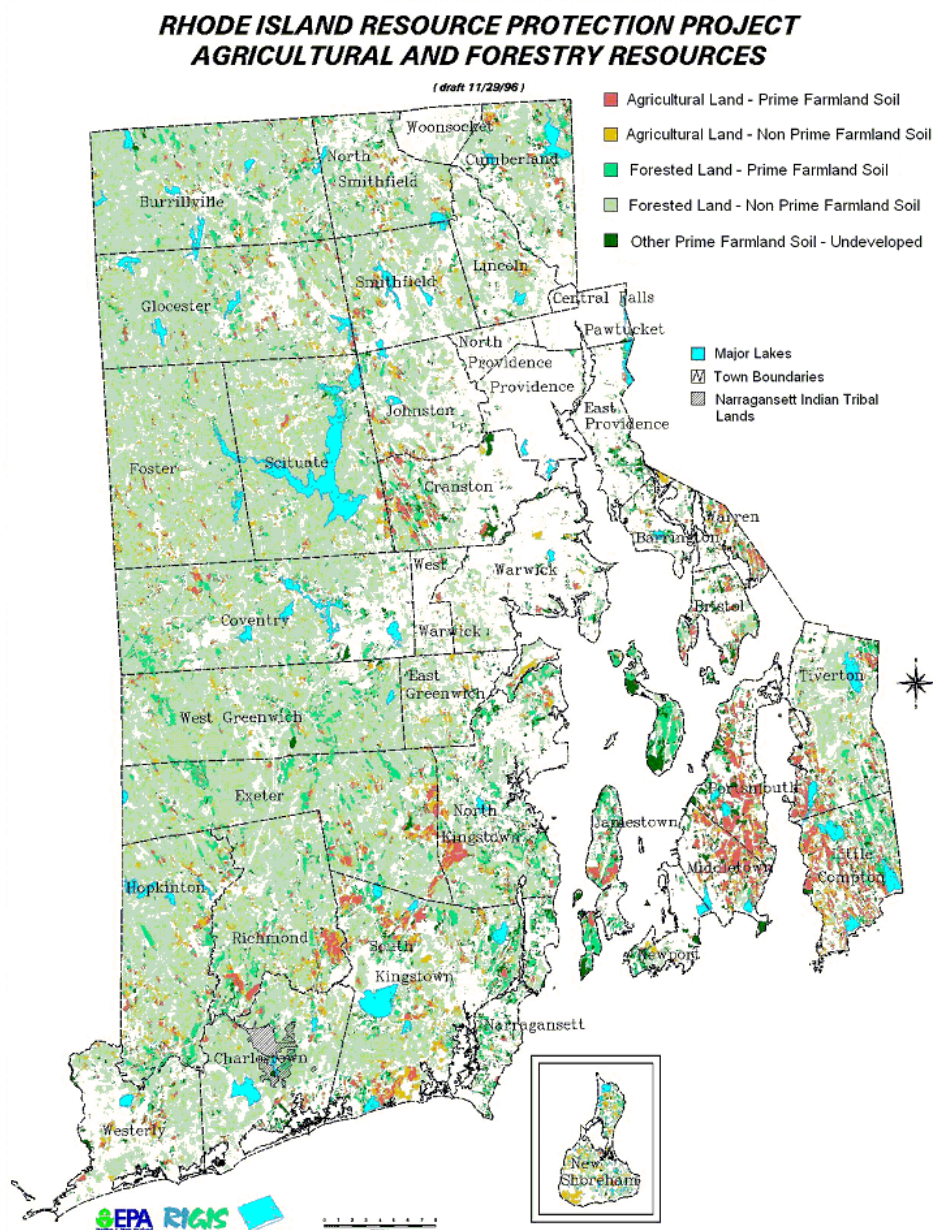
Table 2.1 Approximate Forest Area in Rhode Island from 1630 to 1998 (Butler and Wharton 2002, Widmann 2002)

Year	Area (acres)
1630	599,500
1767	200,000
1887	159,900
1907	246,500
1938	353,000
1953	433,000
1963	433,000
1972-73	399,700
1985	411,800
1993	
1998	393,000

The European colonists that settled in Rhode Island drastically cleared the state's original woodlands, aggressively clearing more than two-thirds of the deciduous, hardwood forests for agriculture (Gibbs et al. 1995). By the mid-18th century, however, the Industrial Revolution had replaced agriculture as Rhode Island's dominant industry 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 current mature forests are second-growth (Gibbs et al. 1995). Today's forests are concentrated in the western part of the state, where RI DEM has several large preservation tracts and development pressures have been lower than in the highly urbanized coastal areas.

Nevertheless, forestland is increasingly fragmented as more and more of it is converted a second time, this time to individual home sites.

Figure 2.8 Agriculture and Forestry Resources (Source: RI RPP 2004)



Non-Forested Land

Non-forested land in Rhode Island includes agricultural land, early successional habitats, and sparsely vegetated habitats. Agriculture in Rhode Island has changed a lot in the last 25 years. As family farms of potato fields have transformed to family farm enterprises utilizing modern technology, the emergence of multi-crop farming has become the rule rather than the exception. The number of dairy farms has drastically declined from over 100 farms in 1977

to just under 30 farms in 2001, and overall agricultural land use has declined as well (Table 3.2). There are over 700 farms in Rhode Island, of which at least 400 are family run (RI DEM 2003t). Over 33,000 acres of land are used for agriculture in Rhode Island (Table 2.2, Figure 2.8).

Agricultural operations gross over 100 million dollars per year. This translates into a return of over 32 million dollars directly back into Rhode Island's economy. Farms differ greatly in size, type and value of commodities produced, technology used and resource endowment. One aspect of positive change in the agricultural industry in Rhode Island is the use of direct marketing: the direct sale of agricultural products from the farm to the consumer. This form of marketing has led to increases in the number of roadside farm stands, Pick-Your-Own operations and farmers' markets operating in the state. Twenty years ago there were only two farmers' markets operating in Rhode Island, now there are 15 and that number is likely to rise.

Table 2.2 Family Farms and Acreage by City or Town (Source: RI DEM 2003t)

City or Town	# of farms	# of farm acres
Barrington	3	234
Block Island	2	-
Bristol	8	308
Burrillville	23	1,275
Charlestown	18	267
Coventry	15	958
Cranston	17	724
Cumberland	10	181
East Greenwich	6	455
East Providence	1	52
Exeter	21	2,072
Foster	29	1,781
Glocester	4	115
Hopkinton	19	3,462
Jamestown	6	513
Johnston	20	713
Kingston	4	175
Lincoln	6	269
Little Compton	19	1,030
Middletown	12	1,085
Narragansett	2	-
Newport	1	-
North Kingstown	24	1,784
North Scituate	22	1,047
North Smithfield	6	641
Pawtucket	1	-
Portsmouth	25	1,292
Providence	2	70
Richmond	10	1,084

Scituate	13	778
Smithfield	13	502
Tiverton	21	1,599
Wakefield	12	1,471
Warren	7	607
Warwick	5	219
West Greenwich	13	3,086
West Kingston	23	2,081
West Warwick	1	-
Westerly	8	895
TOTAL	452	33,072.84

Wetlands

Approximately 18.4% of Rhode Island's landscape (127,721 acres) consists of freshwater and coastal wetlands, excluding the waters of Narragansett Bay and the Pawcatuck River estuary (RI DEM 2004p). The majority (~112,000 acres) of these wetlands are freshwater; the state's estuarine and marine waters are discussed below. The most abundant wetland found in Rhode Island is palustrine forested wetland (~78%) (Table 2.3). Red maple (*Acer rubrum*) or Atlantic white cedar (*Chamaecyparis thyoides*) dominate the forest cover in these wooded swamps, with Atlantic white cedar (*Chamaecyparis thyoides*) second in dominance (RI DEM 2004p). The estimated current acreage of various wetland types is listed in Table 2.3, exclusive of wetlands in the Narragansett and Pawcatuck estuaries.

Statewide data on historic freshwater or coastal wetland loss are not complete and are subsequently a research need. Although Rhode Island has not monitored historic wetland loss, the U.S. Fish and Wildlife Service (USFWS) tracks national wetland loss trends (e.g. Dahl 1990, 2000). According to the USFWS analysis, Rhode Island has lost approximately 37% of its wetlands (Dahl 1990, RI DEM 2004p). In the Providence metropolitan area, urbanization is the dominant cause of major historic wetland loss, while transportation projects and residential development are the leading contributors to wetland loss in rural areas of the state. Loss of wetlands to agriculture is relatively minor when compared to national trends (RI DEM 2004p).

The vast majority of freshwater wetlands within the state is privately owned. Sixteen percent are protected by federal, state, or municipal governments or by non-governmental conservation organizations such as land trusts, The Nature Conservancy, and the Audubon Society of Rhode Island. The Federal government owns approximately 240 acres of the state's freshwater wetlands (less than 1%). These wetlands are concentrated in coastal watersheds (i.e., the Coastal basin, Narragansett Bay Basin, and Point Judith sub-basin of the Saugatucket River basin) (Figure 2.9). The state owns 60% of all protected wetlands (approximately 10,900 acres); 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.

Table 2.3 Estimated Present Abundance of Various Wetland Types in Rhode Island.

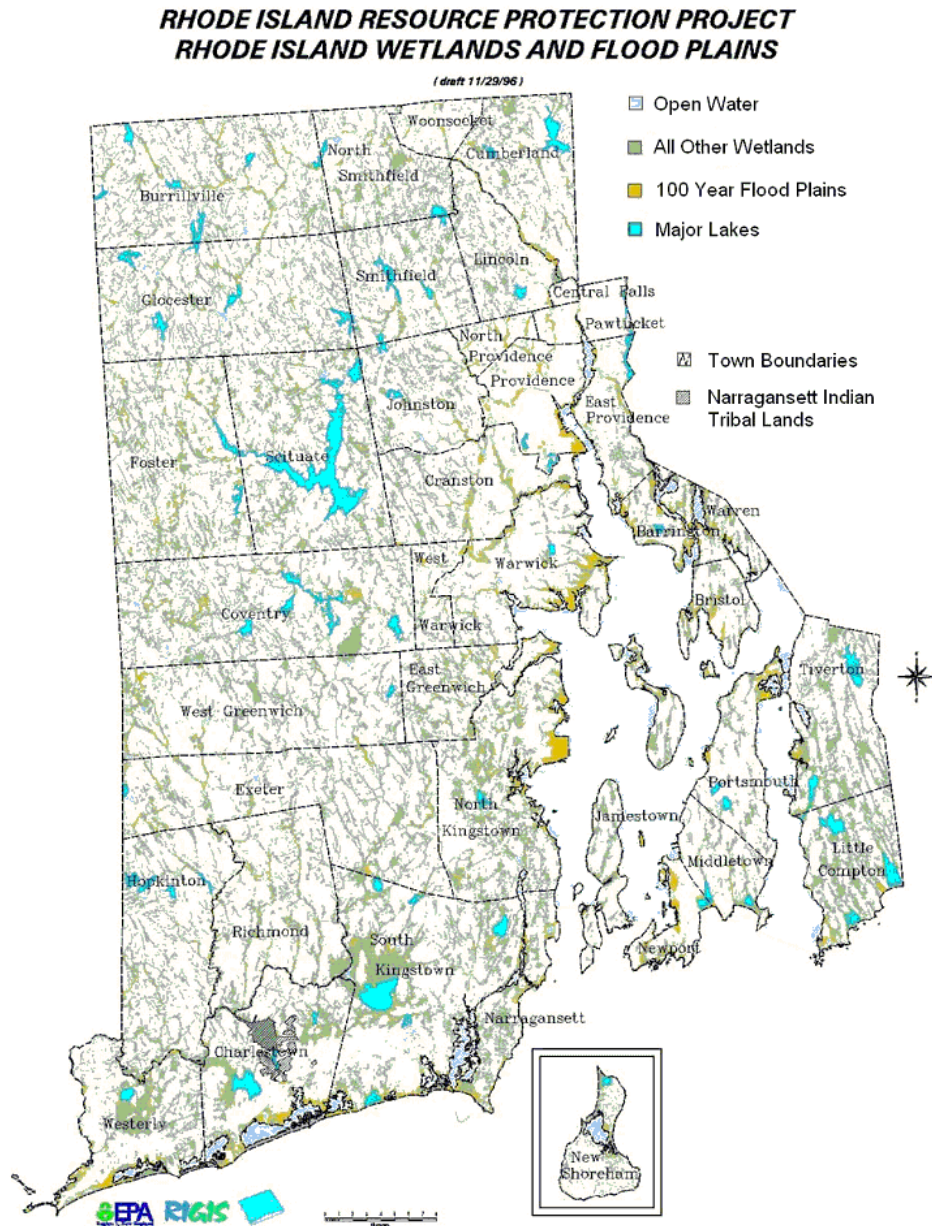
WETLAND TYPE	Area (acres)
Riverine Nontidal Open Water	1,832
Lacustrine Open Water	17,518
Palustrine Open Water	4,481
Palustrine Emergent Wetland: Marsh/Wet Meadow	4,341
Palustrine Emergent Wetland: Emergent Fen or Bog	229
Palustrine Scrub-Shrub Wetland: Shrub Swamp	9,606
Palustrine Scrub-Shrub Wetland: Shrub Fen or Bog	2,060
Palustrine Forested Wetland: Deciduous	60,694
Palustrine Forested Wetland: Coniferous	10,900
Palustrine Forested Wetland: Dead	225
Riverine Tidal Open Water	7.4
Estuarine Open Water	8,175
Estuarine Emergent Wetland	4,014
Estuarine Scrub-Shrub Wetland	93
Marine/Estuarine Rocky Shore	671
Marine/Estuarine Unconsolidated Shore	2,874
TOTAL AREA	127,721

Source: RIGIS. Data based on photo-interpretation of 1988 1:24,000 scale black and white aerial photographs, minimum map unit ¼ acre, as cited in RI DEM (2004p).

Wetland Types Deciduous forested wetlands, or forested swamps, are by far the most abundant freshwater water wetland types; they account for over 50% of the state's freshwater wetland area. Forested wetlands and shrub wetlands together account for over 70% (RI DEM 2005d). Lakes are also abundant and add nearly 16% of the total. At the other extreme, riverine wetlands and fens and bogs are rare; combined they account for less than 4% of the state's total freshwater wetland area. Marshes and ponds fall in the middle; they each account for approximately 4% of the total area. This pattern in the statewide data is generally maintained when the data are broken down by river basin. Swamps and lakes are often the most abundant wetlands; bogs, fens, and riverine wetlands remain the scarcest.

Since 1998, the RI DEM has monitored freshwater wetland loss through its wetland regulatory program; results to date indicate that (permitted) freshwater wetland loss is minimal. From 2001-2003 there was a combined (permitted) loss of 4.72 acres of wetlands, while the RI DEM Office of Planning and Development Land Acquisition Program acquired 47 new properties totaling 3,598 acres during 2002-2003 of which approximately 35% of that area is considered wetland (RI DEM 2004p).

Figure 2.9 Rhode Island's Wetlands and Floodplains (Source: RI RPP 2004)



Wetland protection efforts continue, with several of the state's conservation and grant programs giving priority to projects that involve wetland restoration, enhancement or preservation. Miller and Golet (2001), for example, recently performed an inventory of the state's freshwater wetlands by watershed as part of the development of a Statewide Freshwater Wetland Restoration Strategy, and RI DEM, in conjunction with New England Interstate Water Pollution Control Commission, has published the Rhode Island Wetland Monitoring and Assessment Plan (RI DEM 2005d). The long-term objectives of this plan are to develop baseline data to evaluate wetland condition and to assess the cumulative impacts to wetlands in Rhode Island. Utilizing identified core indicators of water quality such as taxa

richness to assess wetland quality, this 5-year plan is comprehensive and takes a landscape-level approach to assessment and management (RI DEM 2005d).

Rhode Island's Waterscape

Rhode Island is dominated by its waterscape. With 156 square miles of inland waters and 156 square miles of estuaries, these waters occupy almost a quarter of the state's total area (RI DEM 2004p, 2003s). Narragansett Bay reaches 28 miles into the state's interior from the Atlantic Ocean, forming the state's chief geographic feature (RI DEM 2003s). Several of the major watersheds found in the state are shared with neighboring states Connecticut and Massachusetts (Figure 2.10). The state's waters include freshwater, estuarine and marine waters, creating a remarkable diversity of aquatic habitats, although the maritime and industrial heritage of Rhode Island have both capitalized and degraded these resources to varying degrees over time. The RI DEM has created an online interactive Environmental Resource Map that shows the location and distribution of Rhode Island's waterscapes (rivers, streams, ponds, lakes, watersheds, etc.), as well as their water quality and impairment condition(s). It can be viewed online at <http://www.dem.ri.gov/maps/index.htm#GV>.

The EPA reviewed the condition of the nation's watersheds in the late 1990s, analyzing the health of each 8-digit Hydrologic Catalog Unit (HUC) watershed (EPA 2002). This National Watershed Characterization project found that the Blackstone, Narragansett, Quinebaug and Pawcatuck-Wood watersheds in Rhode Island all were affected by less serious water quality problems as of the mid- to late 1990s. The Narragansett watershed, however, was characterized as having a high vulnerability to aquatic degradation problems while the other three watersheds had comparably low vulnerabilities (Abell et al. 2000, EPA 2002). Chapter 3 discusses the particular threats identified by this study in more detail. More recent analyses on the location and condition of the state's waterscapes that have been conducted by RI DEM and its partners are discussed below.

The Nature Conservancy is conducting ecoregional classification and analysis of rivers and streams categorizing stream types, composition and condition based on multiple attributes including ecological land type, fish species, road crossings and density, developed land, natural cover, number of dams, and other characteristics. The assessment for the rivers and streams in the Lower New England / Northern Piedmont ecoregion has recently been conducted, selecting the highest quality examples of each stream or river type throughout the ecoregion. These "Portfolio Rivers" were selected based on being the most intact and hydrologically connected representatives of their stream or river type. The Pawcatuck River system, including the Queen's and Wood Rivers, was selected in Rhode Island as a "Portfolio River," but was also noted for its threats of heavy development and road impacts (Olivero and Anderson 2003).

Rivers and Streams

There are 1,498 miles of rivers and streams in Rhode Island, on which there are over 520 dams of various age, condition, and size (RI DEM 2002i, 2004p., Rivers Council 2004). The largest river system within the state is the Wood-Pawcatuck, which drains most of the southwestern portion of the state and includes portions of Connecticut. The Blackstone River system dominates the eastern portion of the state, entering Rhode Island from Massachusetts near Woonsocket. The Blackstone River has been designated a National Heritage Corridor by the U.S. Congress for its natural and cultural heritage.

The RI DEM maintains an extensive monitoring network on the state's rivers and streams to assess their condition and ability to support aquatic life, fish consumption, water supply and recreational uses (RI DEM 2004p). The most recent assessment included 570 miles of the state's rivers and streams, or 38% of the total 1,498 river miles; nearly three-quarters of these 570 river miles were monitored while the remaining quarter were considered evaluated. Overall, the majority (66%) of the river miles assessed was found to fully support all uses (Table 2.4). Over a third (34%), however, was found to be impaired for one or more of the uses mentioned above.

Table 2.4 Relative Condition of Rhode Island's Rivers and Streams to Support Aquatic Life

USE	Size Assessed	Size Fully Supporting	Size Fully Supporting but Threatened	Size Partially Supporting	Size Not Supporting
Aquatic life support	538.57 mi	406.5 mi (75%)	0	65.96 mi (13%)	66.11 mi (13%)

Source: RI DEM (2004p)

In regards to fish and wildlife resources, 539 of the 570 river miles were assessed for aquatic life use support (Table 2.4). Three-quarters of the rivers assessed were found to support aquatic life, 13% to partially support aquatic life, and 13% to not support aquatic life (RI DEM 2004p). Only 7.72 miles of river and stream were assessed for fish consumption, a portion of the Woonquatucket River from below Smithfield to its confluence with the Moshassuck River; the entire 7.72 miles are considered impaired for fish consumption and the state had issued an advisory to that effect in 2002, and found it still to be impaired for fish consumption two years later (RI DEM 2004p).

Where waters are considered impaired, the RI DEM also analyzes sources contributing to the impairment. Table 2.5 summarizes the identified sources (and their degree) of impairment for the quarter of rivers and streams found to be impaired in the 2004 assessment. Figure 2.11 displays the status of water quality impairment as well as the Habitat Restoration Site Plan Progress.

Figure 2.10 Restoration Sites and Watershed Basins in Rhode Island (Source: CRMC, NOAA, RIGIS 2001)

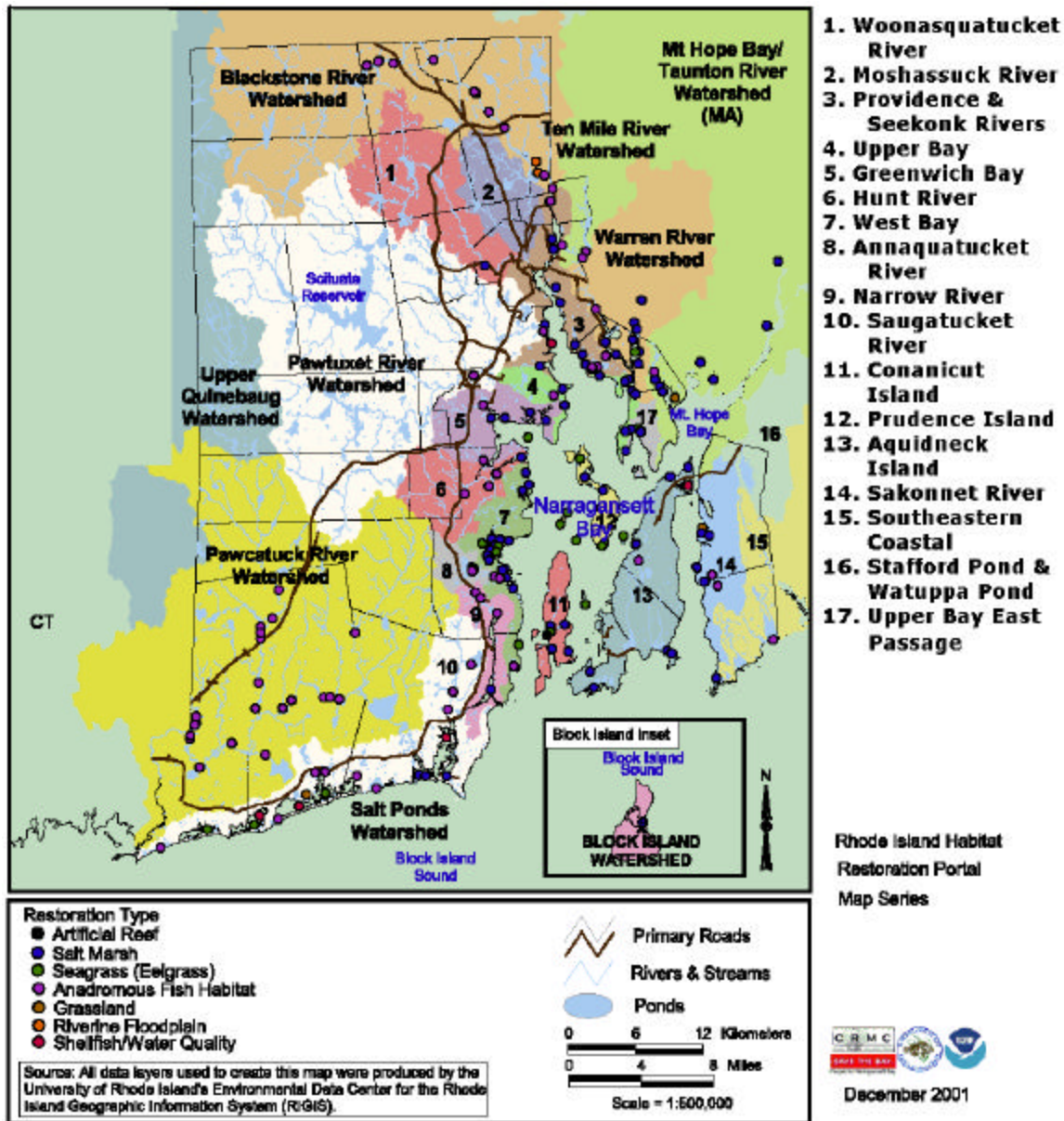


Table 2.5 indicates that non-point source pollution from urban runoff, septic systems and agriculture are the largest contributors to impairment of Rhode Island's rivers and streams. Point source pollution from municipalities and industry are also sources of major impairment. The Blackstone River has historically been one of the nation's most polluted rivers but several restoration projects are presently underway to improve the health of this important river (RI DA 2004a). The Wood-Pawcatuck River basin is the most pristine system in Rhode Island, and almost one-third of its natural habitat has been preserved by RI DEM and its partners. The condition of individual river systems and conservation actions to address their threats and needs are discussed in further detail in Chapter 4.

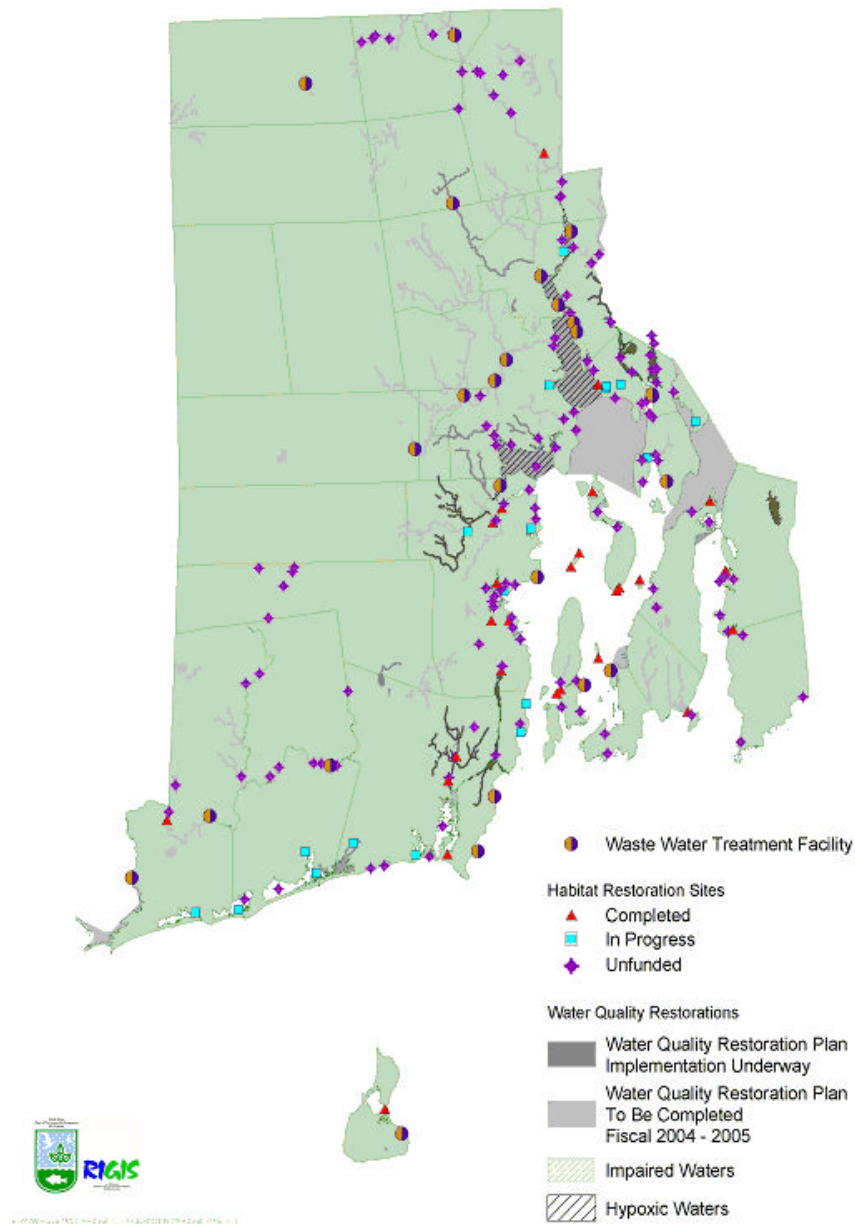
Any rivers or streams that are considered impaired have been placed on the state's 303(d) List of Impaired Waters, as required by federal regulation; these waters are undergoing prioritization and scheduling for Total Maximum Daily Load (TMDL) analysis and management (RI DEM 2004p, 2005c). TMDL plans have been finished for several rivers and streams, outlining sources of and management solutions for their impairment (e.g., RI DEM 2001c, 2001d, 2001e, 2002d, 2002e, 2002l).

Table 2.5 Sources of Impairment for Rhode Island's Rivers and Streams.

Source Category	Contribution to Impairment	
	Major (river miles)	Moderate (river miles)
Agriculture		21.01
Combined sewer overflow	8.92	1.64
Construction		4.00
Contaminated sediments	7.72	
Groundwater loadings	12.47	0.68
Hydromodification	16.40	7.13
Industrial point sources	20.22	8.05
Intensive animal feeding operations		6.37
Land disposal/septic systems	27.96	28.60
Municipal point sources	22.69	18.13
Natural sources	3.72	36.12
Recreational and tourism activities (non boating)		2.49
Resource extraction		3.55
Sediment resuspension	14.97	1.64
Source unknown	10.61	44.97
Urban runoff/storm sewers	30.15	122.08

Source: RI DEM (2004p)

The Rhode Island Rivers Council oversees the management of the state's rivers and streams, and several of the watersheds have individual Watershed Councils approved by the Rivers Council. Each of the individual Watershed Councils and the RI DEM have prepared a Watershed Action Plan that coordinates research, monitoring and restoration of rivers, streams and riparian corridors throughout each watershed (e.g. RI DEM 2001f, 2001g; WPA 2003b; Woonasquatucket River Watershed Council 2003).

Figure 2.11 Condition of Rhode Island's Waters and Habitat Restoration sites (Source: RI RPP 2004)

Lakes and Ponds

There are 20,917 acres of lakes and ponds throughout Rhode Island, most of which are small in size (RI DEM 2004p, Rivers Council 2004). The largest lake is an artificial impoundment – the 13,000 acre Scituate Reservoir on the North Branch of the Pawtuxet River. The Scituate Reservoir supplies water to nearly half of the state's population (RI DEM 2003n). The state's largest natural freshwater lake is Worden Pond in the south-central part of the

state; Great Swamp is contiguous to Worden Pond, and the entire complex has been preserved by the RI DEM and its partners.

The RI DEM assesses the water quality and aquatic health of the state's lakes and ponds as well as its rivers and streams (RI DEM 2004p). The most recent bioassessment analyzed the health of 80% of the state's lakes and ponds; 68% of these were monitored while the remaining 32% were considered evaluated. Of the 16,581 acres of lakes and ponds assessed in this survey, 78% (by area) were found to fully support all uses, 22% were designated as impaired for one or more use, and less than 1% (< 5 acres) were found to be fully supporting but threatened. Over 93% of the lakes surveyed included data on their ability to support aquatic life, and 20% of these lake acres were found to not support aquatic life (Table 2.6). In addition, the Rhode Island Department of Health (RI DOH) has designated four ponds, totaling 503 acres, as impaired for fish consumption and issued an advisory against eating fish from them (RI DEM 2004p).

Table 2.6 Relative Condition of Rhode Island's Lakes and Ponds to Support Aquatic Life

USE	Size Assessed	Size Fully Supporting	Size Fully Supporting but Threatened	Size Partially Supporting	Size Not Supporting
Aquatic life support	15,662.98 ac	12,513.82 ac (80%)	0	2,411.95 ac (16%)	737.21 ac (4%)

Source: RI DEM (2004p)

Most of the state's 45 lakes that are considered impaired suffer from elevated nutrient levels (27 lakes), excess algal growth (17 lakes) and low dissolved oxygen (17 lakes). Metals, elevated pathogen levels and biodiversity impacts also contribute to lake or pond impairment (RI DEM 2004p). Urban runoff and storm sewers contribute to the highest number of acres of impaired lake and pond waters (Table 2.7). Any lakes or ponds that are considered impaired have been placed on the state's 303(d) List of Impaired Waters, as required by federal regulation; all 45 of the impaired lakes and ponds are undergoing prioritization and scheduling for Total Maximum Daily Load (TMDL) analysis and management (RI DEM 2004p, 2005c). TMDL plans have been finished for several lakes and ponds, outlining sources and management solutions to their impairment (e.g. RI DEM 1998a, 2003r, 2004e).

Table 2.7 Sources of Impairment for Rhode Island's Lakes and Ponds

Source Category	Contribution to Impairment	
	Major (acres)	Moderate (acres)
Agriculture		715.5
Atmospheric deposition		33.2
Combined sewer overflow		38.0
Construction		143.4
Groundwater loadings		201.7
Habitat modification (other than hydromodification)		66.1

Hydromodification		609.5
Industrial point sources		130.3
Intensive animal feeding operations		480.1
Internal nutrient cycling (primarily lakes)		224.4
Land disposal		1,230.5
Municipal point sources		252.8
Natural sources		257.0
Recreational and tourism activities (non boating)		308.0
Source unknown	329.5	410.0
Urban runoff/storm sewers	29.4	2,176.2

Source: RI DEM (2004p)

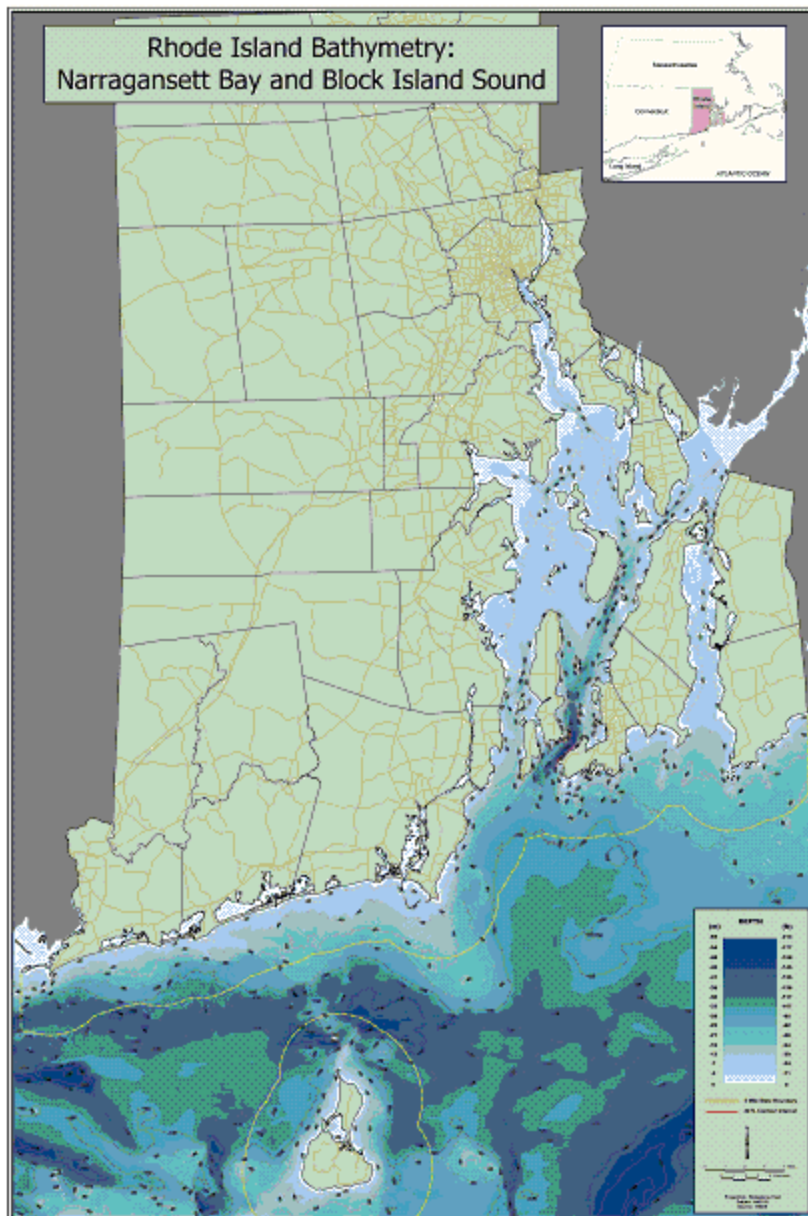
Estuarine and Marine Waters

As a coastal state, Rhode Island contains a significant area of estuaries (Figure 2.12). The National Oceanic and Atmospheric Administration (NOAA) has recognized the ecological value of Rhode Island's estuaries by establishing one of 26 National Estuarine Research Reserves (NERR) in Narragansett Bay. Of the 200+ square miles of Narragansett Bay, open water and salt marsh are the most abundant habitat types (Table 2.8). Altogether, Rhode Island has approximately 3,700 acres of salt marsh in its estuaries. Only 10% or so of these are considered fringe marshes that are less than 5 yards wide (RI DEM 2004p). The Rhode Island Coastal Resources Management Council (CRMC) manages the alteration of the state's coastal marshes, protecting the fish and wildlife resources found in this habitat.

In addition to the open waters and marshes of the state's estuaries, several islands dominate the Narragansett Bay waterscape. Aquidneck, Prudence and Conanicut are the largest of these islands. The Narragansett Bay NERR and the state's Bay Islands Park System have protected over 2,000 acres of these estuarine island habitats (RI DEM 2003n).

The RI DEM assessment of water quality and health in the state includes the state's estuaries. Of the 156+ square miles of estuarine waters assessed in 2004, almost all (99%) were considered monitored as opposed to evaluated (primarily through the RI DEM Shellfish Monitoring Program). The assessment found that approximately 30% of the estuarine waters monitored are impaired while the remaining ~69% fully support all designated uses (RI DEM 2004p). Table 2.9 summarizes the proportions of estuary that support aquatic life and shellfishing. Over a third (36%) of the 116.41 square miles of estuarine waters assessed for aquatic life support were found to be impaired.

In addition, the state has over 132 square miles, excluding Rhode Island and Block Island Sounds, of estuarine waters designated for shellfishing use. Data are available to monitor 99% of these shellfishing waters, and 79% were found to fully support shellfishing, 16% partially support it, and the remaining ~4.5% do not support shellfishing and have been permanently closed (RI DEM 2004p).

Figure 2.12 Estuaries and Marine Waters of Rhode Island – Bathymetry (Source: RIGIS)

Bacterial contamination, nutrient enrichment and low dissolved oxygen levels are the major threats to the state's estuarine waters. Combined sewer overflows are the major source of bacterial contamination. The Upper Bay and coves are impacted by combined sewer overflows, urban runoff and point source discharges, all of which contribute to nutrient enrichment and low DO levels (RI DEM 2004p). Table 2.10 lists the degree to which various sources contribute to the impairment of the state's estuarine waters.

Table 2.8 Abundance of Estuarine and Marine Habitats Inventoried in Narragansett Bay and South County, Rhode Island (does not include the south shore of Little Compton or Block Island)

Habitat Type	Area in Acres
Open Water	124,259.4
High Salt Marsh	2,708.7
Beaches	1,450.5
Rocky Shores	573.3
Tidal Flats	568.6
Low Salt Marsh	443.2
Brackish Marsh	427.6
High Scrub-Shrub Marsh	159.3
Eelgrass Beds	99.5
Pannes and Pools	46.3
Dunes	43.0
Artificial Jetties and Breakwaters	23.1
Oyster Reefs	9.0
Stream Beds	3.5
TOTAL	130,815.0

Source: (Huber (1999) as reported in RI DEM (2004p))

Narragansett Bay has extensive monitoring data available that RI DEM utilizes to assess the relative condition of its habitats. RI DEM (2004p) summarizes the problems and threats affecting each region of the bay. Several of RI DEM's partners also conduct monitoring and research programs in the bay to continually assess the status and condition of individual species (e.g., lobster, oysters, eelgrass) and habitats. These collaborative partnerships have fostered many restoration projects throughout the bay.

Table 2.9 Relative Condition of Rhode Island's Estuaries to Support Aquatic Life, Shellfishing and Fish Consumption

Use	Size Assessed	Size Fully Supporting	Size Fully Supporting but Threatened	Size Partially Supporting	Size Not Supporting
Aquatic life support	116.41 mi ²	74.52 mi ² (64%)	0	5.28 mi ² (5%)	36.61 mi ² (31%)
Shellfishing	131.37 mi ²	104.27 mi ² (79%)	0	20.48 mi ² (16%)	6.62 mi ² (4%)

Source: RI DEM (2004p)

Due to Rhode Island's extensive estuarine system, there are 420 miles of shoreline in the state (RI DEM 2003n). The state's saltwater shoreline, fronting the Atlantic Ocean, provides a diversity of habitats – from sandy barrier beaches backed by shallow lagoons and marshes to rocky headlands. The distribution of this shoreline and the state's small size allow virtually all residents of Rhode Island to live within 25 miles of the coastline (RI DEM

2003n). The RI DEM and the USFWS have protected a significant portion of the shoreline habitat through a State Beach System and several National Wildlife Refuges.

Table 2.10 Sources of Impairment for Rhode Island's Estuaries

Source Category	Contribution to Impairment	
	Major (square miles)	Moderate (square miles)
Agriculture		2.55
Combined sewer overflow	24.28	
Contaminated sediments	0.90	
Groundwater loadings		3.50
Industrial point sources	9.82	
Intensive animal feeding operations		0.73
Land disposal	1.22	5.60
Marinas and recreational boating	1.79	5.22
Municipal point sources	14.45	5.20
Natural sources	0.69	3.12
Source unknown	1.89	1.36
Urban runoff/storm sewers	31.44	13.89

Source: RI DEM (2004p)

The RI DEM has assessed the condition of ~79 miles of the marine shoreline, and none of these waters were found impaired for swimming or shellfishing (RI DEM 2004p). The relative condition of waters near Block Island, the state's dominant offshore marine feature and home to some of the state's most valuable ecosystems and habitats (Gibbs et al. 1995), frequently are monitored by the University of Rhode Island (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.

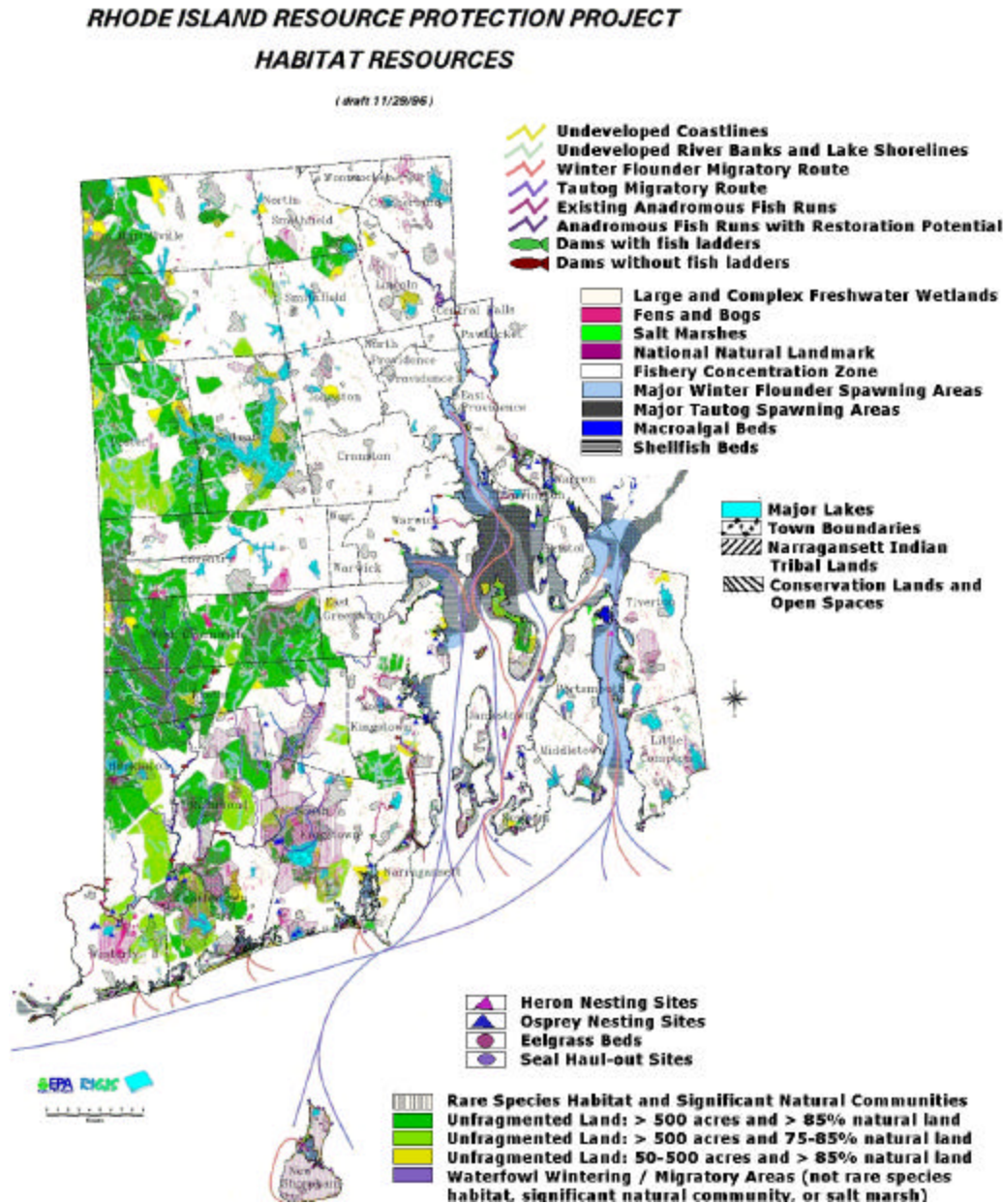
Identifying Key Habitats

As with the identification of GCN wildlife species discussed in Chapter 1, the identification of key habitats involved input and analysis/review by RI DEM DFW staff, scientific experts, and stakeholders. Information and updates of this process were also posted on the web for public review throughout the development of the list of key habitats.

This effort began with the review of partner program relevant efforts. RI DEM DFW previously assessed the location and relative condition of rare species in the state (RI DEM 2001k) (Figure 1.10); NHP and DFW rare species habitat information was evaluated in the key habitat identification process. Critical areas for rare species as well as Biodiversity Focus Areas (RI DEM 1996) have been identified by RI DEM NHP. Other previous efforts included RI's Environmental Sensitivity Index (ESI) project which identified key vulnerable coastal habitats. The RI Resource Protection Project, a joint effort between EPA and RI

DEM involving many natural resource partners, identified a spectrum of habitat resources recommended for protection (Figure 2.13).

Figure 2.13 Habitat Resources (Source: RI RPP 2004)



Neighboring states were contacted for coordination and to attempt regional consistency and standardization. The Technical Team assessed information from the standardized existing ecosystem and vegetative classification systems discussed previously in this chapter. Special emphasis was placed on those systems and habitat codes that were represented in RIGIS (primarily Cowardin et al. 1979 and Anderson et al. 1998) to facilitate geospatial analysis and monitoring efforts throughout the CWCS implementation period. The recent Rhode Island Vegetative Community Classification system developed by Enser and Lundgren (2005) along with the national systems described above became the foundation for the key

habitat identification. This assessment also included the rare natural communities of the Natural Heritage Program as well as those habitats that contained GCN species from the RI DEM DFW datasets.

An initial list of habitats important to GCN wildlife in Rhode Island was prepared by the CWCS Technical Team, as generated from the primary habitat associations assigned to each species. The resulting habitat/community list was sorted according to the number of GCN species contained within each primary habitat (see Table 2.12) to develop an inclusive list. Further analysis by both the Habitat/GIS and Scientific Teams helped to refine these habitats in terms of data available to map and evaluate relative condition and location information. Key habitats were crosswalked with the NVC and NatureServe systems (Appendix 2a) as suggested by the TWW committee for regional and national consistency. Significant cooperative efforts of RI DEM, URI and TNC staff produced descriptions of habitats, their location and relative condition.

This process resulted in a list of 64 key habitats (Level III) (Table 2.11) clustered into 6 broad habitat groupings (Level I) and additional subgroups (Level II) for mapping and conservation application. The last two columns in Table 2.11 conclude the relative threat (H, M, L = high, medium, low) and condition rank (E, G, F, P = excellent, good, fair, poor) of each habitat. A "U" in either threat or condition column signifies that there is insufficient information or knowledge to assign a status (U = Unknown). Chapter 4 provides detailed information on each of these key habitats, including their known location and condition, including more detailed information on threats and actions to address them. Chapter 4 maps those key habitats for which GIS location data are available. Some habitats could not be mapped accurately due to lack of data or GIS coverage and this is recognized as a general statewide research and monitoring need.

The CWCS Technical Team assembled GCN animal species lists associated with each of the key habitats so that the habitats can serve as a means to protect multiple GCN species simultaneously via an ecosystem-based approach to conservation. Table 2.12 summarizes the number of GCN species per taxa that each key habitat supports. During this CWCS process, GCN species were assigned to primary, secondary and tertiary habitats recognizing and reflecting multiple levels of use in more than one habitat type. For the purposes of this document, however, GCN species are presented only once in their primary habitat for conservation focus and reduction of redundancy. An example of this 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 GCN species associated with each key habitat, categorized by taxa, are presented for each of the 64 key habitats in Chapter 4.

Appendix 2a summarizes the status, including location and condition, where data are available, of each of the 64 key habitats identified by the CWCS Technical Team and its partners for Rhode Island. Where technical data were not available, the best professional judgment of the Technical and Habitat Team experts were used to rank the relative condition of each habitat. Insufficient information exists to accurately determine the conditions and

distributions of most key habitats. Research to obtain scientific data to confirm or improve these assessments is included in the priority research needs discussed in Chapters 3 and 4.

GCN species were assigned to primary, secondary and tertiary habitats in this process; however, they are only presented in their primary habitats (see Table 2.12) for conservation focus and document efficiency. See Chapter 4 for descriptions, location, and relative conditions for each of these habitats, as well as the GCN species they contain. Each habitat is presented with threats and actions to address both the key habitats as well as the GCN species they contain.

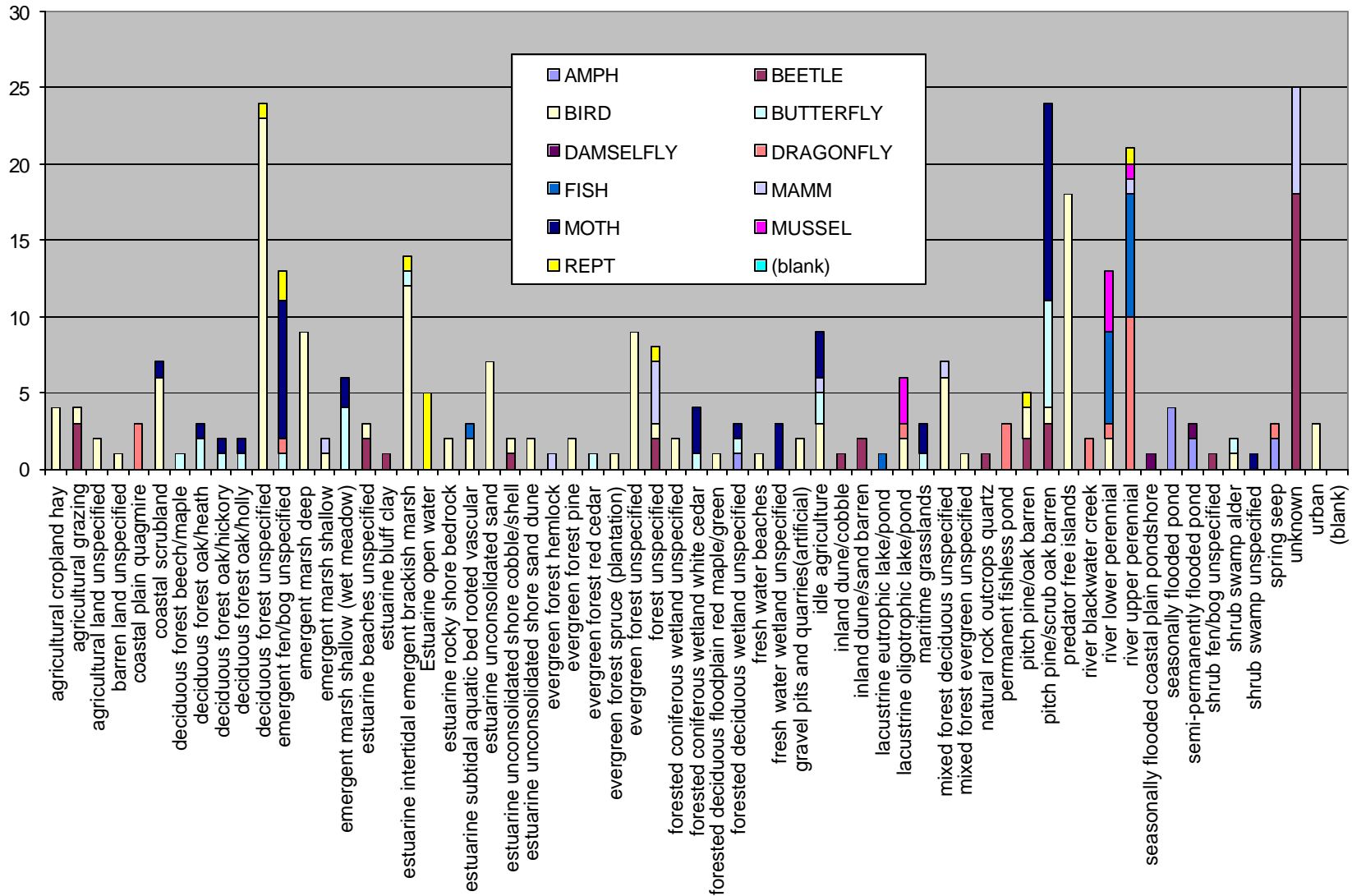
Table 2.11 Key Habitats for GCN Species in Rhode Island

Broad Habitat Grouping		Key Habitat	#	Threat*	Condition*
Forests	Deciduous Forest	Deciduous forest beech/maple	1	M	G
		Deciduous forest oak/heath	2	M	G
		Deciduous forest oak/hickory	3	M	G
		Deciduous forest oak/holly	4	M	G
		Deciduous forest unspecified	5	U	U
	Evergreen Forest	Evergreen forest hemlock	6	H	F
		Evergreen forest pine	7	M	G
		Evergreen forest red cedar	8	M	F
		Evergreen forest spruce (plantation)	9	L	F
		Evergreen forest unspecified	10	U	U
	Pitch Pine Communities	Pitch pine/oak	11	H	F
		Pitch pine/scrub oak barren	12	H	F
	Mixed Forest	Mixed forest deciduous unspecified	13	M	G
		Mixed forest evergreen unspecified	14	M	G
		Forest unspecified	15	U	U
Non-forested Terrestrial	Agriculture	Agricultural cropland hay	16	H	P
		Agricultural grazing	17	H	P
		Idle agriculture	18	M	F
		Agricultural land unspecified	19	U	U
	Early Successional	Maritime grassland	20	H	F
		Coastal shrubland	21	H	G
	Sparsely Vegetated	Barren land unspecified	22	U	U
		Beach grass dune	23	M	F

Broad Habitat Grouping		Key Habitat	#	Threat*	Condition*
		Freshwater beach	24	M	G
		Gravel pits and quarries	25	L	G
		Inland dune / cobble	26	H	P
		Inland dune / sand barren	27	H	P
		Natural quartz rock outcrops	28	M	F
Wetland	Emergent Wetland	Emergent fen/bog	29	M	F
		Coastal plain quagmire	30	M	G
		Emergent marsh deep	31	M	F
		Emergent marsh shallow / wet meadow	32	M	F
		Freshwater wetland unspecified	33	U	U
		Seasonally flooded coastal plain pondshores	34	M	G
	Shrub Wetland	Shrub bog unspecified	35	M	G
		Shrub swamp alder	36	M	G
		Shrub swamp water willow	37	M	F
	Forested Wetland	Forested coniferous wetland white cedar	38	M	G
		Forested coniferous wetland unspecified	39	U	U
		Forested deciduous red maple swamp	40	M	F
		Forested deciduous wetland unspecified	41	M	F
Freshwater	Springs	Springs	42	H	F
	Rivers and Streams	River black water creek	43	M	F
		River upper perennial	44	M	G
		River lower perennial	45	M	F
	Lakes and Ponds	Lacustrine eutrophic lake/pond	46	M	G
		Lacustrine oligotrophic lake/pond	47	M	G
		Permanent fishless pond	48	U	U
		Seasonally flooded pond	49	H	G
		Semi-permanently flooded pond	50	H	G
Marine and Estuarine	Intertidal	Estuarine intertidal emergent brackish marsh	51	M	G
		Estuarine bluff clay	52	L	G
		Estuarine rocky shore bedrock	53	L	G
		Estuarine unconsolidated shore sand dune	54	U	U
		Estuarine unconsolidated shore cobble / shell	55	L	G
		Estuarine beaches unspecified	56	M	F

Broad Habitat Grouping		Key Habitat	#	Threat*	Condition*
	Subtidal	Estuarine subtidal aquatic bed rooted vascular	57	M	G
		Hard / Rocky Bottom	58	U	U
		Soft Bottom / Unconsolidated Sediments	59	U	U
		Varied Bottom / Invertebrate Beds	60	U	U
		Estuarine / Marine (open water)	61	L	G
Other		Predator free islands	62	M	F
		Urban	63	L	E
		Unknown	64	U	U

Table 2.12 Pivot Table of Key Habitats and the Number of GCN Species they support



Chapter 3: Problems Affecting Species of Greatest Conservation Need (GCN) and their Habitats in Rhode Island

Rhode Island's species of Greatest Conservation Need and their key habitats face numerous problems or threats that may adversely affect them and compromise the effectiveness of the conservation actions intended to conserve and restore them. Some of these threats are global or national, while others may be regional, statewide, or local. Identifying the threats affecting Rhode Island's GCN species and key habitats is an important component in developing appropriate conservation actions and achieving the goals of the Comprehensive Wildlife Conservation Strategy. Once identified, the threats can be targeted and addressed through actions that RI DEM DFW and its partners developed throughout this CWCS process, and plan to implement for long-term conservation of GCN species and key habitats. The previous two chapters identified Rhode Island's GCN species (Element 1) and key habitats (Element 2); this chapter addresses the threats affecting both (Element 3).

General Problems Affecting Rhode Island's Fish and Wildlife Resources

National and international often affect migratory species that divide their life histories between different parts of the country, continent, or the world. Avian species that breed in the Arctic, for example, may migrate to South America for the winter. As a result of these long migrations, these birds can be impacted by threats in their northern breeding habitats, at migratory stopover sites, or at their southern wintering habitats. Problems such as global climate change or rising sea levels can affect these birds by changing the location and distribution of their breeding, migratory, and overwintering habitat. Migratory marine fish may spend portions of the year in Rhode Island waters but other portions of the year in the South Atlantic. Highly migratory species such as whales, sharks and tuna can be affected by problems throughout the Atlantic Ocean – in Canada, the United States or the Caribbean.

Olson and Dinerstein (2002) identified 238 priority ecoregions for global conservation, citing threats to global biodiversity such as human disturbance, habitat loss and fragmentation, and water quality. Freshwater habitats are threatened by non-native species, dams, pollution and habitat degradation (Master et al. 1998, Abell et al. 2000, Olson and Dinerstein 2002). Coastal and marine habitats are threatened nationally by pollution, coastal development, overfishing, climate change, habitat alteration, bycatch, invasive species, and aquaculture (Pew 2003). Terrestrial habitats are globally threatened by habitat degradation, wildlife exploitation, and habitat conversion resulting from agriculture, forestry, or development (Olson and Dinerstein 2002).

In the northeastern United States and Rhode Island, regional and localized threats add to the national and international threats mentioned above. The commercial trade in reptiles and amphibians has been identified as a regional threat to herpetofauna (NEES & WDTC, in press). Development, human disturbance, catastrophic oil spills, and inadequate funding for

surveys and management threaten the region's shorebirds (Clark and Niles 2000, Brown et al. 2001). The state's forests and their fauna are threatened by habitat loss, fragmentation, residential development, pests and pathogens, climate change, acid deposition, and invasive plant species (Butler and Wharton 2002). General or statewide threats that were identified in multiple plans and by stakeholder input as affecting Rhode Island's fish and wildlife resources and their habitats are summarized in Table 3.1.

Table 3.1 General Statewide Threats to Rhode Island's Fish and Wildlife

- | |
|--|
| <ul style="list-style-type: none"> ○ Habitat loss and fragmentation from lack of conservation planning and coordination (resulting in land conversion, etc.) ○ Habitat loss from inadequate-sized reserves (including poor landscape context, loss of connectivity, etc.) ○ Habitat fragmentation from lack of focal area approach to conservation ○ Lack of GCN species and key habitat data needed for incorporation into the comprehensive strategy ○ Lack of research to guide threat assessment and prioritization of conservation planning ○ Lack of strategy to implement landscape-level biodiversity and water quality/quantity monitoring to support planning and assessment ○ Lack of strategy to support priority research ○ Lack of advocacy for environmental review ○ Lack of authority from and enforcement of current regulations ○ Lack of advocacy for comprehensive wildlife conservation ○ Broad scale temporal and spatial climate change |
|--|

Habitat Loss and Fragmentation - Land Use Changes

Some of these general statewide threats reflect landscape-level land-use trends in Rhode Island. The state's cultural history has played an important role in shifting land uses over time, leading to changes in the abundance and distribution of various habitats (Figure 3.2). The role of forests in the state's landscape has changed through the years and the aquatic ecosystems also face significant degradation and loss issues.

As true historically as for other New England states, Rhode Island's natural landscape has been significantly altered by the increase in human population and associated human activities. At the time of European settlement in Rhode Island, an estimated 40,000 Native Americans were using the land for hunting, fishing and agriculture. The colonists quickly cleared the state's forests (which dominated the landscape) and converted them to farms; grazing of animals was the predominant agricultural land use (Gibbs et al. 1995). European settlers cleared an estimated two-thirds of Rhode Island's forests; up to 90% of the state was covered by forests prior to European colonization (Butler and Wharton 2002). Agriculture was the dominant land use, covering three-quarters of the state during the colonial period.

In 1793, the Industrial Revolution was initiated in Rhode Island and much agricultural commerce was displaced by industrial land uses (cotton processing, wool production, base and precious metal processing). Textiles became a central industry in the Blackstone River corridor, with numerous mills built along the river and its tributaries (Gibbs et al. 1995). 1800s Rhode Island was the most urbanized and industrialized state in the country. Pollution of the state's waterways accompanied this industrial explosion and continues to threaten aquatic habitats today despite improvements made in recent years (Gibbs et al. 1995). Industrial land use continues to slowly increase throughout the state (Table 3.2).

Table 3.2 Land Use and Land Cover Changes in Rhode Island, 1970-1995 (Source: RI DA 2000).

Land Use/Cover Category	1970 Land Use* (% of total land)	1988 Land Use (% of total land)	1995 Land Use (% of total land)	Land Use Change (1970-1995)
Forest	59.2	44.9	43.6	-15.6 %
Residential	12.8	18.7	20.0	+ 7.8 %
Agricultural	9.0	7.3	7.1	- 1.9 %
Water	5.5	3.8	4.0	- 1.5 %
Open Land	3.8	2.0	2.0	- 1.8 %
Wetlands**	1.9	13.1	13.0	n/a**
Institutional & Cemeteries	1.4	1.6	1.5	+ 0.1 %
Developed Recreational	1.4	1.6	1.6	+ 0.2 %
Commercial	1.0	1.8	1.9	+ 0.9 %
Urban Open Land / Vacant	0.8	0.8	0.6	- 0.2 %
Roads	0.8	0.9	0.9	+ 0.1 %
Industrial	0.8	1.0	1.2	+ 0.4 %
Transportation & Utilities	0.7	1.0	1.0	+ 0.3 %
Gravel Pits & Quarries	0.7	0.8	0.8	+ 0.1 %
Waste Disposal	0.2	0.4	0.4	+ 0.2 %
Mixed Commercial & Industrial	n/a	0.2	0.2	n/a

* Note that the 1970 survey utilized a different methodology using 65 land use and land cover categories, which have been crosswalked to 15 categories by RI DA (2000) that are approximately equivalent to the 16 categories used in the 1988 and 1995 methodology.

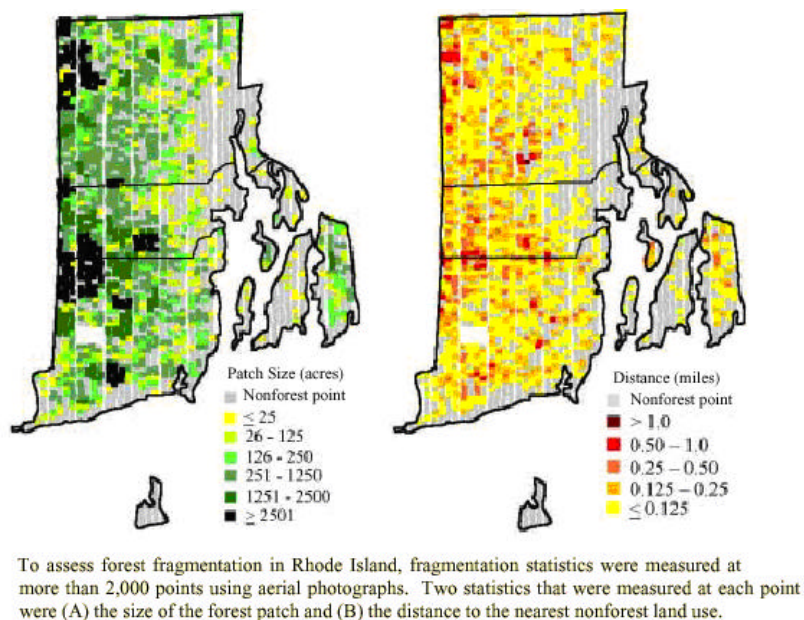
** Note that the 1970 Wetlands category included areas classified as Shallow Freshwater, Bogs and Saltwater Marshes, while the 1988 and 1995 Wetlands category includes areas classified as Open Freshwater, Shallow Freshwater Wetland, Deep Freshwater Wetland, and Saltwater Wetland. Forested wetlands were not distinguished as a land cover type in the 1970 survey. Therefore the two classifications systems are not directly correlative for wetlands.

By the 1850s, when the state's agricultural production was eclipsed by the country's westward expansion, the abandoned fields gradually reverted to forest (Gibbs et al. 1995). Only 61,223 acres of agricultural land remained in 2002 and the average farm size is now 71 acres; nursery, greenhouse and flower stock are now the top revenue source for the state's

agricultural industry (USDA 2004b). Agricultural land use continues to decline, while residential land use increases (Table 3.2). Today, land use patterns have shifted to reflect the increasing population density of Rhode Island and the rise in urban sprawl threatens many of the state's key habitats (Figure 3.2).

Forest recovery peaked in the 1950s and has been declining ever since; by 1998, only 59% of the state was forested (Widmann 2002). During the 1990s, the human population grew by 4.5% to 1,048,319 inhabitants, making Rhode Island the second most densely populated state in the nation (RI DEM 2003n). Yet the state ranks 9th in the nation in percentage of forest cover, making the state one of the few places in the world where so many people live within the forest (Widmann 2002). The largest population growth in the state is occurring in rural areas, with communities in southern Washington County facing the highest growth levels; some rural towns have experienced growth rates exceeding 20% in the last decade (RI DA 2000, RI DEM 2003n). The Natural Resources Inventory estimates that in 1997, 30.5% of Rhode Island was developed, the second highest percentage of developed land in the country (USDA 2004a).

Figure 3.1 Forest Fragmentation (Source: RI DEM Division of Forest and Environment, USDA USFS)



Land cover changes for the years 1972, 1985, and 1999 have been derived through analyses of satellite-based remote sensing images by the Rhode Island Agricultural Experiment Station and the Laboratory for Terrestrial Remote Sensing at the University of Rhode Island (Figure 3.2; <http://www.ltrs.uri.edu/research/URIAES.htm>). This analysis found that there have been three distinct periods of land use in Rhode Island, with massive forest clearing for small farms and villages from the 1600s to the mid-1800s, followed by an urban migration that abandoned farms and allowed them to reforest from the mid-1800s to the 1930s, and since the 1930s a migration away from the cities to the emerging suburbs. Between 1988 and 1995, Rhode Island saw a 7.0% increase in developed land, losing 5,478 hectares of non-urban land to urban uses; the majority of the non-urban land loss was forest land (3,248

hectares). Providence County showed the greatest area converted to urban use (3,066 hectares), while Washington County had the highest increase in built-up land (9.6%). South Kingstown converted more non-urban land to urban use than any other municipality during this period (380 hectares), and West Greenwich had the highest increase in urban conversion (30.6%). The study also concluded that Rhode Island's forest ecosystem declined by 2.6% in area from 1988 to 1995 and became patchier, or more fragmented. Deciduous forests suffered the highest losses in area (Novak 2003, http://www.ltrs.uri.edu/personal/alyssa/Alyssa_elp/intro%20images/intro.htm).

Land use changes in the state also have been monitored by the Rhode Island Statewide Planning Program since 1961 (RI DA 1999b, 2000); changes for the years 1970, 1988, and 1995 have been derived through systematic analyses of aerial photographs, using 37 land use and land cover categories (Table 3.2). This analysis indicates that development has increased nine times faster than Rhode Island's population, and confirms that the leading source of development is residential land use (RI DA 2000). Over the 25 year period of analysis, Rhode Island's undeveloped area declined by 12.8%; both forest and farmland are declining (RI DA 2000). An estimated 300 acres of farmland are developed annually according to the U.S. Department of Agriculture's Natural Resources Inventory (USDA 2004a). Approximately 6,600 acres of land were developed in the five year period between 1992 and 1997, 19.7% of which was farmland (USDA 2004a). Between 1982 and 1992, Rhode Island developed an average of 2,700 acres of (non-federal) land a year; this land conversion rate decreased to 1,300 acres a year from 1992 to 1997 (USDA 2004a). Figure 3.3 illustrates the predicted trends of land use and development for Rhode Island by the Statewide Planning Program.

The RI DEM has created an online interactive Environmental Resource Map that shows the location and distribution of Rhode Island's land use types at <http://www.dem.ri.gov/maps/index.htm#GV>. The Southern New England Gap Analysis Program (SNE GAP) provides the best-predicted distribution of vegetative communities at this time. The Environmental Data Center of URI has developed a Critical Resources Atlas of digital maps, such as Critical Biodiversity Areas, wetland soils maps, and groundwater recharge areas selected by watershed or town boundary (<http://www.edc.uri.edu/riatlas/>). These maps do not identify individual habitat types, however, they do identify protected and critical areas. RI DEM and EPA's Resource Protection Areas Program identified and mapped important resource areas in the state, and RI DEM Division of Planning and Development's Land Acquisition and Protection Plan (1996) identifies land protections areas. The state of Rhode Island has protected ~56,000 acres of land and water, not including state-administered easements for agricultural development rights, recreation, forestry or conservation, nor the over 65 fishing and boating access sites that total over 4,300 additional acres, nor the many acres conserved by its partners (Appendix 7c).

Figure 3.2 Land Use and Land Cover Change in Rhode Island 1972-1999 (RI Agricultural Experiment Station, Novak 2003)

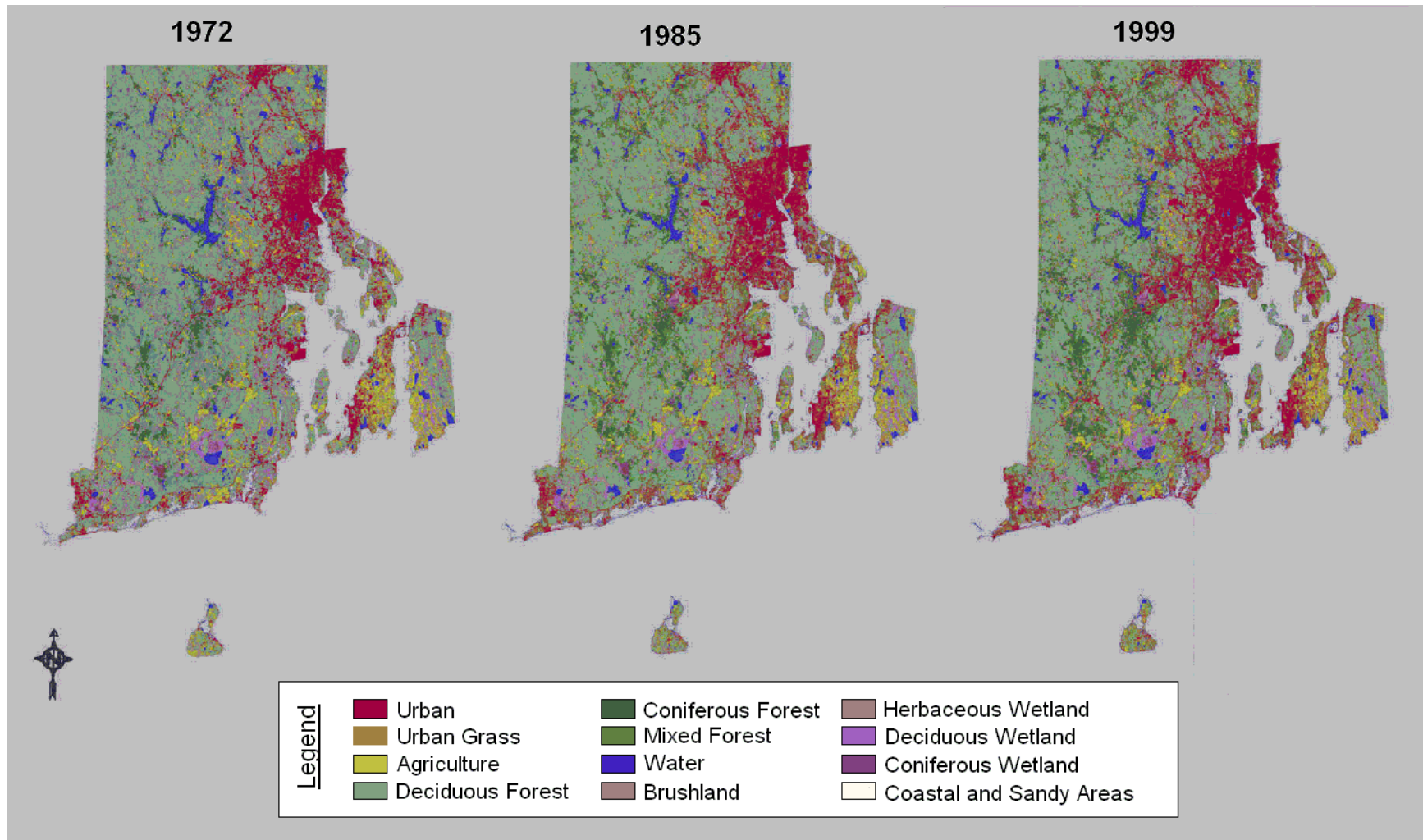
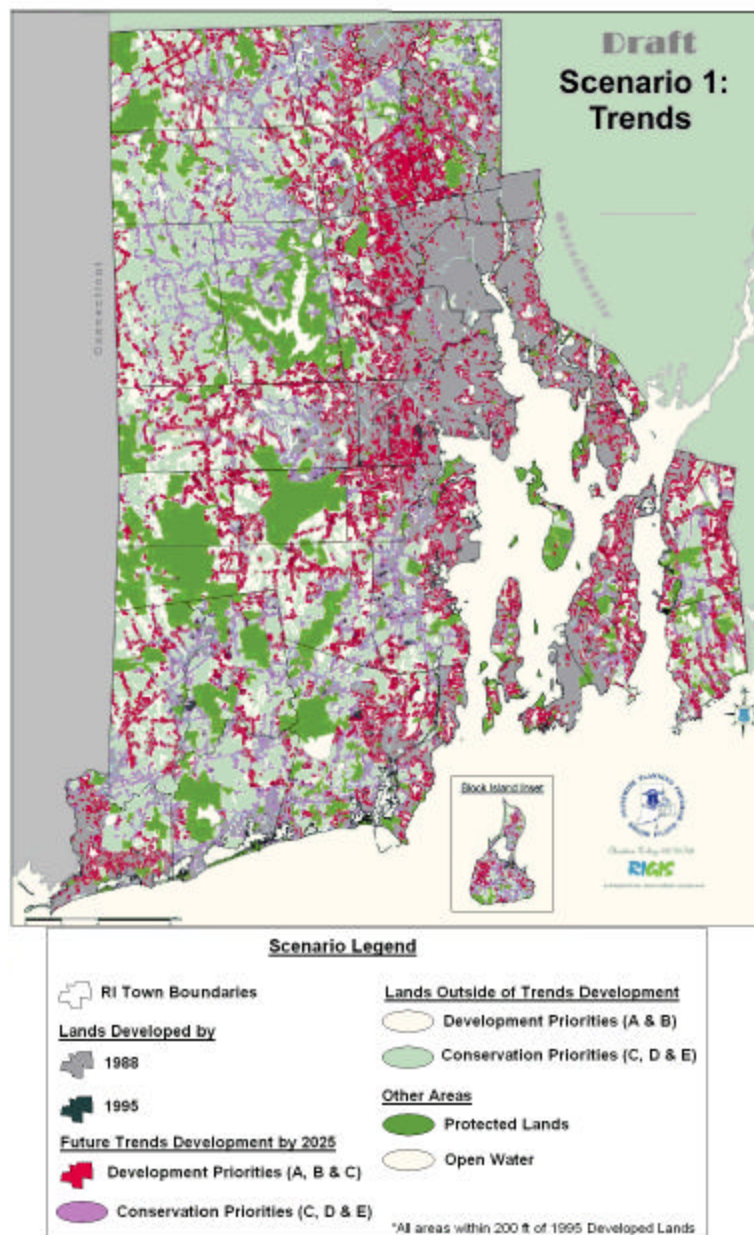


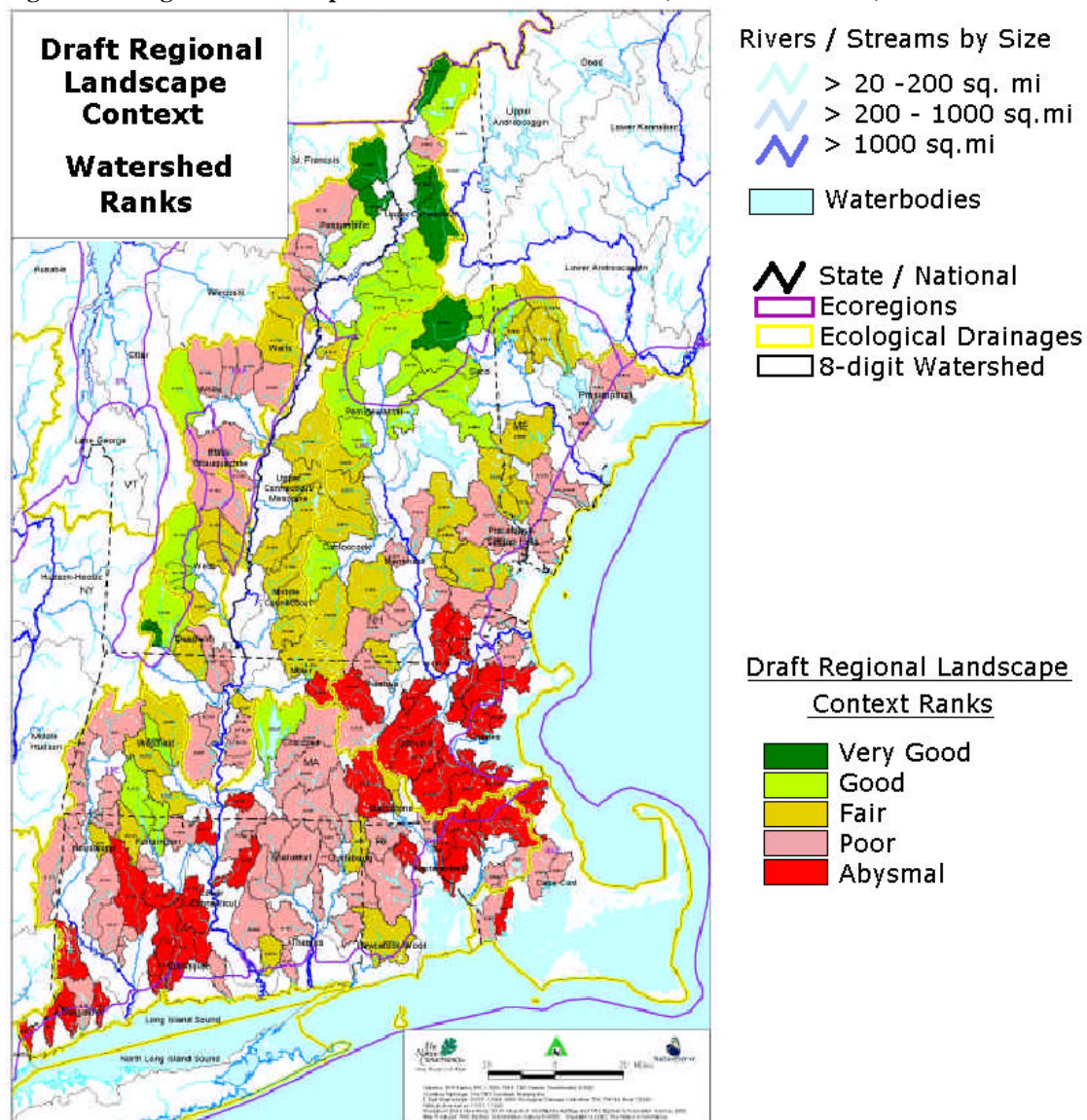
Figure 3.3 Scenario 1: Trends from Statewide Land Use and Policy Plan (Source: RI SPP 2005)



Loss and Degradation of Aquatic Habitat

For aquatic species and habitats, this CWCS process identified loss of habitat value for wildlife through hydrologic impacts such as water withdrawals for irrigating agricultural fields and golf courses, non-point source pollution from development and urban runoff, and point source pollution from municipal and industrial discharges as primary, overarching threats across many habitats within Rhode Island. Increased sedimentation and pollution from adjacent land use changes/development was another important multi-habitat problem needing conservation action.

Figure 3.4 Regional Landscape Context Watershed Ranks (Source: TNC 2005)



Trends in water quality and aquatic life of rivers and streams have been monitored through the cooperative efforts of RI DEM, individual Watershed Councils, URI and other partners (e.g. RI DEM 2004p). Changes in water quality have been well-documented, as important aquatic systems and habitats continue to degrade and become unsuitable as fish and wildlife habitat. Three families of benthic macroinvertebrates, Ephemeroptera, Plecoptera, and Trichoptera (EPT, mayflies, stoneflies, caddisflies) and the Hilsenhoff Biotic Index (HBI) are indicators of water quality and degraded aquatic conditions, allowing for long-term monitoring of the condition of Rhode Island's aquatic ecosystems. The RI DEM routinely monitors and maps trends in water quality, aquatic life support and sources of impairment for the state's rivers, streams, lakes, ponds, estuaries and marine waters (RI DEM 2004p). The Wood River has served as a reference site for detailed monitoring since 1993 (RI DEM 2004p), and the Wood-Pawcatuck Watershed Association (WPWA) conducts detailed monitoring of several stream reaches

in the Pawcatuck River watershed (Burgess 2002, Saila et al. 2004). RI DEM's Narragansett Bay Estuary Program continues to identify degraded aquatic habitats for restoration. The Environmental Data Center at URI also has a variety of digital resources related to aquatic habitats such as aquifer protection, drainage basin, discharges, and water quality classification maps (<http://www.edc.uri.edu/riatlas/>).

The Nature Conservancy has recently initiated an assessment of the streams and rivers throughout the Lower New England / Northern Piedmont ecoregion, determining which are the most intact and functional for each river and stream type. Assessment parameters include ecological land type (elevation, geology, slope, etc.), fish species, road crossings, road density, developed land, natural cover, number of dams, and other characteristics (Figure 3.4).

Abell et al. (2000) performed a threats assessment on the freshwater aquatic ecoregions of North America, including their North Atlantic Ecoregion that covers most of New England and all of Rhode Island. The analysis found that 50-89% of the catchment area, in terms of land cover, had been altered within the North Atlantic Ecoregion. In their estimation, the same proportion (50-89%) of the surface waters in the ecoregion have been degraded; the same percentage of surface waters have been altered in some way, too. The assessment also determined that the degree of original habitat in the ecoregion that had been fragmented is High, and the impact of species exploitation is Low. The authors found that Rhode Island has 12 non-indigenous fish species introduced to inland waters but that the impact of introduced species is Low. Overall, the likelihood of future threats impacting the aquatic systems of the North Atlantic Ecoregion is High (Abell et al. 2000).

The EPA has also conducted a threats assessment – the Index of Watershed Indicators – on the watersheds of North America (EPA 2002). Based on data obtained primarily in the 1990s and using 8-digit Hydrologic Unit Code (HUC) for watersheds, the Index of Watershed Indicators (IWI) assessed the health and threats to each watershed for 18 or more indicators. Indicators include water quality parameters, the loss of wetlands, urban and agricultural runoff potential, atmospheric deposition, contaminated sediments, and other variables that affect the health of aquatic ecosystems. Table 3.4 highlights the threats assessment for the four 8-digit HUC watersheds in Rhode Island – Blackstone, Narragansett, Pawcatuck-Wood, and Quinebaug. For their period of assessment (the late 1990s), all four watersheds were found to have less serious water quality problems. The Narragansett watershed was the only one of the four found to have a high vulnerability to problems threatening its aquatic ecosystem, with contaminated sediments, urban runoff, ambient water quality indicators, hydrologic modification due to dams, and estuarine pollution found to be significant problems (EPA 2002). Since this threats assessment is outdated, however, it is unknown whether these watershed characterizations and threat classifications are reflective of current conditions in Rhode Island. An updated assessment of these aquatic indicators has been identified as a CWCS research need in order to determine if the state's watersheds are improving or degrading over time.

Degradation of estuarine and marine waters utilized by waterfowl threatens traditional wintering habitats, as does habitat loss to development (USFWS 1999a). “The continuing movement of population away from the urban centers towards coastal and inland rural communities poses the most significant threat to the state’s wetland resources” (RI DEM 2003s). Although specific numbers are not available, RI DEM (2003s) estimates that up to half of the state’s salt marshes have been lost. Dahl and Johnson (1991) estimate that Rhode Island lost 37% of its wetlands – over 37,500 acres – from the 1780s to the 1980s, and that wetlands once covered 13.2% of the state. Today, the forested swamps of Providence, Kent and Washington Counties and the estuarine habitats of Washington County are the most threatened by development pressures (RI DEM 2003s).

Identifying Threats and Problems affecting GCN Species and their Habitats

RI DEM DFW’s Technical and Scientific Teams compiled additional information on threats to GCN species and grouped and condensed these threats when similar for species suites or broader taxa. They are listed under each habitat section in the next Chapter and they are listed in detail in Appendix 3. The RI DEM DFW database was used to generate a list of threats to GCN taxa by sorting threats by species and then grouping them when possible to taxa. The top three recurring threats to GCN species are lack of information, habitat loss and degradation, and species competition or predation (primarily due to invasive exotic species). These taxa focused threats, summarized in Table 3.5, were posted on the website along with their associated actions and stakeholder and public review.

Threats to broad habitat groupings are described in Chapter 4 under each habitat grouping, and threats to habitat can be found in Appendix 3 outlining threats at the statewide, taxa, and habitat levels. Broad, coarse filter threats have been documented across focal areas in the state and are summarized below in Table 3.5 and 3.6. Figure 3.5 is the Rhode Island’s Resource Protection Projects illustration of potential threats to Rhode Island’s natural resources.

The foundation for the method used to determine problems impacting GCN species and key habitats for this CWCS planning process was a compilation of over 150 existing conservation programs and plans, from an exhaustive literature search which represented the best available and long-established knowledge base and expertise. Appendices 1a list the major local, state, regional and national resources used to identify threats to Rhode Island’s fish and wildlife. Some resources (some key examples listed previously in this chapter) were focused on species or taxa, while others were focused on the ecosystem, watershed, or community levels.

Threats were identified, assessed, and prioritized in several ways. The compilation of existing recognized threats to species of GCN included threats assessments by other agencies and stakeholders. For example, TNC’s Threats Assessment and Viability

Analysis (TNC 2000) for its Ecoregional target species was reviewed and integrated for Rhode Island's Ecoregions (Beers and Davison 1999, Barbour et al. 2003) as well as for its regional freshwater aquatics. A summary of threat assessments from PIF conservation plans for Rhode Island's Bird Conservation Region and other related regional/international plans applicable to Rhode Island was also prepared and integrated into this process (Rosenberg 2004). Standardized protocols for aquatic biological monitoring and stressor assessment were used to assess water quality and stressors (e.g. RI DEM 2004p). Additionally, RI DEM DFW staff and a wide variety of stakeholders were solicited to capture their input on current problems affecting wildlife species and key habitats.

Table 3.3 Index of Watershed Indicators (IWI) for Rhode Island Watersheds (EPA 2002)

	Watershed (8-digit HUC)			
	Pawcatuck-Wood	Narragansett	Blackstone	Quinepaug
Overall Watershed Characterization	Less Serious Water Quality Problems – Low Vulnerability	Less Serious Water Quality Problems – High Vulnerability	Less Serious Water Quality Problems – Low Vulnerability	Less Serious Water Quality Problems – Low Vulnerability
Loss of Wetlands ¹	High	High	High	Moderate
Wetland Aquatic Species at Risk	1 species known at risk	> 5 species known at risk	> 5 species known at risk	1 species known at risk
Contaminated Sediments	Inconclusive data	High Degree of Concern	Inconclusive data	Inconclusive data
Chemicals in Surface and Ground Waters	< 5% of samples exceed half of MCL levels	Insufficient data	Insufficient data	< 5% of samples exceed half of MCL levels
Ambient Water Quality – Toxics (1990-98)	Insufficient data	Insufficient data	Insufficient data	0-10% observations exceed reference level
Ambient Water Quality – Conventional (1990-98)	0-10% observations exceed reference level	> 50% observations exceed reference level	0-10% observations exceed reference level	0-10% observations exceed reference level
Urban Runoff Index (1990) ²	0-1%	> 4%	> 4%	0-1%
Agricultural Runoff Index (1990-95)	Moderate level of potential impact	Moderate level of potential impact	Moderate level of potential impact	Moderate level of potential impact
Population Change (1980-1990)	> 7 % Increase	0 – 7 % Increase	> 7 % Increase	> 7 % Increase
Hydrologic Modification from Dams	Moderate volumes of impounded water	High volumes of impounded water	Moderate volumes of impounded water	Moderate volumes of impounded water

Estuarine Pollution Index	Insufficient data	High susceptibility	Insufficient data	Insufficient data
Atmospheric Deposition (1996)³	= 7 kg/ha/yr	= 7 kg/ha/yr	= 7 kg/ha/yr	= 7 kg/ha/yr
Nutrient Export (1987)⁴	< 4.45 lbs/ac (500 kg/km ²)	4.45 – 8.90 lbs/ac (500-1000 kg/km ²)	> 8.90 lbs/ac (1000 kg/km ²)	< 4.45 lbs/ac (500 kg/km ²)

¹ Wetlands lost measured from 1982-1992 and from the 1780s-1980s.

² Percentage of land area exceeding 25% imperviousness

³ Atmospheric deposition of nitrate and ammonium, in kilograms per hectare per year

⁴ Annual nitrogen yields, in pounds per acre or kilograms per square kilometer

Table 3.4 Threats to GCN Taxa

Threat Description	Invertebrates				Herpetofauna	Birds	Freshwater Fish	Marine Fish	Mammals
	Dragonflies & Damselflies	Mussels	Beetles	Butterflies and Moths					
Lack of GCN species and key habitat data incorporated into CWCS	X	X	X	X	X	X	X	X	X
Lack of research to guide threat assessment and prioritization of conservation planning	X	X	X	X	X		X		X
Habitat fragmentation from lack of focal area approach to conservation	X	X		X	X		X		X
Loss of habitat from plant succession				X		X		X	X
Lack of management and restoration of degraded Lepidoptera and/or Mussel habitat		X		X					
Habitat loss of critical microfeatures				X				X	
Demographic changes from excessive predation (animal)		X					X	X	
Demographic changes from incidental take (human)		X			X			X	
Habitat loss and demographic changes from invasive species (vegetation and animal)	X	X		X	X	X	X	X	
Demographic changes from aquatic invasives	X	X		X	X		X	X	
Habitat loss from impairment of aquatic contiguity		X			X		X	X	
Habitat degradation from impairment of water quality	X	X					X	X	

Threat Description	Invertebrates				Herpetofauna	Birds	Freshwater Fish	Marine Fish	Mammals
	Dragonflies & Damselflies	Mussels	Beetles	Butterflies and Moths					
Habitat fragmentation and degradation from chemical contaminants and disease	X	X	X	X	X	X	X	X	
Habitat fragmentation from road effects	X	X			X	X	X		
Lack of information from research to address habitat and taxonomic issues			X	X	X	X	X	X	X
Lack of information for monitoring and on-going assessment	X	X	X	X	X	X	X	X	X

Table 3.5 Threats to Broad Landscape Scale Habitats of Rhode Island

Identified Threat	Habitat	Source
Heavy demand for irrigation water withdrawals for agriculture and golf courses	Pawcatuck River watershed	Pawcatuck (1998)
Non-point source pollution from erosion and sedimentation, agricultural runoff, septic tanks (outdated systems, dense development, improper maintenance), urban runoff	Pawcatuck River watershed	Pawcatuck (1998)
Conflict between restoration of mill dams and restoration of anadromous fish runs	Pawcatuck River watershed	Pawcatuck (1998)
Elevated lead levels	Pawcatuck River watershed	Pawcatuck (1998)
Development, urban/suburban sprawl, poor planning	Forests, farmland, open space, greenspace	Butler and Wharton (2002), RI DA (2000), RI DEM (2003n), USDA (2004a), Widmann (2002)
Point-source pollution from industrial discharge, historic to today	Narragansett Bay	Gibbs et al. (1995)

Identified Threat	Habitat	Source
Non-point source pollution from contaminated runoff, domestic sewage (permanently closing some areas to shellfishing)	Narragansett Bay	Gibbs et al. (1995)
Sewage pollution -- combined sewer overflows in urban areas, failing/inadequate septic systems, boats in Bay	Narragansett Bay, groundwater, rivers and streams	Gibbs et al. (1995)
Metals pollution – copper, lead, zinc, cadmium, chromium, silver, nickel, mercury – from industrial discharge	Rivers and streams via sewers	Gibbs et al. (1995)
Road runoff pollution – metals, oil, gasoline	Groundwater, rivers and streams, Narragansett Bay	Gibbs et al. (1995)
Lawn and farm runoff pollution – nutrients from fertilizer, toxic pesticides	Groundwater, rivers and streams, Narragansett Bay	Gibbs et al. (1995)
Invasive species	Forests, wetlands, estuaries, marine areas	RINHS (2003), Carlton (2001), Pew (2003)

These previously identified threats (examples summarized above) were then reviewed by RI DEM programs and divisions' staff. An additional stakeholder workshop was conducted to review the draft list and prioritize threats and their corresponding actions and was posted on the website. The resulting threats were associated with key habitats to facilitate analysis, identify research needs and develop conservation actions. Some threats recurred in many plans and applied to many species and habitats, and were therefore termed as statewide, overarching threats (Figure 3.6). Some threats were specific to one habitat or applied only to closely related habitats or species and were therefore grouped and condensed accordingly, while others emerged from this process as general problems applicable to most if not all habitats across Rhode Island. Table 2.11 presented the best available assessment (by the Technical and Habitat Teams) of degree of threat to each key habitat and its relative condition. See Chapter 4 for more detailed descriptions of habitat condition and threats. Appendix 3 lists the general statewide threats, taxa focused threats, and threats to key habitats.

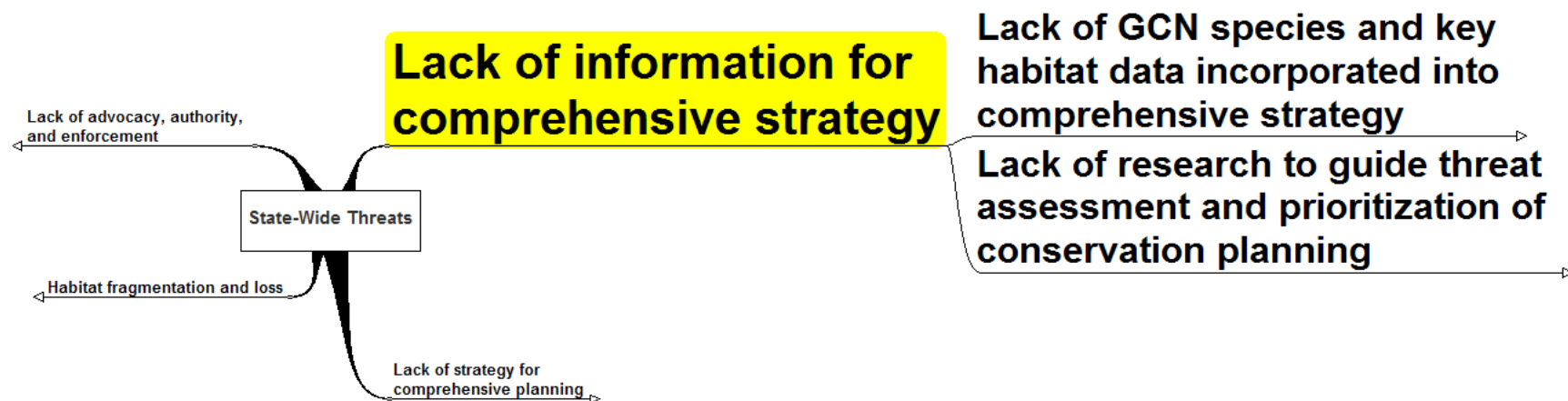
RHODE ISLAND'S COMPREHENSIVE WILDLIFE CONSERVATION STRATEGY

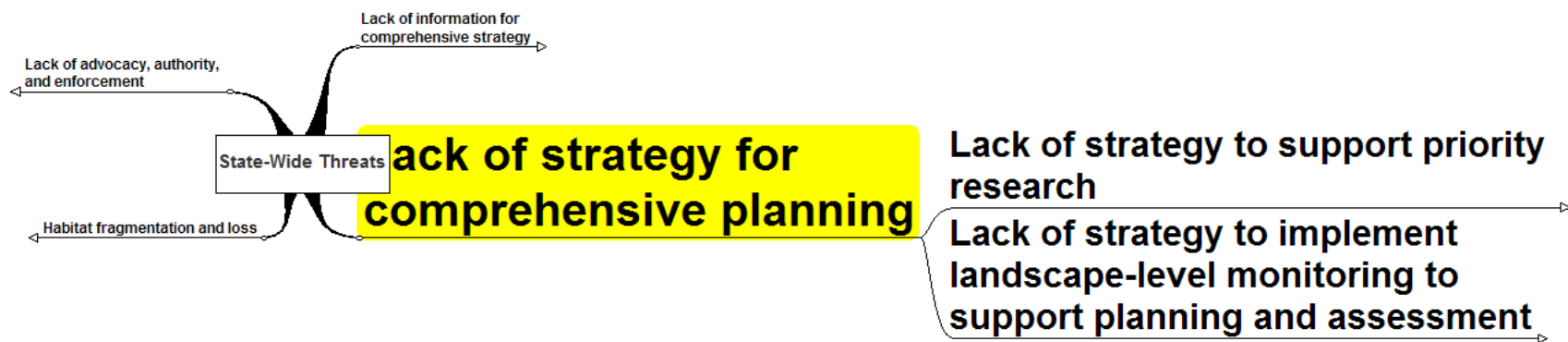
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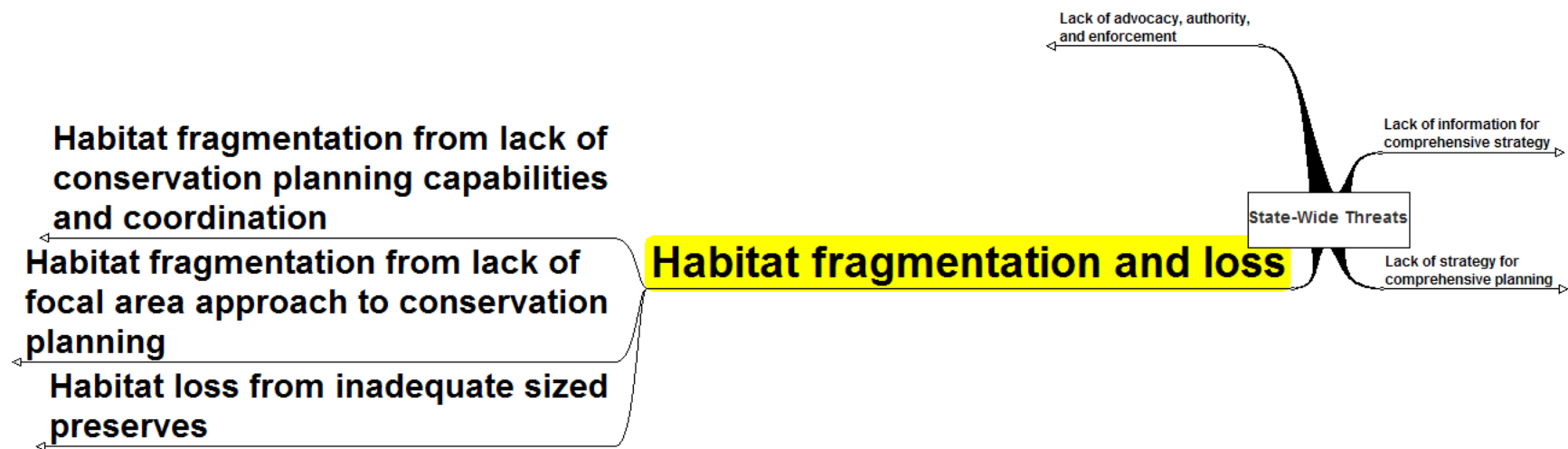
Threat Description	Deciduous	Evergreen	Mixed	Agriculture	Early Successional	Sparsely Vegetated	Emergent	Shrub	Forested	Springs/Seeps	Rivers/Streams	Lakes/Ponds	Marine/ Estuarine Open	Estuarine Brackish Marsh	SAV Subtidal Beds	Estuarine Unconsolidated Shore	Soft Bottom	Hard / Rocky Bottom	Varied Bottom	Predator Free Islands	Unknown	Urban
Lack of information for monitoring and on-going assessment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Point source pollution													X	X	X	X	X	X	X			
Non-point source pollution													X	X	X	X	X	X	X			
Water temperature changes and regulation													X	X	X	X	X	X	X			
Inadequate fisheries management													X	X		X	X	X	X			
Oil spills, marine accidents and ocean dumping													X	X	X	X	X	X	X			
Freshwater diversions, dam removal and waterway restoration													X	X	X	X	X	X	X			

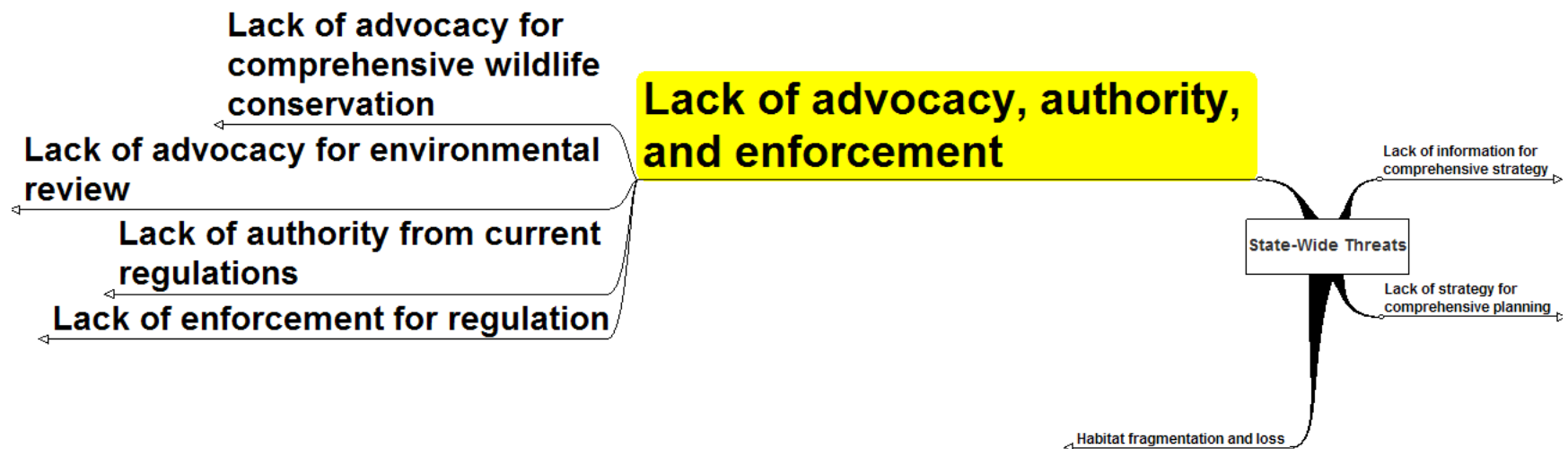
Figure 3.6 Mindmap of Statewide Threats to Rhode Island's GCN Species and Key Habitats (Source: TCI 2005)











Chapter 4: Actions to Conserve Rhode Island's GCN Species and Key Habitats

Chapter 1 describes Rhode Island's wildlife and identifies species in most need of conservation. Chapter 2 describes Rhode Island's land and waterscapes and identifies important wildlife habitats in the state. Chapter 3 presents the problems and threats facing GCN species and their habitats. It is the purpose of this chapter to now present actions that address these threats and conserve Rhode Island's GCN species and their associated habitats. This directly addresses the overall mission of RI DEM DFW, which is to ensure that the freshwater, marine, and wildlife resources of the State of Rhode Island will be conserved and managed for equitable and sustainable use (RI DEM DFW 2004). This Chapter directly addresses Element 4, but also presents Elements 1 through 3 in the context of habitats, presenting the description, location and condition of each key habitat. Appendices 3 and 4 present these actions in detailed formats to demonstrate the links between actions and threats and to organize their compilation at the statewide, taxa and habitat levels.

How Conservation Actions were Developed and Prioritized

Numerous existing conservation and management plans have identified conservation goals, objectives, and strategies for a variety of fish and wildlife resources and their habitats at the local, state, regional, and national scales. The approach of this CWCS was to review these current efforts and priority conservation actions and adapt them as appropriate to address Rhode Island's specific species and habitats in greatest need of conservation. This not only improves the probability of being implemented but also their overall effectiveness by recognizing the sound, relevant work of partners by integrating them into this effort. To that end, this process began with a comprehensive review of existing international, national, regional, state, and local conservation and management plans. This was conducted to identify those conservation actions that would best address the threats and problems identified in Chapter 3 and protect the GCN species and key habitats discussed in Chapters 1 and 2 respectively. Figure 4.1 depicts the approach used to develop and link all actions to the threats they were developed to address (example shown here reflects the links for a statewide threat to the resulting conservation actions developed to address it).

Once these actions were compiled, they were reviewed by CWCS Technical Team, organized, and used as a foundational reference to develop a database of actions that addressed each threat identified (see Appendices 3 and 4) for Rhode Island's target species and habitats. Actions were only developed for the highest priority threats identified. This served as the first order of prioritization. Each action developed was also assigned a rank of 0-3 (H, M, L in the case of marine) to represent the degree of urgency and priority need for that action for each GCN species. These scores were summed for relative priority scores for each action (see Appendix 4). Where information was insufficient to identify conservation actions, the process focused on identifying research, inventory, and monitoring needs to obtain such missing information. Actions were condensed and refined by the Technical and Scientific Teams through further consultation with staff, taxa experts and partners to develop a draft list of actions that most effectively addressed the identified high priority threats and captured the priorities repeated in partners' plans.

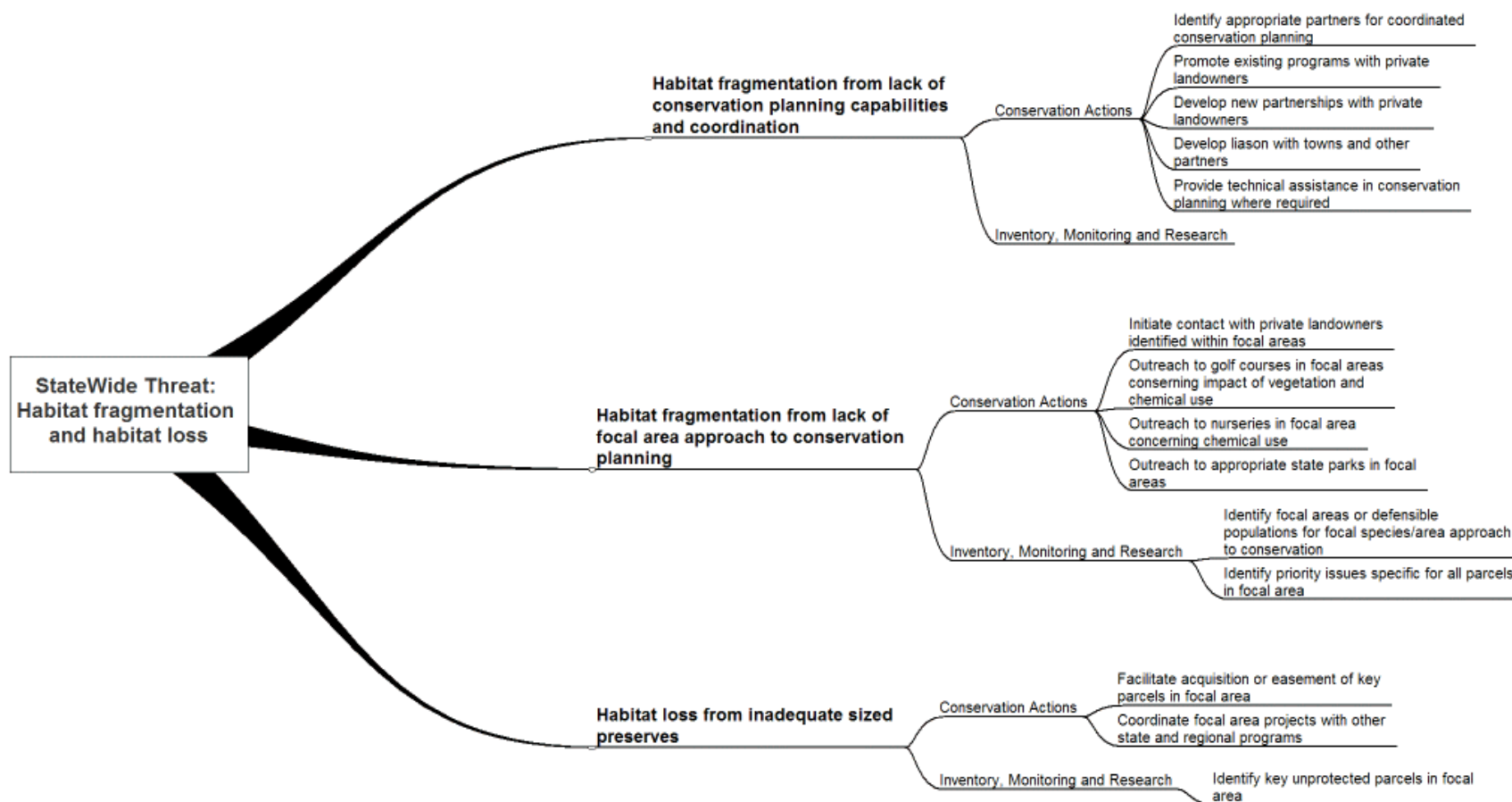
The draft list of actions was then reviewed by RI DEM DFW and other program staff and experts prior to posting it on the web. Stakeholder input was further solicited at a workshop focused on threats and action review and prioritization. Over 300 partners and stakeholders were invited, and follow-up invitations were sent to those participants from the previous GCN species and habitat workshops and meetings throughout 2004-2005. Only a core group of individuals responded to participate (almost 30) and provided valuable input and feedback. The list of threats, conservation actions, and inventory, research and monitoring needs were posted on the web for several months of public comment which was then incorporated as the final list was developed.

Conservation actions and threats were compiled and prioritized in several ways. First they were sorted in the database by scale/tier. This produced a list of three (3) tiers: 1) statewide, overarching, 2) taxa or species suite-focused, and 3) habitat- focused threats and actions. Conservation threats and their accompanying actions for Tier 1 are those that are operating in all parts of Rhode Island and have potential to affect all species. Projects like assimilation of parcel data, land acquisition, and mitigation of contaminants will have application no matter where they are implemented and to which species they are applied. Therefore, these are considered the highest priority conservation actions that have the greatest potential to affect the most species for the longest time.

Tier 2 includes those actions that have a high potential to affect clusters of species; i.e., the threats and actions are applicable to multiple (usually taxonomically related) species. In many cases, for example, data needs, research projects, and the creation of digital GIS coverages are appropriate for a cluster or suite of species, but not all. These threats and actions are mostly independent of habitat boundaries and are considered more general and less related to habitat than the following. Many of the most important, highest priority conservation actions are contained in the first two tiers because actions on cut across species and habitat boundaries.

Tier	Scale	GCN Species
1	Statewide	All
2	Geographic	Select groups- Taxa
3	Local/patch	Habitat-specific

Figure 4.1 Development of Conservation Actions to address Threats



However, it is also necessary to consider conservation at the species and habitat level. This provides focal areas which help target and direct the statewide and taxa level (Tier 1 and 2) actions on the landscape. In fact, this CWCS relies heavily on key habitat identification as a form of “coarse filter” approach to capture clusters of GCN species in conservation initiatives. Whenever possible, focal species were identified to help further target conservation action development. This was particularly true for aquatic taxa, especially marine, where focal species were identified to represent guilds or groups of species with similar needs (i.e. anadromous, demersal, etc.). Focal species (indicative species chosen to represent a group of species/taxa) were selected using additional criteria based upon the degree of (indigenous) use of key habitats (i.e. of Narragansett Bay and Rhode Island’s coastal waters by all life stages) as well as their management and protection status. Conservation actions developed for these focal species would then address the wider array of other species in that same habitat.

Individual habitat or community lists were generated (Tier 3) where additional specific actions were deemed necessary for that community. Actions are presented in figure and tabular format to demonstrate the approach and links from threat to associated action (see Figure 4.1 and Appendix 4) and present the list of statewide, taxa and habitat actions that apply to each habitat.

All actions presented in this document are considered priority actions. Those actions that have a greater conservation effect across taxa and habitats were considered highest priority and are presented first here as statewide, overarching actions (Tier 1). The broader taxa level actions that address a broader suite of species and habitats present the next level of priority (Tier 2). The finer filter habitat and species level priority actions are then presented under each specific habitat within the habitat section (Tier 3). Their relative priority scores provide additional prioritization guidance within and between habitats and tiers (Appendix 4). It is recognized, however, that adaptive management and external factors will affect the priority implementation order of these actions, as new information or opportunities arise, as this strategy is designed to respond to those needs. It should be recognized that all these actions are priority actions needed for the conservation of GCN species representing different spatial and temporal needs. Where information was insufficient to identify conservation actions, the process focused on identifying research, inventory, and monitoring needs to obtain such missing information, identifying priorities and tangible products to fill these information gaps.

Organization of Conservation Actions

The following sections present conservation actions and inventory, research and monitoring needs to reflect the tiered organization described above. This approach addresses the fact that conservation occurs at multiple levels, from the most specific population and local level to the more broad, statewide and overarching taxa and geographic scales. This chapter presents conservation actions across the spectrum of levels in order to capture the breadth of conservation needed in Rhode Island.

Presented first are the broadest, overarching, statewide actions (Tier 1), then the taxa focused (Tier 2) and finally the most specific species or habitat focused actions for each of the terrestrial and aquatic habitats. **It is important to recognize that, in order to avoid redundancy, this CWCS plan is organized so that threats and conservation actions are**

placed in only one tier and presented once, generally at the broadest level. For example, if land acquisition has relevance for all species and in all areas of the state, then it is not repeated (it is implied) in each habitat summary and is presented at the statewide level. Similarly, those habitat generalists, say to all forest types, will only appear once in the general habitat category and are implied throughout each specific forest ed key habitat. Please see Appendix 4 for the compilation of all actions (each assigned a number for database tracking- Action#) for each habitat along with performance measures and relative priority scores.

Overarching Statewide Conservation Actions and Inventory, Research, and Monitoring Needs

THREAT: Lack of advocacy for comprehensive wildlife conservation

Action: Augment ability of the RI DEM DFW to implement the CWCS.

It should be clear from the number of general statewide needs and tasks identified during this process that this CWCS will require significant new effort within RI DEM DFW. However, the extent to which it can be implemented is also dependent upon external factors outside of RI DEM DFW's control. A number of long-standing constraints limit the RI DEM DFW's ability to fully implement the CWCS. These specific tasks will better enable DEM FFW to implement this CWCS:

- **Generate a protected source of match for SWG funds.**

There is no dedicated state funding (match for federal SWG dollars) for work on these GCN species and their key habitats. Over the past several years the RI DEM DFW's appropriation from the General Fund of the State of Rhode Island has shrunk dramatically. Whereas hunting and fishing license fees allow matching of existing federal aid for game/fish research and management, there is presently insufficient in-house match for the CWCS target GCN species. There is no salt water license to provide such a match for marine species and habitats.

M: Sufficient state-level match for SWG program funds.

- **Provide/ enhance resources and staff to administer/ implement CWCS tasks.**

Several restricted receipt accounts were also recently dissolved by the General Assembly, so there is presently no protected repository for this type of match, even if it could be generated. Given the present situation, RI DEM DFW will have to rely exclusively on in-kind matching sources or will be forced to rely heavily on partners for match. There is also a long-term hiring constraint within RI DEM, so RI DEM DFW is presently unable to hire new positions. Administration of the SWG funds will add significant burdens to existing staff, therefore additional staff to review grants, review research proposals, and administer the federal assistance program will be necessary.

M: Additional staff and resources to administer, implement, and coordinate the CWCS with partners at the local, state, regional and national levels.

- **Provide additional staff training in GIS, statistics, and other analytical techniques on a regular basis.**

Significant training needs also exist if RI DEM DFW staff is to be properly skilled in implementing the broad spectrum of wildlife diversity conservation actions called for in this plan. Staff biologists should be provided with periodic training opportunities in GIS, statistical methods, population modeling, and other relevant skills.

M: # training courses completed, # staff participating, # products produced with improved GIS and other new skills by RI DEM DFW staff

THREAT: Habitat loss from inadequately-sized preserves

Actions (45-47): Facilitate acquisition or easement of key parcels and coordinate acquisitions with other state and regional programs.

Because most of Rhode Island's future needs will rely on the amount of habitat remaining, fee acquisition and easements that protect land will be among the most important components of CWCS. Acquisition, in conjunction with effective preserve design and focal area approaches (see below) has the greatest potential to protect the most species for the longest time. No other strategy or suite of strategies can mitigate for a lack of habitat.

M: # of new acquisition or easements of key habitat parcels by DEM or its partners

M: # of unprotected parcels identified and mapped in focal area; % incorporated into existing digital data bases

M: # of partners involved in acquisition and/or easements in focal areas; # of key parcels added to partners plans as priority

THREAT: Lack of GCN species and key habitat data incorporated into comprehensive strategy

Actions (2-3): Digitize all state parcel data in digital form and create an overlay of protected lands and waters.

This CWCS envisions that implementation of conservation actions will rely heavily, on digital data obtained through RIGIS and other sources. In order to strategize preserve designs and management planning on and near significant wildlife areas, it will be necessary to have access to digital parcel data for all appropriate cities and towns. Some townships in Rhode Island already have parcel data in digital formats, while others still rely on paper plat maps. It will be a major job to acquire and assemble parcel data in digital formats. Another significant task in this category is to update the conservation ownership map for the entire state. These needs also apply to the aquatic environment, where GIS and digital data are needed. These products in tandem will greatly facilitate the preserve design and focal area approaches that will be keystones of the CWCS implementation strategy.

M: New digital coverage of protected land/water

M: Number of parcels converted to digital; % of parcels with digital data

M: Number of overlays created; % of protected lands with overlay

Actions (6-7): Assemble all existing life history and known locality information.

There is a broad data management need to research peer-reviewed information (literature and other) that identify significant biological data and conservation needs for GCN species, limited

now by existing staff level and time. An improved information management system is needed to input, manage and track new literature. Some of these species were formerly tracked by the Natural Heritage Program, now housed in the Rhode Island Natural History Survey. The additional data management needs of CWCS and RI DEM DFW need to be addressed and a strategy for enhancing the state agency's needs for additional data management capabilities developed within the next few years to provide for effective data and project tracking and monitoring.

M: # of additional data sources and life history data entered into the RI DEM DFW database and utilized by staff

M: % of GCN species with digital life history information; % of key habitats with digital data

M: % of GCN species with digital abundance/distribution information; % of key habitats with digital data

Actions (10 & 14): Enhance GIS data - Geo-reference existing taxonomic data sets and create new GIS coverages (spatially explicit information) on the status, location and distribution of GCN species and location and condition of key habitats.

Existing data and coverages are insufficient to accurately document and map the location, distribution and condition of Rhode Island's key habitats. New data and maps are needed to fill the gaps documented by DEM and its partners during a collaborative attempt to map these GCN species and key habitats with the best available composite data from each partner. The action needed is for DEM and its partners to collect this information and update it with each iteration of this CWCS. Maps of key habitats will be produced by DEM through a collaborative effort with its partners (as in this initial effort- see Appendix 2b).

There are several important spatial data sets of taxonomic groups that exist in hard copy only and need to be digitized and disseminated. These are priority actions and needs which would make important contributions to the CWCS project, RIGIS and other partners. Examples of these include the grassland bird survey that was completed in 1995. These files should be converted to ArcView® shape files with attributes for the various field habitats surveyed. This product would allow better analysis of habitat characteristics and monitoring for an entire suite of grassland-adapted species. A similar data set exists for birds that inhabit salt (Reinert and Deragon) and fresh water marshes (Raithel and Enser). Other similar significant ongoing data projects include the Butterflies of Rhode Island (Pavulaan 1994), the Reptiles and Amphibians of Rhode Island (Raithel), the Rhode Island distribution of New England cottontail (Tefft), and the Tiger Beetles of Rhode Island (Enser and Raithel). This effort would provide the spatial and temporal data that could then be used to track and monitor these targeted species, habitats and the success of subsequent CWCS actions. Similar data sets exist for aquatic resources such as the Freshwater Fish Survey (Libby 2004) and numerous marine resources (RI DEM, Marine Fisheries) that need to be digitized and maintained through GIS coverages and more comprehensive data management. For some GCN species, little or no data exist and need to be collected and digitized.

M: # maps of key habitats produced by DEM and partners, # of distribution and location maps produced for GCN species

M: # new or improved GIS coverages for GCN species and key habitats, # of existing data sets digitized

M: # of new GIS data sets; # of new inventory, monitoring, or research projects identified

M: # of taxonomic data sets with Geo-references

THREAT: Lack of strategy to implement landscape-level monitoring to support planning and assessment

Actions (149-151): Conduct routine assessment/monitoring of GCN species and habitats.

The CWCS recognizes that monitoring of wildlife populations and their habitats produce performance measures upon which to evaluate the effectiveness of the CWCS process. However, it will not be possible to conduct annual inventories for the vast majority of GCN species. Some species, including several beetles, have not been seen in Rhode Island for decades. Other species, while known to presently occur in the state, are so cryptic that even annual detection of presence at a given site is problematic. The action for Rhode Island is to develop an effective monitoring framework for a wide array of GCN species and their habitats to assess and monitor status in the most effective and efficient way. According to Albert Einstein, “Not everything that is important can be measured and not everything that can be measured is important.”

The immediate task for the CWCS should be to determine whether there are metrics that can be measured and which are also important; i.e., they have value in predicting the quality of wildlife habitat. A component of the CWCS should therefore be to investigate whether important monitoring data for a wide variety of species can be obtained efficiently and cost-effectively. Fortunately, there is an increasing body of evidence that the spatial geometry of patches (size and alignment) have value in predicting the quality of wildlife habitats. Landscape features like roads and impermeable surfaces may be adequate surrogates for detecting (negative) habitat quality and these data can be obtained fairly efficiently through remote sensing (RS). A task to construct a derivative of RS data, perhaps an algorithm of fragmentation, to track Rhode Island's landscape would provide for strong inferences about the quality of habitats. Such a tool, when coupled with judicious use of field checking and the focal species approach mentioned above, should be extremely useful. There are also other approaches that might be incorporated into the CWCS monitoring needs. For example, periodic checks of forest health, water quality and other environmental monitoring are already conducted in Rhode Island (see Appendix 5). These should all be evaluated and an effective monitoring framework developed for application to GCN species and key habitats, as well as monitoring the spatial and temporal effectiveness of these.

M: # of remote sensing data obtained; % incorporated into existing data bases

M: # of measures developed; % incorporated into existing data bases

M: Development of algorithm; incorporation into existing databases

THREAT: Lack of research to guide threat assessment and prioritization of conservation planning**Actions (25-26): Assess threats to species and habitats.**

This task is a strategic planning function designed to recognize or create *de facto* wildlife “preserves” and defend them from degradation. This preserve area concept will be heretofore referred to in this document as a conservation area. For some taxonomic groups this will involve a focal or keystone species (coarse filter) approach (Raithel unpublished). The targeting of focal species could simplify conservation planning with the implication that, if one can maintain the most sensitive species in a conservation area, the rest should be secure there also (Lovejoy and Oren 1981). Landres et al. (1988) provided guidelines and caveats in the use of indicator species and Lambeck (1997) also discussed focal species methods. A keystone species is generally considered to be one that has far greater importance in ecosystem processes than its abundance would suggest, but the term has been used in varying contexts since Paine (1969) first coined the term (Mills et al. 1993). Some authors have advocated that keystone species be the focus of conservation and management actions for entire systems. If populations of these species can be kept robust, benefits will accrue to other species in the ecosystem (Power et al. 1996, Mills et al. 1993) and is relevant to the focal species approach used here (Raithel unpublished).

Because the goal of protecting the full complement of biotic diversity seems overwhelming, even in this small state, selecting certain species or aggregations to use as “umbrellas” or “poster children” to stimulate conservation action (Wright and Hubbell 1983, Soulé and Simberloff 1986) is one of the approaches used in this CWCS (Raithel unpublished). For example, amphibians are sensitive to environmental traumas and are therefore good indicators of habitat health (Vitt et al. 1990, Wyman 1990, Pearman 1997). Their habitats are also quite vulnerable (White et al. 1996). This CWCS will focus on prioritization of conservation actions according to species vulnerability, rather than perceived rarity because abundant species can actually be among the most vulnerable in a given system and Tilman et al. (1994), Terborgh (1974) and Pimm et al. (1988) provide general discussion of factors that influence species vulnerability. Focal areas could be assessed according to intactness of faunas (e.g., present vs. expected species composition) or site diversity, although neither diversity (see Pearman 1997) nor population sizes are absolute indicators of habitat or site quality (Raithel unpublished).

M: # of new threats identified, existing threats qualified or updated with new information, # of new conservation action/research projects identified and completed to address threats

M: # of new sites identified; # of conservation actions updated to include new habitats

Action (22): Identify all critical habitats.

As above, CWCS recognizes that more effective planning and design of areas treated as *de facto* wildlife preserves (rather than traditional “multiple use areas where species conservation is not the primary objective”) will be essential to ensuring long-term viability for GCN species. Diamond and May (1976) and Diamond (1978) discussed general considerations regarding reserve size and characteristics, although Noss (1983), Soulé and Simberloff (1986) and Saunders et al. (1991) noted the reality that preserve design decisions are often made in an already-fragmented landscape and sometimes located for political, not biological, criteria.

Large areas of contiguous landscape with good habitat quality and multiple habitat patches in close enough proximity to allow free movement of animals among them will be needed to preserve the GCN fauna of Rhode Island. Such large scale requirements (several thousand acres each) will necessarily hinge on existing public lands, primarily those in western Rhode Island. Noss (1983) stated that, "Large, essentially unmanaged areas unquestionably offer the best prospects for long-term maintenance of ecosystem processes and integrity." As much conservation effort as possible should be placed into buffering and enlarging existing large public lands, because bigger preserves usually contain more habitats and therefore more biotic diversity (Soulé and Simberloff 1986, Saunders et al. 1991). Focusing on core areas, well away from roads, helps to prioritize and target this CWCS work. If core areas can be established with wildlife conservation as a primary (or at least important) goal, essentially by preventing a continuing fragmentation of the ownership pattern, then secondary issues such as management, direct loss of animals, invasive species management, and connectivity of focal populations can be addressed. The Great Swamp Management Area, Arcadia M.A., Carolina M.A., Big River M.A., and George Washington M.A. presently constitute significant wildlife refuges. The maintenance of the W. Alton Jones campus as a biological reserve is also critical to amphibian conservation in western Rhode Island (Raithel unpublished).

Observed patterns of species loss in Rhode Island indicate which preserves have not been adequate to sustain certain species, however uncertainty remains about how much protected land base will ultimately be required to maintain populations in perpetuity (Noss and Harris 1986, Soulé and Simberloff 1986, Saunders et al. 1991). In designing preserves, therefore, there will always be risk that there are not enough habitats to sustain all species. Diamond (1975) wrote, "Even if a reserve does include some of the type of habitat preferred by a threatened species, the species may still disappear because of population fluctuations, spatial or temporal variation in resources". In Rhode Island, existing "preserves" may not be large enough now (Goodman 1987) because the pressure from public usage and degradation form an inhospitable matrix will increase with time. Since protected parcels will continue to "decay" if they are below some critical minimum sizes (Lovejoy and Oren 1981), then a strategy of prioritization to make them larger is appropriate (Diamond 1976, Terborgh 1976, Whitcomb et al. 1976, Picton 1979, Cole 1981, Soulé and Simberloff 1986, Burkey 1989).

M: # acres, parcels of critical habitat identified and updated with temporal and spatial data for GCN species ad key habitats

M: # of new threats identified or existing threats qualified to capture newly discovered or developing threats; # of new conservation actions/research projects identified to address threats

THREAT: Habitat fragmentation from lack of conservation planning capabilities and coordination

Actions (30-34): Develop and continue partnerships with private landowners and identify any other appropriate partners.

Because focal areas necessarily need to be larger than the extent of already protected land, it will be necessary to form partnerships with other landowners within a radius of the preserve.

Such partners could include private landowners, state and federal regulatory agencies, other conservation NGOs, and involved municipalities. Many entities in or near the focal area should have opportunities to influence (both positively and negatively) wildlife populations within the areas of interest.

Action 31: Outreach to appropriate partners, initiate landowner contact.

Therefore, it is critical to develop outreach programs to these parties and develop strategies to contact them, outline goals of the project, and build relationships to the extent possible. This process will be very labor-intensive. Efforts will be prioritized and target focal areas and critical habitats identified above.

Action 32: Promote existing programs to private landowners and provide technical assistance where required.

There are a number of existing programs (LIP, WHIP etc.) designed to promote opportunities for private landowners and other entities to enhance wildlife conservation and habitat management on their properties. For such activities to be maximally useful, the various activities should be coordinated. One way to do this is to apply existing programs in or near focal areas and critical habitats identified above. There may, for example, be management projects identified on private land within a focal area. That landowner may be eligible for funding to perform the task but may be unaware of the many partners' programs that offer financial and technical assistance (see Chapter 7 and Appendix 7). Working with such local, state, regional and federal partners facilitates a coordinated landowner outreach effort and maximizes the conservation program delivery to preserve the integrity of these important parcels and focal areas.

M: # of partners involved in coordinated planning; # of partner's own plans including elements of this CWCS

M: # of new private landowners involved in planning process

M: # of programs with increased participation

M: # of partners/landowners receiving technical assistance

M: # of towns and other partners with established liaison; # of town or partner meetings attended

THREAT: Lack of advocacy for comprehensive wildlife conservation

Actions (162 & 163): Compile, publish, and disseminate data and results.

A more indirect way to make the results of surveys, research, and conservation planning to the conservation mainstream is to publish results in peer-review journals or other appropriate media outlets. Staff should be supported and encouraged to publish or attend/present at symposia and advance the public image and the mission of RI DEM DFW and the role of the CWCS.

M: # of research and plan results published

M: # of research and plan results mailed to partners/stakeholders; # of web site hits to access PDF reports

Actions (164 & 165): Organize education/outreach programs, including workshops, technical support.

It will be necessary to develop cost-effective ways to create outreach to parties who can assist with wildlife conservation. Workshops and other methods may allow contact with several entities at once and thereby facilitate information exchange regarding conservation of GCN species and key habitats.

M: # of workshops; # of staff trained in GIS, statistics, etc.

THREAT: Habitat fragmentation from lack of focal area approach to conservation**Actions (38 & 42): Develop focal area and focal species approaches in Rhode Island.**

A focal area approach is a form of biological triage. Implicit in this approach are several assumptions. 1) Given the rapid and accelerating rate of habitat loss, time is too short and the stressors too severe to protect/defend all important areas. 2) All areas are not equally important to wildlife conservation. 3) Unless there is a strong component of the CWCS process whose function is to strategize and create large *de facto* wildlife reserves and defend them aggressively from internal and external degradation, then all area-sensitive species will disappear from the Rhode Island landscape. As mentioned above, such areas should be large and shaped roughly like circles or squares (to maximize road-less core areas). This approach does not claim that small preserves near urban centers are entirely bereft of biological value – certainly some species will persist in those places. However, if the CWCS is to protect viable populations of all species at the state scale, then the more difficult challenges will lie with species that require large tracts of contiguous habitat. Species that have a demonstrable ability to persist in small, urbanized habitat patches will not become endangered here. This approach is not new. Aldo Leopold, more than 50 years ago, envisioned a series of preserves with core areas surrounded by zones (buffers) of varied types of public usage and development that increased in intensity the farther one got from the core. He recognized that wildlife needed core areas where they could be left alone but also was pragmatic enough to concede that human needs also had to be accounted for. His blueprint keeps the more intense public uses farther away from core areas. Although Leopold was a visionary and a very keen and careful thinker, there are few examples of this strategy being implemented in the areas where it is needed the most – in the rapidly developing northeastern United States.

M: % of landowners contacted within focal areas

M: # of state parks contacted in focal areas; # of parks implementing recommendations

Actions (37 & 39): Identify focal areas or defensible populations and issues specific to all parcels in focal areas.

Identification of a viable population for any given species is very difficult – adequate survey data and population models are unavailable for the vast majority of species. However, there are spatial attributes that will be useful in identifying focal areas, and metrics such as habitat diversity can also be incorporated into the selection process. First and foremost, focal areas must be large, on the order of several thousand acres each. Accepting this tenet narrows choices considerably. This approach should be stratified according to the various land masses of Rhode Island. For example, all large islands should be treated independently - a focal

approach on Block Island would necessarily occur at a different spatial scale than one for western Rhode Island. Focal areas should have road-less cores as large as is possible at the geographical scale desired and should ideally, but not necessarily, have a significant proportion of protected acreage. A focal area will have a core of protected land and a buffer zone of varying extent where the goal will be to maximize the integrity of the overall preserve. All of the issues that could compromise the integrity of the core area should be identified and strategized.

M: # of focal areas or defensible populations identified; % incorporated into existing digital data bases

M: # of priority issues identified; # of new conservation actions/research projects developed to address issues

Action 46: Identify and pursue the protection and conservation of unprotected parcels in focal areas through acquisition.

One level of action in a focal area approach will be to identify and prioritize unprotected parcels of land in critical areas. This will require a strategic approach with progress metrics such as geometric formulae like perimeter-area ratios.

M: # of new acquisitions of or easements on key parcels in focal areas

THREAT: Habitat fragmentation and degradation from chemical contaminants and disease

Action 127: Conduct outreach to appropriate landowners in focal areas regarding chemical management.

Once the potential effects of contaminants have been evaluated, additional outreach to all parties that own or use land within a focal area should be contacted to discuss issues about chemical use etc. Golf courses, because they are large, road-less, and primarily vegetated habitats, can contribute to the integrity of adjacent preserves. In some parts of the country golf course chemical use and management strategies have been adjusted to provide maximal wildlife value while retaining the features important to golfers. Contaminants to important freshwater and marine environments need to be addressed. Opportunities exist to work with the USACOE and DOT to minimize and mitigate adverse impact of projects to important freshwater and estuarine/marine habitats.

M: # of landowners contacted; # of public relations materials developed and delivered concerning home chemical management

Action 144: Determine lethal and non-lethal effects of contaminants.

One of the issues affecting nearly all GCN species is the effect of contamination (including disease) on wildlife populations. In order to safeguard preserve areas and other significant wildlife populations, the CWCS should identify and attempt to mitigate all sources of contamination likely to degrade habitat. This process should also be conducted outside of preserve areas. For example, some modifications in the spraying regime for golf courses could potentially add to the viability of the Carolina Management Area. Sources of contamination from roads are particularly invasive, primarily to aquatic life forms, and coordination with DOT should attempt to mitigate affects from drains and other road run-off into nearby wetlands. Contaminant runoff into Narragansett Bay is a continuing need to be addressed.

M: Completion of needed research by RI DEM or partners; # of research recommendations incorporated into conservation actions

THREAT: Lack of strategy to support priority research

Action 140: Develop process to facilitate research priorities.

It seems likely that many appropriate research needs will be identified in the CWCS but that these projects will be beyond the abilities of existing staff. Therefore an effective process to solicit Request for Proposals (RFP) should be developed, including scientific/peer review, for research conducted with SWG funds. This will provide for partner collaboration in the implementation of this CWCS and the development of partnerships at the local, state, regional, and national levels.

M: Effective research planning and prioritization process established

Taxa-focused Conservation Actions

In addition to the above actions that apply to GCN species and key habitats statewide, the following list of conservation actions and research needs was developed to address threats to multiple species or taxa. In other words, they apply to guilds or species groups at a broader scale and context than single species or taxa. This list also reflects actions and needs identified in partners' plans for Rhode Island's GCN species groups. Therefore, the first action is to:

Action: Implement (and support the implementation of) existing partners' conservation plans at the local, state, regional, national levels, including threatened and endangered species recovery plans, USFWS and NMFS management plans, etc. as relevant to Rhode Island.

M: # of recovery plan priority actions implemented for T and E species in Rhode Island, # of other partners' management plan actions (local, state, regional and national) accomplished in Rhode Island for GCN species

Each of the following taxa groups / guilds (Mammals, Birds, Herpetofauna, Freshwater Fish, Beetles, Lepidoptera, Odonates, Mussels) are followed by a list of overall threats and conservation actions/ inventory, research, monitoring needs at the taxa group / guild level. Each conservation action and inventory, research, monitoring needs has an associated performance measure (M) by which the success of the action can be measured and unique database tracking #.

Mammals

Threats:

- o Lack of research to guide threat assessment and prioritization of conservation planning.
- o Habitat fragmentation from lack of focal area approach to conservation
- o Loss of habitat from plant succession

Inventory/Research/Monitoring Needs: (Database tracking # followed by action and measure)

19: Survey GCN species at priority sites.

Measure: # of sites surveyed for GCN species and % incorporated into existing digital databases.

17: Research and develop sampling protocols.

Measure: # of sampling protocols developed; % incorporated into existing data bases.

23: Determine geographic distribution of GCN species.

Measure: # of sites surveyed, # of GCN species mapped, and % incorporated into existing digital databases.

Conservation Actions:

61: Coordinate burn management with other state and regional programs.

Measure: # of partners involved in burn management and # of partners incorporating priority parcels into their burn management plans.

27: Coordinate processing of specimens and conversion and storage of electronic data.

Measure: # of partners involved in coordinated research and # of partners providing data for and using RI DEM databases.

40: Outreach to golf courses in focal areas concerning impact of vegetation and chemical use.

Measure: # of golf courses contacted within focal areas and # of golf courses implementing recommendations

41: Outreach to nurseries in focal areas concerning chemical use.

Measure: # of nurseries contacted in focal areas and # of nurseries implementing recommendations.

Birds

Threats:

- o Lack of GCN species and key habitat data incorporated into comprehensive strategy.
- o Habitat fragmentation and degradation from chemical contaminants and disease
- o Loss of habitat from plant succession

Inventory/Research/Monitoring Needs:

145: Facilitate research to identify and mitigate disease potential.

Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.

Conservation Actions:

11: Create GIS coverage of forest age-class.

Measure: # of GIS data sets.

12: Create GIS coverage of shrublands.

Measure: # of GIS data sets.

13: Create GIS coverage of field habitats.

Measure: # of GIS data sets.

131: Facilitate detection and diagnosis of diseases outbreaks.

Measure: # of strategies developed to facilitate disease detection and diagnosis and # of new procedures implemented.

61: Coordinate burn management with other state and regional programs.

Measure: # of partners involved in burn management and # of partners incorporating priority parcels into their burn management plans.

Herpetofauna

Threats:

- o Demographic changes from incidental take (human)
- o Habitat loss and demographic changes from invasive species (vegetation and animal)
- o Demographic changes from aquatic invasives
- o Habitat fragmentation from lack of focal area approach to conservation
- o Habitat fragmentation and degradation from chemical contaminants and disease
- o Habitat fragmentation from road effects
- o Lack of information for monitoring and on-going assessment
- o Habitat loss from impairment of aquatic contiguity
- o Lack of research to guide threat assessment and prioritization of conservation planning.

Inventory/Research/Monitoring Needs:

85: Research invasive species management and monitoring protocols.

Measure: Completion of needed research by RI DEM or partners and # of monitoring protocols established.

91: Identify potential damaging aquatic invasives and exotics.

Measure: Completion of needed research by RI Dem or partners and # of new species added to management plans.

125: Identify chemical sources and compounds of concern

Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.

134: Identify areas of significant road effects in focal areas

Measure: # of sites identified and mapped and % incorporated into existing digital databases.

135: Assess means to mitigate road effects.

Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.

99: Assess pathways of introduction from water gardens and mail order

Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions

17: Research and develop sampling protocols.

Measure: # of sampling protocols developed; % incorporated into existing data bases.

Conservation Actions:

80: Develop and provide educational program/materials to reduce incidental mortality and take from humans.

Measure: # of educational programs developed and delivered concerning human take and incidental mortality to GCN species.

82: Coordinate incidental take programs with regional or national initiatives.

- Measure: # of partners involved in incidental take programs and # of partners with incidental take actions incorporated into their plans.*
- 86: Create and implement invasive species monitoring protocol.
Measure: # of sites with invasive monitoring protocols implemented and % incorporated into existing databases.
- 87 / 90: Coordinate invasive species management with other state and regional programs.
Measure: # of partners involved in invasive species programs and # of partners with invasive species management added to their plans.
- 159: Monitor spatial qualities of habitat.
Measure: # of sites with monitoring and % incorporated into existing databases.
- 40: Outreach to golf courses in focal areas concerning impact of vegetation and chemical use.
Measure: # of golf courses contacted within focal areas and # of golf courses implementing recommendations
- 41: Outreach to nurseries in focal areas concerning chemical use.
Measure: # of nurseries contacted in focal areas and # of nurseries implementing recommendations.
- 110: Enhance habitat connectivity for priority species with culverts.
Measure: # of culverts established and # of sites with GCN species monitored over time.
- 126: Coordinate with mosquito abatement personnel for chemical management.
Measure: # of partners involved in water quality protection and # of partners with modifications to existing procedures to address water quality.
- 128: Coordinate chemical management with other state and regional programs.
Measure: # of partners involved in chemical management and # of partners with chemical priorities added to their plans.
- 136: Establish discussions with state and local D.O.T.
Measure: # of partners involved in on-going discussions to limit habitat fragmentation from road construction and # of road plans impacted.
- 137: Conduct road mitigations where required.
Measure: # of mitigation projects established.
- 92: Develop and implement sampling protocol for aquatic exotics.
Measure: # of sampling protocols developed and % incorporated into existing data bases.

Freshwater Fish

Threats:

- o Habitat loss and demographic changes from invasive species (vegetation and animal)
- o Habitat loss from impairment of aquatic contiguity
- o Habitat degradation from impairment of water quality
- o Demographic changes from excessive predation (animal)
- o Demographic changes from aquatic invasives
- o Habitat fragmentation and degradation from chemical contaminants and disease
- o Habitat fragmentation from road effects
- o Habitat fragmentation from lack of focal area approach to conservation
- o Lack of research to guide threat assessment and prioritization of conservation planning.

- o Lack of information for monitoring and ongoing assessment

Inventory/Research/Monitoring Needs:

- 85: Research invasive species management and monitoring protocols.
Measure: Completion of needed research by RI DEM or partners and # of monitoring protocols established.
- 91: Identify potential damaging aquatic invasives and exotics.
Measure: Completion of needed research by RI Dem or partners and # of new species added to management plans.
- 93: Assess threat from fish.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions
- 103: Identify potential damaging exotic plants.
Measure: Completion of needed research by RI Dem or partners and # of new species added to management plans.
- 104: Identify priority areas for invasive plant management.
Measure: # of priority sites identified and mapped and % incorporated into existing digital databases.
- 114: Evaluate water quality effects on priority species.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- 118: Assess effects of water releases at dams.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- 119: Assess effects of water withdrawals.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- 120: Assess effects of prolonged drawdowns.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- 121: Assess effects of sedimentation.
Measure: Completion of needed research by RI DEM or partners; # of research recommendations incorporated into conservation actions.
- 145: Facilitate research to identify and mitigate disease potential.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- 74: Evaluate need for predator control intervention for priority species.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- 98/99: Assess pathways of introduction from water gardens and mail order
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions
- 125: Identify chemical sources and compounds of concern
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- 134: Identify areas of significant road effects in focal areas

- Measure: # of sites identified and mapped and % incorporated into existing digital databases.*
- 135: Assess means to mitigate road effects.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- 17: Research and develop sampling protocols.
Measure: # of sampling protocols developed; % incorporated into existing data bases.
- 18: Identify priority sites for survey.
Measure: # of priority sites identified and % incorporated into existing digital databases.
- 19: Survey GCN species at priority sites.
Measure: # of sites surveyed for GCN species and % incorporated into existing digital databases.
- 24: Determine relative abundance of GCN species.
Measure: # of sites surveyed, # of GCN species inventoried, and % incorporated into existing digital databases.

Conservation Actions:

- 86: Create and implement invasive species monitoring protocol.
Measure: # of sites with invasive monitoring protocols implemented and % incorporated into existing data bases.
- 87 / 90: Coordinate invasive species management with other state and regional programs.
Measure: # of partners involved in invasive species programs and # of partners with invasive species management added to their plans.
- 92: Develop and implement sampling protocol for aquatic exotics.
Measure: # of sampling protocols developed and % incorporated into existing databases.
- 75: Develop predator control program to conduct intervention where appropriate for priority species.
Measure: # of sites with predator control plans developed and # of predator control plans implemented.
- 94 / 95: Coordinate aquatic exotic management with stocking agencies and mosquito abatement personnel.
Measure: # of partners involved in aquatic exotic management and # of partners with modifications to existing procedures to address exotics.
- 96: Develop and implement program to mitigate effect of aquatic exotics.
Measure: # of mitigation projects established.
- 105: Develop and implement invasive species management program.
Measure: # of invasive management plans established.
- 106: Develop and provide educational information about invasive species.
Measure: # of educational programs developed and delivered concerning invasive species.
- 110: Enhance habitat connectivity for priority species with culverts.
Measure: # of culverts established and # of sites with GCN species monitored over time.
- 111: Expand public awareness of fish passage issues.

- Measure: # of educational programs developed and delivered concerning fish passage issues.*
- 115: Develop strategies to mitigate aquatic degradation.
Measure: # of mitigation projects established.
- 116 / 117: Coordinate water quality protection with appropriate DOT, regional and federal programs.
Measure: Coordinate water quality protection with appropriate DOT, regional and federal programs.
- 158: Coordinate monitoring with other state and regional monitoring programs.
Measure: # of partners involved in monitoring and # of partners providing data for and using RI DEM databases.
- 159: Monitor spatial qualities of habitat.
Measure: # of sites with monitoring and % incorporated into existing databases.
- 126: Coordinate with mosquito abatement personnel for chemical management.
Measure: # of partners involved in water quality protection and # of partners with modifications to existing procedures to address water quality.
- 128: Coordinate chemical management with other state and regional programs.
Measure: # of partners involved in chemical management and # of partners with chemical priorities added to their plans.
- 136: Establish discussions with state and local D.O.T.
Measure: # of partners involved in on-going discussions to limit habitat fragmentation from road construction and # of road plans impacted.
- 137: Conduct road mitigations where required.
Measure: # of mitigation projects established.
- 40: Outreach to golf courses in focal areas concerning impact of vegetation and chemical use.
Measure: # of golf courses contacted within focal areas and # of golf courses implementing recommendations
- 41: Outreach to nurseries in focal areas concerning chemical use.
Measure: # of nurseries contacted in focal areas and # of nurseries implementing recommendations.

Marine/Estuarine Fish

Because many of these GCN species are highly mobile and utilize a number of marine and estuarine habitats, a broad grouping combining Estuarine and Marine was developed to facilitate conservation planning. Several guilds were identified (pelagic/anadromous, catadromous, demersal fish) and focal species were identified as an additional step to further target actions and needs.

Threats:

- o Direct loss and fragmentation of wetlands due to shoreline development, bulkheads, and poor urban development.
- o Direct loss of wetlands due to dredging, dredge disposal, ditching and draining, and other benthic disturbances.
- o Changes in the freshwater regime resulting from fresh water diversions, dam removal and waterway restoration, and ditching wetlands

- o Direct contamination of marshes from point source pollution from industrial discharge, heavy metals, sediment, and other contaminants
- o Sedimentation and contamination of marshes from non-point source pollution from erosion, sedimentation, agriculture run off, and septic systems
- o Nutrient loading from sewage pollution (i.e., combined sewage overflow, failing and inadequate systems, boat waste)
- o Temperature changes and regulation
- o Inadequate fisheries management of accidental mortality and where more resources are harvested in an area than the ecosystem can sustain
- o Direct contaminants from oil spills, marine accidents, and ocean dumping
- o Invasive (alien) species that directly effect habitat, competitors, predators, pathogens or parasites, and/or changes in the native species dynamics, directly competing with the native species
- o Lack of information on historical changes in this habitat type
- o Incomplete survey information for *Cicindela marginata*
- o Heavy pesticide spraying
- o Shoreline stabilization and development
- o Increasing recreational use of marine shorelines
- o Invasive (alien) species that directly effect habitat, competitors, predators, pathogens or parasites, and/or changes in the native species dynamics, out competing native species

Inventory/Research/Monitoring Needs and Conservation Actions

Pelagic/Anadromous Fish:

For this group/guild, Atlantic sturgeon, shortnose sturgeon, alewife/ blueback herring, American shad, rainbow smelt, and tomcod were identified as focal species representing the wider array pelagic/ anadromous fishes.

- o Research abundance and distribution of species for which status and habitat can be determined, by including additional data collection in present studies.
Measure: # of areas surveyed, # of species/populations located, GIS maps produced, and new data collected and compiled by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Conduct a literature search to survey life history information, identify what has already been done on the species, how this information can be used to better understand Rhode Island's species, and identify other research needs. Digitize existing information into a central repository.
Measure: measures of life history metrics established/collected, GIS maps produced, and # of research recommendations incorporated into conservation actions.
- o Develop a strategic conservation plan for anadromous fish and eel that will provide needed fish passage locations for shad, which can serve as a representative species.
Measure: conservation plan developed; # of fish ladders established; # of sites with GCN species monitored over time
- o Use gut content analyses to investigate the causes of high mortality after spawning, determining what is preying on species following spawning or if there are environmental causes.

- Measure: # of species with gut content analyses completed, # of causes of mortality identified, and # of research recommendations incorporated into conservation actions.*
- o Research predator / prey relationships to determine where species are in the food chain by identifying their most common food sources and what preys on them.
Measure: # of species identified in the food chain and # of research recommendations incorporated into conservation actions.
- o Identify and map critical areas in the life history of species, particularly spawning areas, and determine site fidelity to those areas.
Measure: # of sites identified and mapped and % incorporated into existing digital databases.
- o Begin surveys in Narragansett Bay for pelagic fish earlier in the year to survey spring fish.
Measure: # of areas surveyed, # of species/populations located, GIS maps produced, and new data collected and compiled by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Determine appropriate indicator species or parameters to monitor water quality for pelagic / anadromous fauna.
Measure: # of indicator species and water quality monitoring parameters identified and implemented, by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Research marine mortality to determine the mortality rate of anadromous fish once they return to the estuary.
Measure: identification of mortality rate and # of research recommendations incorporated into conservation actions.

For Catadromous Fish: For this group/guild, the American eel was identified as a focal species.

- o Research environmental sensitivity for slight changes in environmental factors that may lead to large impacts to the resource.
Measure: identification of environmental sensitivity of catadromous species to environmental factor and # of research recommendations incorporated into conservation actions.
- o Follow up the anadromous fish conservation plan by identifying fish ladders in need of retrofits to modify and maintain eel ramps at all fish ladders or dams.
Measure: # of fish ladders established; # of sites with GCN species monitored over time
- o Monitor the population and abundance of eels over their life span, gathering life history data and identifying other research needs.
Measure: # of areas surveyed, # of populations located, measures of life history metrics established/collected, GIS maps produced, and new data collected and compiled by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Assess the recruitment of eels into and out of lakes by monitoring their migration out of freshwater.
Measure: # of lakes surveyed, identification of recruitment rates, and # of research recommendations incorporated into conservation actions.

Demersal Finfish: For this group/guild, the hogchoker, cunner, oyster toadfish, windowpane and winter flounder and tautog were identified as focal species.

- o Research the bioaccumulation of pollutants in bottom feeders by locating, reducing and monitoring the input of pollutants into the water column.
Measure: # of pollution sources located, monitored and minimized, and # of research recommendations incorporated into conservation actions.
- o Conduct a literature search to survey life history information, identify what has already been done on the species, how this information can be used to better understand Rhode Island's species, and identify other research needs.
Measure: measures of life history metrics established/collected, GIS maps produced, and # of research recommendations incorporated into conservation actions.
- o Assess which species are the most susceptible to threats and monitor them as indicator species.
Measure: # of indicator species identified and monitored and # of research recommendations incorporated into conservation actions.
- o Assess whether a succession of species may be occurring as a result of temperature changes.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Identify key locations where short-term closures may have the most impact to restore fish populations and close those areas to fisheries.
Measure: # key locations identified, # short-term closures implemented and monitored, and # of research recommendations incorporated into conservation actions.
- o Monitor the growth rates of demersal finfish to determine if they are growing at the historical rate or if there is a population that has already been studied that shows a similar pattern.
Measure: # of species with growth rates and trends identified and # of research recommendations incorporated into conservation actions.
- o Research the impacts of pollution through tissue sampling of demersal finfish.
Measure: # of species with tissue analyses completed, impacts of pollution identified, and # of research recommendations incorporated into conservation actions.
- o Research predator / prey relationships to determine where species are in the food chain by identifying their most common food sources and what preys on them.
Measure: # of species identified in the food chain and # of research recommendations incorporated into conservation actions.
- o Identify and map critical areas in the life history of species, particularly spawning areas.
Measure: # of sites identified and mapped and % incorporated into existing digital databases.
- o Research whether hypoxia is changing the growth patterns for species of demersal finfish by using laboratory testing.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.

Marine Invertebrates

Because some marine GCN species are highly mobile and utilize a number of marine and estuarine habitats, a broad grouping combining Estuarine and Marine was developed to facilitate conservation planning. Several guilds were identified (benthic, estuarine, and habitat specific invertebrates) and focal species were identified as an additional step to further target actions and needs.

Threats:

- o Direct loss and fragmentation of wetlands due to shoreline development, bulkheads, and poor urban development.
- o Direct loss of wetlands due to dredging, dredge disposal, ditching and draining, and other benthic disturbances.
- o Changes in the freshwater regime resulting from fresh water diversions, dam removal and waterway restoration, and ditching wetlands
- o Direct contamination of marshes from point source pollution from industrial discharge, heavy metals, sediment, and other contaminants
- o Sedimentation and contamination of marshes from non-point source pollution from erosion, sedimentation, agriculture run off, and septic systems
- o Nutrient loading from sewage pollution (i.e., combined sewage overflow, failing and inadequate systems, boat waste)
- o Temperature changes and regulation
- o Inadequate fisheries management of accidental mortality and where more resources are harvested in an area than the ecosystem can sustain
- o Direct contaminants from oil spills, marine accidents, and ocean dumping
- o Invasive (alien) species that directly effect habitat, competitors, predators, pathogens or parasites, and/or changes in the native species dynamics, directly competing with the native species
- o Lack of information on historical changes in this habitat type
- o Incomplete survey information for *Cicindela marginata*
- o Heavy pesticide spraying
- o Shoreline stabilization and development
- o Increasing recreational use of marine shorelines
- o Invasive (alien) species that directly effect habitat, competitors, predators, pathogens or parasites, and/or changes in the native species dynamics, out competing native species

Inventory/Research/Monitoring Needs and Conservation Actions:

Benthic Invertebrates: For this group/guild, the mantis shrimp, lobster and crabs (red, green, etc.) were identified as focal species. Actions taken to address these species are thought to address the other species in this habitat as well.

- o Research abundance and distribution of species for which status and habitat can be determined, by including additional data collection in present studies.
Measure: # of areas surveyed, # of species/populations located, GIS maps produced, and new data collected and compiled by RI DEM or partners and # of research recommendations incorporated into conservation actions.

- o Monitor the status and condition of species before they are impacted by building commercial fisheries.
Measure: # of species monitored by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Expand species surveys and increase data collection by adding selected target species to existing surveys.
Measure: # of species added to existing surveys and # of research recommendations incorporated into conservation actions.
- o Conduct a literature search to identify key periods of the life history of benthic invertebrates and identify other research needs.
Measure: measures of life history metrics established/collected, GIS maps produced, and # of research recommendations incorporated into conservation actions.
- o Research environmental sensitivity for slight changes in environmental factors, which may lead to large impacts to the resource.
Measure: identification of environmental sensitivity of species to environmental factors and # of research recommendations incorporated into conservation actions.
- o Identify harvest levels of benthic invertebrate species.
Measure: # of species with harvest levels identified and # of research recommendations incorporated into conservation actions.
- o Assess impacts to shellfish restoration projects and determine if they are adversely affecting restoration efforts.
Measure: # of projects with before, during and after restoration monitoring, and # of research recommendations incorporated into conservation actions.
- o Assess the site fidelity of benthic invertebrates, whether they will relocate to spawn or not spawn at all following disturbance.
Measure: # of species with site fidelity determined, # of projects with before, during and after disturbance monitoring, and # of research recommendations incorporated into conservation actions.
- o Research predator / prey relationships to determine where species are in the food chain by identifying their most common food sources and what preys on them.
Measure: # of species identified in the food chain and # of research recommendations incorporated into conservation actions.
- o Research life history data to locate species in their pre-emergent life stage.
Measure: measures of life history metrics established/collected, GIS maps produced, and # of research recommendations incorporated into conservation actions.
- o Assess the vulnerability of species during their reproductive cycle.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Identify and map critical areas in the life history of species, particularly spawning areas.
Measure: # of sites identified and mapped and % incorporated into existing digital databases.

Estuarine Invertebrates: For this group/guild, the fiddler, blue and horseshoe crabs and quahog were identified as focal species.

- o Research environmental sensitivity for slight changes in environmental factors that may lead to large impacts to the resource.
Measure: identification of environmental sensitivity of species to environmental factors and # of research recommendations incorporated into conservation actions.
- o Conduct a literature search to identify key periods of the life history of estuarine invertebrates, gather abundance and distribution data, and identify other research needs.
Measure: measures of life history metrics established/collected, GIS maps produced, and # of research recommendations incorporated into conservation actions.
- o Identify and map critical areas and habitat types in the life history of species, particularly spawning areas, by incorporating estuarine invertebrates into other surveys.
Measure: # of sites identified and mapped and % incorporated into existing digital databases.
- o Assess competition between species and inter-specific competition to determine if they are competing and, if so, how, where and what the competition is doing to the stocks.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Assess which species may be indicators of the health of the marsh / estuarine environment.
Measure: # of indicator species identified and monitored, and # of research recommendations incorporated into conservation actions.
- o Research predator / prey relationships to determine where species are in the food chain by identifying their most common food sources and what preys on them.
Measure: # of species identified in the food chain and # of research recommendations incorporated into conservation actions.
- o Assess the water quality of estuarine invertebrate habitats, identifying the need for additional conservation actions.
Measure: # of indicator species and water quality monitoring parameters identified and implemented, and # of research recommendations incorporated into conservation actions.

Habitat Specific Invertebrate Taxa: For this group/guild, the blue mussel and sponge beds were identified as the focal species.

- o Research abundance and distribution of species for which status and habitat can be determined, by including additional data collection to existing surveys.
Measure: # of areas surveyed, # of species/populations located, GIS maps produced, and new data collected and compiled and # of research recommendations incorporated into conservation actions.
- o Conduct a literature search to identify and map critical areas in the life history of habitat specific invertebrates and identify other research needs.
Measure: measures of life history metrics established/collected, GIS maps produced, and # of research recommendations incorporated into conservation actions.
- o Assess the length of time for habitat specific invertebrates to reestablish following disturbance.
Measure: # of projects with before, during and after construction monitoring and # of research recommendations incorporated into conservation actions.

- o Research epiphytic growth on plants to determine if they are out-competing other species or if they are in a balance.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Identify where habitat specific invertebrates are in the food chain, what they are a food source for, and determine if they are limited or a limiting factor.
Measure: # of species identified in the food chain and # of research recommendations incorporated into conservation actions.
- o Assess whether stocks of habitat specific invertebrates are in decline.
Measure: # of species with stock assessments completed and # of research recommendations incorporated into conservation actions.

Beetles

Threats:

- o Habitat fragmentation and degradation from chemical contaminants and disease
- o Lack of research to guide threat assessment and prioritization of conservation planning.

Inventory/Research/Monitoring Needs:

- 125: Identify chemical sources and compounds of concern
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- 17: Research and develop sampling protocols.
Measure: # of sampling protocols developed; % incorporated into existing data bases.
- 18: Identify priority sites for survey.
Measure: # of priority sites identified and % incorporated into existing digital databases.
- 19: Survey GCN species at priority sites.
Measure: # of sites surveyed for GCN species and % incorporated into existing digital databases.

Conservation Actions:

- 128: Coordinate chemical management with other state and regional programs.
Measure: # of partners involved in chemical management and # of partners with chemical priorities added to their plans.
- 126: Coordinate with mosquito abatement personnel for chemical management.
Measure: # of partners involved in water quality protection and # of partners with modifications to existing procedures to address water quality.

Lepidoptera

Threats:

- o Lack of research to guide threat assessment and prioritization of conservation planning.
- o Habitat loss and demographic changes from invasive species (vegetation and animal)
- o Habitat fragmentation from lack of focal area approach to conservation
- o Lack of management and restoration of degraded Lepidoptera and/or Mussel habitat

- o Lack of information for monitoring and on-going assessment
- o Habitat fragmentation and degradation from chemical contaminants and disease
- o Loss of habitat from plant succession
- o Habitat loss of critical micro-features
- o Lack of information from research to address habitat and taxonomic issues

Inventory/Research/Monitoring Needs:

18: Identify priority sites for survey.

Measure: # of priority sites identified and % incorporated into existing digital databases.

19: Survey GCN species at priority sites.

Measure: # of sites surveyed for GCN species and % incorporated into existing digital databases.

20: Identify breeding locations and geographic distribution.

Measure: # of sites identified and mapped and % incorporated into existing digital databases.

23: Determine geographic distribution of GCN species.

Measure: # of sites surveyed, # of GCN species mapped, and % incorporated into existing digital databases.

85: Research invasive species management and monitoring protocols.

Measure: Completion of needed research by RI DEM or partners and # of monitoring protocols established.

103: Identify potential damaging exotic plants.

Measure: Completion of needed research by RI Dem or partners and # of new species added to management plans.

104: Identify priority areas for invasive plant management.

Measure: # of priority sites identified and mapped and % incorporated into existing digital databases.

125: Identify chemical sources and compounds of concern

Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.

64: Identify suitable restoration projects for Lepidoptera habitat.

Measure: # of restoration projects identified and mapped and % incorporated into existing digital databases.

71: Evaluate need for specialty cover types and identify priority sites for management.

Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.

99: Assess pathways of introduction from water gardens and mail order

Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions

56: Identify priority parcels needing seral-stage management.

Measure: # of parcels identified and mapped and % incorporated into existing digital databases.

141: Assess taxonomy/population relationships.

Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.

Conservation Actions:

- 86: Create and implement invasive species monitoring protocol.
Measure: # of sites with invasive monitoring protocols implemented and % incorporated into existing databases.
- 87 / 90: Coordinate invasive species management with other state and regional programs.
Measure: # of partners involved in invasive species programs and # of partners with invasive species management added to their plans.
- 159: Monitor spatial qualities of habitat.
Measure: # of sites with monitoring and % incorporated into existing databases.
- 40: Outreach to golf courses in focal areas concerning impact of vegetation and chemical use.
Measure: # of golf courses contacted within focal areas and # of golf courses implementing recommendations
- 41: Outreach to nurseries in focal areas concerning chemical use.
Measure: # of nurseries contacted in focal areas and # of nurseries implementing recommendations.
- 65: Implement priority restoration projects for Lepidoptera habitat.
Measure: # of restoration projects implemented and # of restoration sites with GCN species monitored over time.
- 105: Develop and implement invasive species management program.
Measure: # of invasive management plans established.
- 106: Develop and provide educational information about invasive species.
Measure: # of educational programs developed and delivered concerning invasive species.
- 126: Coordinate with mosquito abatement personnel for chemical management.
Measure: # of partners involved in water quality protection and # of partners with modifications to existing procedures to address water quality.
- 128: Coordinate chemical management with other state and regional programs.
Measure: # of partners involved in chemical management and # of partners with chemical priorities added to their plans.
- 57: Manage important habitats as required.
Measure: # of sites managed and # of sites with GCN species monitored over time.
- 61: Coordinate burn management with other state and regional programs.
Measure: # of partners involved in burn management and # of partners incorporating priority parcels into their burn management plans.
- 27: Coordinate processing of specimens and conversion and storage of electronic data.
Measure: # of partners involved in coordinated research and # of partners providing data for and using RI DEM databases.

Odonates

Threats

- o Habitat loss and demographic changes from invasive species (vegetation and animal)
- o Demographic changes from aquatic invasives
- o Habitat fragmentation from lack of focal area approach to conservation
- o Habitat fragmentation and degradation from chemical contaminants and disease

- o Habitat fragmentation from road effects
- o Habitat degradation from impairment of water quality
- o Lack of research to guide threat assessment and prioritization of conservation planning.
- o Lack of information for monitoring and on-going assessment

Inventory/Research/Monitoring Needs:

- 24: Determine relative abundance of GCN species.
Measure: # of sites surveyed, # of GCN species inventoried, and % incorporated into existing digital databases.
- 20: Identify breeding locations and geographic distribution.
Measure: # of sites identified and mapped and % incorporated into existing digital databases.
- 19: Survey GCN species at priority sites.
Measure: # of sites surveyed for GCN species and % incorporated into existing digital databases.
- 114: Evaluate water quality effects on priority species.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- 23: Determine geographic distribution of GCN species.
Measure: # of sites surveyed, # of GCN species mapped, and % incorporated into existing digital databases.
- 91: Identify potential damaging aquatic invasives and exotics.
Measure: Completion of needed research by RI Dem or partners and # of new species added to management plans.
- 93: Assess threat from fish.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions
- 103: Identify potential damaging exotic plants.
Measure: Completion of needed research by RI Dem or partners and # of new species added to management plans.
- 104: Identify priority areas for invasive plant management.
Measure: # of priority sites identified and mapped and % incorporated into existing digital databases.
- 125: Identify chemical sources and compounds of concern
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- 18: Identify priority sites for survey.
Measure: # of priority sites identified and % incorporated into existing digital databases.
- 99: Assess pathways of introduction from water gardens and mail order
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions
- 134: Identify areas of significant road effects in focal areas
Measure: # of sites identified and mapped and % incorporated into existing digital databases.
- 135: Assess means to mitigate road effects.

- Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.*
- 85: Research invasive species management and monitoring protocols.
Measure: Completion of needed research by RI DEM or partners and # of monitoring protocols established.
- Conservation Actions:
- 40: Outreach to golf courses in focal areas concerning impact of vegetation and chemical use.
Measure: # of golf courses contacted within focal areas and # of golf courses implementing recommendations
- 41: Outreach to nurseries in focal areas concerning chemical use.
Measure: # of nurseries contacted in focal areas and # of nurseries implementing recommendations.
- 87: Coordinate invasive species management with other state and regional programs.
Measure: # of partners involved in invasive species programs and # of partners with invasive species management added to their plans.
- 86: Create and implement invasive species monitoring protocol.
Measure: # of sites with invasive monitoring protocols implemented and % incorporated into existing databases.
- 126: Coordinate with mosquito abatement personnel for chemical management.
Measure: # of partners involved in water quality protection and # of partners with modifications to existing procedures to address water quality.
- 117: Coordinate water quality protection with appropriate DOT, regional and federal programs
Measure: Coordinate water quality protection with appropriate DOT, regional and federal programs.
- 115: Develop strategies to mitigate aquatic degradation.
Measure: # of mitigation projects established.
- 116: Coordinate water quality protection with appropriate DOT, regional and federal programs.
Measure: Coordinate water quality protection with appropriate DOT, regional and federal programs.
- 90: Coordinate invasive species management with other state and regional programs.
Measure: # of partners involved in invasive species programs and # of partners with invasive species management added to their plans.
- 92: Develop and implement sampling protocol for aquatic exotics.
Measure: # of sampling protocols developed and % incorporated into existing data bases.
- 94 / 95: Coordinate aquatic exotic management with stocking agencies and mosquito abatement personnel.
Measure: # of partners involved in aquatic exotic management and # of partners with modifications to existing procedures to address exotics.
- 96: Develop and implement program to mitigate effect of aquatic exotics.
Measure: # of mitigation projects established.
- 105: Develop and implement invasive species management program.
Measure: # of invasive management plans established.
- 106: Develop and provide educational information about invasive species.

- Measure: # of educational programs developed and delivered concerning invasive species.*
- 128: Coordinate chemical management with other state and regional programs.
Measure: # of partners involved in chemical management and # of partners with chemical priorities added to their plans.
- 136: Establish discussions with state and local D.O.T.
Measure: # of partners involved in on-going discussions to limit habitat fragmentation from road construction and # of road plans impacted.
- 137: Conduct road mitigations where required.
Measure: # of mitigation projects established.
- 159: Monitor spatial qualities of habitat.
Measure: # of sites with monitoring and % incorporated into existing databases.

Mussels

Threats

- o Demographic changes from excessive predation (animal)
- o Demographic changes from incidental take (human)
- o Habitat loss and demographic changes from invasive species (vegetation and animal)
- o Demographic changes from aquatic invasives
- o Habitat fragmentation from lack of focal area approach to conservation
- o Habitat fragmentation and degradation from chemical contaminants and disease
- o Habitat fragmentation from road effects
- o Lack of management and restoration of degraded Lepidoptera and/or Mussel habitat
- o Habitat loss from impairment of aquatic contiguity
- o Habitat degradation from impairment of water quality
- o Lack of research to guide threat assessment and prioritization of conservation planning.
- o Lack of information for monitoring and on-going assessment

Inventory/Research/Monitoring Needs:

- 85: Research invasive species management and monitoring protocols.
Measure: Completion of needed research by RI DEM or partners and # of monitoring protocols established.
- 91: Identify potential damaging aquatic invasives and exotics.
Measure: Completion of needed research by RI Dem or partners and # of new species added to management plans.
- 98 / 99: Assess pathways of introduction from water gardens and mail order
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions
- 114: Evaluate water quality effects on priority species.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- 118: Assess effects of water releases at dams.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- 119: Assess effects of water withdrawals.

- Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.*
- 120: Assess effects of prolonged drawdowns.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- 121: Assess effects of sedimentation.
Measure: Completion of needed research by RI DEM or partners; # of research recommendations incorporated into conservation actions.
- 125: Identify chemical sources and compounds of concern
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- 134: Identify areas of significant road effects in focal areas
Measure: # of sites identified and mapped and % incorporated into existing digital databases.
- 135: Assess means to mitigate road effects.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- 18: Identify priority sites for survey, especially for freshwater fish and invertebrates.
Measure: # of priority sites identified and % incorporated into existing digital databases.
- 19: Survey GCN species at priority sites.
Measure: # of sites surveyed for GCN species and % incorporated into existing digital databases.
- 24: Determine relative abundance of GCN species.
Measure: # of sites surveyed, # of GCN species inventoried, and % incorporated into existing digital databases.
- 64: Identify suitable restoration projects.
Measure: # of restoration projects identified and mapped and % incorporated into existing digital databases.
- 74: Evaluate need for predator control intervention for priority species.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- 122: Assess effects of stream bank disturbance.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.

Conservation Actions:

- 40: Outreach to golf courses in focal areas concerning impact of vegetation and chemical use.
Measure: # of golf courses contacted within focal areas and # of golf courses implementing recommendations
- 41: Outreach to nurseries in focal areas concerning chemical use.
Measure: # of nurseries contacted in focal areas and # of nurseries implementing recommendations.
- 82: Coordinate incidental take programs with regional or national initiatives.
Measure: # of partners involved in incidental take programs and # of partners with incidental take actions incorporated into their plans.

- 86: Create and implement invasive species monitoring protocol.
Measure: # of sites with invasive monitoring protocols implemented and % incorporated into existing databases.
- 87 / 90: Coordinate invasive species management with other state and regional programs.
Measure: # of partners involved in invasive species programs and # of partners with invasive species management added to their plans.
- 92: Develop and implement sampling protocol for aquatic exotics.
Measure: # of sampling protocols developed and % incorporated into existing data bases.
- 96: Develop and implement program to mitigate effect of aquatic exotics.
Measure: # of mitigation projects established.
- 115: Develop strategies to mitigate aquatic degradation.
Measure: # of mitigation projects established.
- 116 / 117: Coordinate water quality protection with appropriate DOT, regional and federal programs.
Measure: Coordinate water quality protection with appropriate DOT, regional and federal programs.
- 126: Coordinate with mosquito abatement personnel for chemical management.
Measure: # of partners involved in water quality protection and # of partners with modifications to existing procedures to address water quality.
- 128: Coordinate chemical management with other state and regional programs.
Measure: # of partners involved in chemical management and # of partners with chemical priorities added to their plans.
- 136: Establish discussions with state and local D.O.T.
Measure: # of partners involved in on-going discussions to limit habitat fragmentation from road construction and # of road plans impacted.
- 137: Conduct road mitigations where required.
Measure: # of mitigation projects established.
- 158: Coordinate monitoring with other state and regional monitoring programs.
Measure: # of partners involved in monitoring and # of partners providing data for and using RI DEM databases.
- 80: Develop and provide educational program/materials to reduce incidental mortality and take from humans.
Measure: # of educational programs developed and delivered concerning human take and incidental mortality to GCN species.
- 109: Enhance habitat connectivity for priority species with fish ladders.
Measure: # of fish ladders established and # of sites with GCN species monitored over time.
- 111: Expand public awareness of fish passage issues.
Measure: # of educational programs developed and delivered concerning fish passage issues.
- 65: Implement priority restoration projects for Lepidoptera and/or Mussel habitat.
Measure: # of restoration projects implemented and # of restoration sites with GCN species monitored over time.
- 75: Develop predator control program to conduct intervention where appropriate for priority species.

- Measure: # of sites with predator control plans developed and # of predator control plans implemented.*
- 110: Enhance habitat connectivity for priority species with culverts.
Measure: # of culverts established and # of sites with GCN species monitored over time.
- 157: Continue established long-term monitoring protocols.
Measure: # of sites with monitoring and % incorporated into existing databases.

Habitat Level Conservation Actions for Key Habitats and their GCN Species

Each of the six broad habitat groups containing Rhode Island's key habitats has been assessed for its location, condition, associated GCN species, and degree of threat(Table 4.1). Priority conservation actions to address needs and/or threats have been identified. Summaries for each key habitat are presented here and the complete list of threats is found in Appendix 3 and conservation actions in Appendix 4. The following table lists each key habitat as well as its relative condition (E, G, F, P = excellent, good, fair, poor) and threat (H, M, L – high, medium, low) level. U indicates that insufficient information or knowledge exists to assign a qualitative rank.

Table 4.1 Condition of Rhode Island's Key Habitats

Broad Habitat Grouping Level I & II		Key Habitat Level III	#	Threat	Condition	Comment
Forests	Deciduous Forest	Deciduous forest beech-maple	1	M	G	
		Deciduous forest oak/heath	2	M	G	Oak forests generally in good condition relatively speaking for a widespread community.
		Deciduous forest oak-hickory	3	M	G	
		Deciduous forest oak/holly	4	M	G	
		Deciduous forest unspecified	5	U	U	

Broad Habitat Grouping Level I & II		Key Habitat Level III	#	Threat	Condition	Comment	
	Evergreen Forest	Evergreen forest hemlock	6	H	F	Although widespread, threat reflects woolly adelgid and conversion of these forests to deciduous types; condition fair because many lost already.	
		Evergreen forest pine	7	M	G		
		Evergreen forest red cedar	8	M	F		
		Evergreen forest spruce (plantation)	9	L	F		
		Evergreen forest unspecified	10	U	U		
	Evergreen Forest Pitch Pine Communities	Evergreen forest pitch pine/oak	11	H	F		
		Evergreen forest pitch pine/scrub oak barren	12	H	F	Threat is high for all Pitch Pine types because highly developable; also fire gone to maintain barrens. Condition is fair based on outright loss of habitat and succession in areas that have not burned.	
	Mixed Forest	Mixed forest deciduous unspecified	13	M	G		
		Mixed forest evergreen unspecified	14	M	G		
		Forest unspecified	15	U	U		
	Non-forested Terrestrial	Agriculture	Agricultural cropland hay	16	H	P	
			Agricultural grazing	17	H	P	
Idle agriculture			18	M	F		
Agricultural land unspecified			19	U	U		

Broad Habitat Grouping Level I & II		Key Habitat Level III	#	Threat	Condition	Comment
	Early Successional	Maritime grassland	20	H	F	Threat is high because due to development pressure; condition of grasslands fair because little is left of historic range. (These are not "managed" habitats).
		Coastal shrubland	21	H	G	
	Sparsely Vegetated	Barren land unspecified	22	U	U	
		Beach grass dune	23	M	F	
		Freshwater beach	24	M	G	
		Gravel pits and quarries	25	L	G	
		Inland dune / cobble	26	H	P	
		Inland dune / sand barren	27	H	P	Very small occurrences and no fire to maintain them naturally.
		Natural quartz rock outcrops	28	M	F	Not much of this habitat type.
Wetland	Emergent Wetland	Emergent fen/bog	29	M	F	
		Coastal plain quagmire	30	M	G	
		Emergent marsh deep	31	M	F	
		Emergent marsh shallow / wet meadow	32	M	F	
		Freshwater wetland unspecified	33	U	U	
		Coastal plain pondshores	34	M	G	Coastal plain ponds have been conservation targets for many years and many have been secured.

Broad Habitat Grouping Level I & II		Key Habitat Level III	#	Threat	Condition	Comment	
	Shrub Wetland	Shrub bog unspecified	35	M	G	Although not abundant, community is generally in good condition and protected by wetlands regulations.	
		Shrub swamp alder	36	M	G		
		Shrub swamp water willow	37	U	U		
	Forested Wetland	Forested coniferous wetland white cedar	38	M	G	Although of regional conservation concern, Rhode Island white cedar habitats generally in good condition and widely distributed.	
		Forested coniferous wetland unspecified	39	U	U		
		Forested deciduous red maple swamp	40	M	F	Although a common community, subject to fragmentation and isolation	
		Forested deciduous wetland unspecified	41	M	F		
	Freshwater	Springs	Springs	42	H	F	More work needed to assess this habitat type.
		Rivers Stream	River blackwater creek	43	M	F	
River upper perennial			44	M	G		
River lower perennial			45	M	F		
Lakes and Ponds		Lacustrine eutrophic lake/pond	46	M	G		
		Lacustrine oligotrophic lake/pond	47	M	G		
		Permanently fishless pond	48	H	F		
	Seasonally flooded pond	49	H	G			

Broad Habitat Grouping Level I & II		Key Habitat Level III	#	Threat	Condition	Comment
		Semi-permanently flooded pond	50	H	G	Little protection offered by regulation; no protection of surrounding uplands.
Marine and Estuarine	Intertidal	Estuarine intertidal emergent brackish marsh	51	M	G	
		Estuarine bluff clay	52	L	G	Most of the estuarine/maritime communities are relatively stable with threats reduced in recent decades by regulation.
		Estuarine rocky shore bedrock	53	L	G	
		Estuarine unconsolidated shore sand dune	54	U	U	
		Estuarine unconsolidated shore cobble / shell	55	L	G	
		Estuarine beaches unspecified	56	M	F	
	Subtidal	Estuarine subtidal aquatic bed rooted vascular	57	M	G	
		Hard / Rocky Bottom	58	U	U	
		Soft Bottom / Unconsolidated Sediments	59	U	U	
		Varied Bottom / Invertebrate Beds	60	U	U	
		Estuarine / Marine (open water)	61	L	G	
Other		Predator free islands	62	M	F	
		Urban	63	L	E	
		Unknown	64	U	U	

It is important to note that GCN species are presented here at the most appropriate levels/ scales for conservation actions or needs. GCN species are listed under the most broad habitat category if they occur in more than one key habitat. However, if a species is specific to a key habitat, it is listed in that habitat. Therefore, for many of the key habitats where only a few species are listed, other , more generalist habitat GCN species also occur, but their conservation actions are listed under the broader habitat grouping.

Threats and actions are also presented at the most appropriate level to avoid redundancy. Every attempt has been made to present them at the broadest habitat level and they have

been rolled up from the specific habitat to the general category whenever actions or threats were common. A detailed list of all threats for each habitat is found in Appendix 3 and Appendix 4 lists all conservation actions and needs for each habitat.

Forested Habitats (Upland)

Description and Location: Forests are defined by Anderson et al. (1976) as having a tree-crown aerial density of at least 10 percent crown closure, stocked with trees capable of producing timber or other wood products, and exerting an influence on the climate or water regime. Anderson et al. (1976) classifies forests into three categories: Deciduous, Evergreen, and Mixed. In Rhode Island these categories are further classified by Enser and Lundgren (2005) into 12 upland forest communities and several cultural (planted) types are recognized as well. A total of 15 Level III forest types have been identified as key habitats that support GCN species:

Deciduous Forests

- Deciduous Forest Beech-Maple
- Deciduous Forest Oak/Heath
- Deciduous Forest Oak-Hickory
- Deciduous Forest Oak/Holly
- Deciduous Forest Unspecified

Evergreen Forests

- Evergreen Forest Hemlock
- Evergreen Forest Pine
- Evergreen Forest Red Cedar
- Evergreen Forest Spruce (Plantation)
- Evergreen Forest Unspecified

Pitch Pine Communities

- Evergreen Forest Pitch Pine-Oak Barren
- Evergreen Forest Pitch Pine/Scrub Oak Barren

Mixed Forests

- Mixed Forest Deciduous Unspecified
- Mixed Forest Evergreen Unspecified
- Forest Unspecified

Situated in the southern New England portion of the Appalachian Forest, Rhode Island forests are dominated by deciduous trees, the primary species being oaks (*Quercus* spp.) and red maple (*Acer rubrum*). Coniferous forests constitute about 15 percent of the state's forest land with white pine (*Pinus strobus*), pitch pine (*Pinus rigida*), and hemlock (*Tsuga canadensis*) the principal species, and mixed deciduous/coniferous stands are also common (Alerich 2000). The principal forests of the state are defined by the US Forest Service Forest Legacy Program

as the western half of mainland Rhode Island, and a section of eastern Newport County in the interior portions of the towns of Tiverton and Little Compton.

Mature forests have many attributes beneficial to wildlife: an understory with herbaceous plants and shrubs for food and cover; bole cavities for nesting; bark flaps for feeding and roosting, and large dead trees, standing and lying in the forest floor. Studies of forest-nesting birds, including Robbins et al. (1989), have demonstrated that larger forest tracts, ranging up to 1000's of hectares, support the highest diversity of forest-interior specialists. This group is represented in the Northeast by the following GCN species: cerulean warbler, wood thrush, worm-eating warbler, Baltimore oriole, black-billed cuckoo, black-throated blue warbler, Louisiana waterthrush, scarlet tanager, Canada warbler, blackburnian warbler, rose-breasted grosbeak, eastern wood-pewee, black-and-white warbler, hairy woodpecker, purple finch, northern goshawk, red-shouldered hawk, sharp-shinned hawk, Cooper's hawk, and barred owl (Dettmers and Rosenberg 2000, Hodgman and Rosenberg 2000, Rosenberg 2004).

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 windthrows and insect or other pathogen outbreaks that killed individuals or small groups of trees, resulting in canopy breaks (Bormann and Likens 1979, Seymour et al. 2002). Larger disturbances from hurricanes or wildfires occurred less frequently. Natural disturbance produces forests that are structurally diverse at different heights, with dense nesting cover at the shrub and or low/canopy levels that support a higher diversity of forest-nesting species (Dettmers and Rosenberg 2000).

Some species associated with successional habitats of regenerating forests have also been identified as GCN species in the Northeast include blue-winged warbler, prairie warbler, American woodcock, eastern towhee, whip-poor-will, and yellow-breasted chat (Dettmers and Rosenberg 2000). Seedling/sapling forests and other younger age class forests support pioneer trees and a higher diversity of shrubs and herbaceous plants that provide unique nesting and feeding habitats (Brooks 2003). Loss of successional forest in the northeast due to fire suppression, reduction in timber harvest and other disturbances – including development – have, and could continue to, further reduce the distribution of successional forest habitats (Askins 2001, Litvaitis 2003, DeGraaf and Yamasaki 2003). Further reduction in early successional forest habitats in Rhode Island could lead to declines in some GCN species including ruffed grouse, New England cottontail, American woodcock, prairie warbler and chestnut-sided warbler. Detailed habitat descriptions and conservation actions for some of these species are found in the following: Pitch Pine Habitats (prairie warbler, eastern towhee, whip-poor-will), Coastal Shrubland (yellow-breasted chat, American woodcock), and Old Field/Idle Agriculture (blue-winged warbler).

The challenge and opportunity exists in Rhode Island to manage the state's forests with an appropriate balance of interior forest and areas of broader use and management to capture a mix of forest age classes and structure to provide for forest health and wildlife diversity.

Condition: Considering its long history and level of economic development, the current amount of forested land in Rhode Island is remarkable. Nearly all of Rhode Island's pre-

settlement forest was eliminated from the landscape by the early 1800's, cleared to supply the needs of an expanding population for lumber, charcoal and other wood products, and for raising crops and grazing livestock. It has been estimated that 80% of the state was devoted to farming by 1850 (Griffiths 1965). As the fertile lands of the Midwestern United States became the nation's agricultural focus, Rhode Island farms were abandoned and the populace concentrated in urban centers. Abandoned farmland reverted to forest, and in 1960 it was estimated that more than 70% of the state was forested. Since that time there has been a gradual but steady decline in the state's forest land – reduced to 60% by 1985, and 59% by 1998 (Butler and Wharton 2002).

The most recent US Forest Service inventory of Rhode Island's forests in 1998 (Alerich 2000) indicates that forest covers 59% of the state, or about 393,000 acres. This figure compares with 63.6% (411,800 acres) estimated in 1985, or an average loss of roughly 1400 acres/year during the thirteen years between surveys. Using this rate of loss, a 2005 estimate of forest cover in Rhode Island can be placed at 383,000 acres. This figure represents a decline in forest cover since the modern-day peak of the 1960's when more than 75% of the state was forested. However, there is significantly more forested land today when contrasted with the agricultural era circa 1850 when about 20% of the state was forested (Griffiths 1965).

Results of the 1998 survey also show that Rhode Island's forests have continued to mature with 54% classified as sawtimber stands, which have the majority of their stocking in large trees. The increase of 20% in this size class since 1985 reflects the aging of trees in the poletimber category, which declined to 40% of forest cover during the same period, with seedling/sapling stands remaining constant at 6% cover (Alerich 2000). This inventory indicates that the forests of Rhode Island have matured during the past several decades.

Although there are more areas with trees in Rhode Island than were present 100 years ago, there are today few areas that have large enough core areas to contain the full complement of expected species and concomitant ecosystem processes. According to Rosenberg et al. (2003), some key characteristics that determine a forest's quality as breeding bird habitat include its size and shape, degree of isolation from other forests, and surrounding land use. Rhode Island forest patches are becoming smaller and more isolated by fragmentation features, including roads and development. A recent report by Ewing and Kostyack (2005) identifies how suburban sprawl is one of the key causes of forest fragmentation, and that this development pattern is proceeding unchecked in many communities. According to the Partners in Flight Southern New England Plan (Dettmers and Rosenberg 2000), impacts of forest fragmentation are a major concern in this region. Rosenberg et al. (2003) lists key characteristics determining a forest's quality as breeding bird habitat as size and shape, degree of isolation from other forests, surrounding land use, and its age and structural development. An overview of these forest legacy features such as downed logs, dead trees, etc., large patch attributes and the associated wildlife is featured in Keddy and Dunscomb (1996).

The age and structural development of forests also influences their species composition. In recent years there has been an overall maturation of Rhode Island's forests and consequent reduction in the amount of under-story vegetation that is critical for ground-nesting birds. A proliferating deer herd is contributing to defoliation of the understory vegetation in some areas

of the state, and efforts to curb herd growth must include access to private property to be effective. Some of the structural characteristics of forests can be manipulated by forest and wildlife managers to benefit certain species of birds.

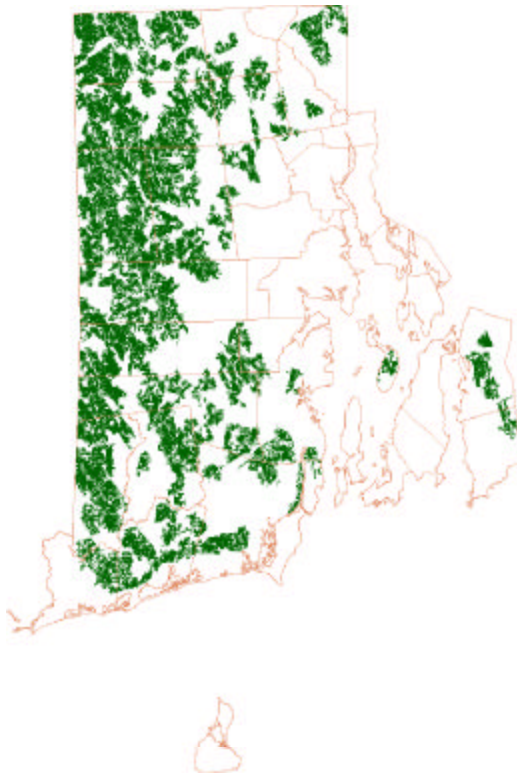
The Nature Conservancy has recently assessed the forest matrix blocks in Rhode Island and adjacent areas, and this assessment found that approximately 55% of the Wood River Barrens (46,000 acres) is in conservation ownership and includes three core roadless areas – one of 11,000 acres, a second at 6,000 acres and the last at roughly 4,000 acres. The overall viability, size and condition of the Wood River Barrens are rated as “fair,” however, due to a lack of mature forest features (i.e., snags, structural diversity, big trees, coarse woody debris) and insufficient connectivity to other forest areas. The landscape context is considered “good,” but the Wood River Barrens are most threatened by the loss of forest interior habitat within the core forest and fragmentation of the forest block; primary home development was considered the most significant threat, and if left unabated, the forest block would become seriously degraded (K. Essington, TNC, personal communication).

This plan recognizes within forest habitat categories that some priority species require large tracts of relatively mature forest where forest management like thinning and cutting are not appropriate. Species that require such areas include cerulean warbler, Acadian flycatcher, pileated woodpecker, northern goshawk, and Louisiana waterthrush. On the other hand, several other birds species contained within the deciduous Forest Unspecified habitat category would benefit from manipulations designed to create and maintain early seral stages of vegetation. Such priority species include American woodcock, blue-winged warbler, chestnut-sided warbler, prairie warbler, and field sparrow. For the purpose of this plan, early successional forest types are contained within this category and are considered to be distinct from maritime shrub lands, which are located primarily along the coast, have different maintenance mechanisms, and have slightly different values to bird species. The key to balancing the needs of GCN species that require large tracts of forested land in Rhode Island will be the determination and designation of areas to be maintained as mature forest as well as those areas that would benefit from active management.

The challenge and opportunity in Rhode Island is to manage the state's forests with a balance of stand size classes across the larger landscape, while retaining or expanding the large forest cores (road-less areas) to meet the needs of forest interior species. There are only a small set of options to meet the needs of those more sensitive species, so forest conservation efforts should target existing large tracts of mature deciduous forest and well-forested landscapes, while reducing edge effect to create larger forest blocks. Areas outside of these forest cores provide numerous opportunities to be managed for fauna dependent on species or structure of younger forests or early successional habitats. Landscape-level analyses need to be conducted to determine the highest priority areas for forest conservation in the state to inform a statewide plan of land protection and management. This plan begins the process of identifying core forest landscapes for conservation by RI DEM DFW and its partners. Landscape analyses should also include an assessment of coastal shrubland, pitch pine, and managed shrub/open fields to determine the conservation needs for GCN species inhabiting these habitats.

Deciduous Forest

Description and Location: Anderson et al. (1976) defines “deciduous forest land” as all forested areas having a predominance of trees that lose their leaves at the end of the frost-free season or at the beginning of a dry season. These include hardwoods such as oak, maple, or hickory and the “soft” hardwoods, such as aspen (*Populus tremuloides*). Rhode Island is situated in the New England lowlands portion of the Eastern Broadleaf Forest Province, as defined by Bailey (1995). This Province is characterized by a temperate deciduous forest, dominated by tall broadleaf trees that provide a dense, continuous canopy in summer, and shed their leaves completely in the winter. Lower layers of small trees and shrubs develop weakly, and in spring a luxuriant ground cover of herbs quickly develops, but is greatly reduced after trees reach full foliage and shade the ground. Several forest associations have been identified in this Province and Rhode Island is included in the Appalachian oak association, occurring east of the mountains, where the dominant tree species are oaks and American chestnut (*Castanea dentata*) was formerly common.



Rhode Island's deciduous forests can be divided further into several key community types that correspond in part to soil type, moisture regime and topographic position: Beech- Maple, Oak / Heath, Oak- Hickory, and Oak / Holly Forest. Descriptions below are based on Enser and Lundgren (2005). These four primary deciduous forest types often integrate across the landscape, and several variants (and additional types) are described in more detail in Enser and Lundgren (2005). In addition, higher representation in the overstory by conifers (usually white and/or pitch pine) can result in some stands being typed as Mixed Forests (deciduous and conifer mix), which are described in a separate section below.

Condition: Like all forested habitats, fragmentation and encroachment of undesirable matrix conditions are reducing and isolating patches of quality forest. Although there are many areas with trees in the state, there are very few patches that are large enough to have sufficient protected core areas to function as high quality forests. Because the GCN species here are Lepidoptera, aerial spraying, release of parasitoids and general issues of forest health and disease may threaten habitats.

Threats to Species and Habitat:

- Loss of habitat from plant succession
- Habitat loss of critical micro-features
- Lack of information from research to address habitat
- Lack of information for monitoring and on-going assessment
- Demographic changes from excessive predation (animal)
- Habitat fragmentation and degradation from human disturbance
- Habitat loss and degradation from invasive species (vegetation and animal)
- Lack of research to guide threat assessment and prioritization of conservation planning

It is important to note for each specific habitat that other GCN species depend on forests but are not listed here – e.g., bats, invertebrates (dragonflies beetles moths and more), amphibians, and others. Instead, they are listed and addressed under the statewide or broader forest categories (i.e. #5 deciduous forest unspecified). The following GCN species are specific or focal to these specific communities. This applies to all subsequent habitats as well.

1) **Deciduous Forest Beech - Maple [DFBM]**

Description and Location: Enser and Lundgren (2005) define this habitat as Beech – Maple – Red Oak Forest. It occurs on moist, well-drained sites and is characterized by several co-dominant trees including American beech (*Fagus grandifolia*), sugar maple (*Acer saccharum*) and red oak (*Quercus rubra*). Common associates are white ash (*Fraxinus americana*), yellow birch (*Betula alleghaniensis*), hop hornbeam (*Ostrya virginiana*), red maple (*Acer rubrum*), basswood (*Tilia americana*), and American elm (*Ulmus americana*). The tall shrub layer includes American hornbeam (*Carpinus caroliniana*), witch hazel (*Hamamelis virginiana*), and flowering dogwood (*Cornus florida*), and occasional representation by northern species such as striped maple (*Acer pensylvanicum*) and hobblebush (*Viburnum lantanoides*). The ground layer is generally high in species diversity with many spring ephemerals and ferns. This type is closely related to the “Northern Hardwood Forest” typical of northern New England. In Rhode Island, Deciduous Forest Beech- Maple type is located mostly in the northern and western parts of the state, such as at the George Washington Management Area in Glocester.

Condition: The rich variant of Beech / Maple Forest is an uncommon habitat type in Rhode Island, as it is restricted to richer (circumneutral) soils. Because the GCN species in this category requires a specific food plant (wild columbine) that requires this condition, only a small proportion of all deciduous forests will contain this animal species. Additional

inventory and evaluation of the habitat for this species are warranted before a thorough evaluation can occur.

GCN Species:
Butterflies / Moths
Erynnis lucilius

Inventory / Research / Monitoring Needs and Conservation Actions

- o Identify priority parcels to retain as core forest areas with minimal management.
Measure: # of parcels identified and mapped and % incorporated into existing digital databases.
- o Research additional habitat use issues. Because *Erynnis lucilius* is linked to its food plant wild columbine, appropriate habitat will be the subset of deciduous forests that contain this species. Patches of wild columbine will have to be located and searched for the presence *E. lucilius*.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Determine metapopulation structure.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Initiate monitoring of primary resources (food plant)
Measure: # new and existing sites assessed and monitored, # of new populations found

2) Deciduous Forest Oak / Heath [DFO]

Description and Location: Oak / Heath Forest occupies drier acidic soils and is dominated by black oak (*Quercus velutina*) and/or scarlet oak (*Q. coccinea*) along with common associates, white oak (*Q. alba*), black birch (*Betula lenta*), black gum (*Nyssa sylvatica*), red maple and sassafras (*Sassafras albidum*). White pine (*Pinus strobus*) and/or pitch pine (*P. rigida*) may also be present in small amounts. American chestnut (*Castanea dentata*) was a common associate prior to the chestnut blight, although saplings are still found in the understory. This type is often referred to as a “heath” type because the shrub layer is composed primarily of ericaceous shrubs, with characteristic species being black huckleberry (*Gaylussacia baccata*), mountain laurel (*Kalmia latifolia*), and blueberry (*Vaccinium pallidum*). Oak / Heath Forests are distributed statewide but are most abundant in the southern part of the state. Chestnut Oak Forest (dominated by chestnut oak, *Quercus prinus*) is a closely related type that can be encompassed as a variant of the Oak / Heath Forest for the purposes of this plan.

Condition: Because it typically occupies sandy outwash soils and generally acidic conditions, this forest type is among the most common in Rhode Island. Several examples of this habitat occur on protected lands.

GCN Species

Butterflies / Moths

Callophrys augustinus

Parrhasius m-album

Psaphida thaxterianus

Inventory / Research / Monitoring Needs and Conservation Actions

All GCN

- Identify priority parcels to retain as core forest areas with minimal management.
Measure: # of parcels identified and mapped and % incorporated into existing digital databases.
- Research additional habitat use issues. The food plants of these species are not thought to be limiting populations, but populations may nevertheless be more local than the primary cover type would suggest. Additional inventory and analysis of habitat requirements of these species are desirable.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- Determine metapopulation structure.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- Initiate monitoring of species at breeding sites.
*Measure: # of sites with monitoring and % incorporated into existing databases.
Periodic site visits are desirable to ascertain continuance of populations, but annual counting of individuals is not practical.*

3) Deciduous Forest Oak - Hickory [DFOH]

Description and Location: On well-drained sites where soils are slightly more mesic and nutrient-rich, an Oak - Hickory Forest may develop that is typically dominated by red oak (*Q. rubra*) or black oak (*Q. velutina*), with lesser representation by white oak (*Q. alba*) and hickories, including pignut hickory (*Carya glabra*), shagbark hickory (*C. ovata*), and mockernut hickory (*C. tomentosa*). Other associated trees include white ash (*Fraxinus americana*), red maple (*Acer rubrum*), tulip tree (*Lireodendron tulipifera*) and white pine (*Pinus strobus*). A tall shrub understory is typically present with saplings of the canopy trees along with witch hazel (*Hamamelis virginiana*) and flowering dogwood (*Cornus florida*). Common low shrubs are blueberries (*Vaccinium pallidum* and *angustifolium*), maple-leaved viburnum (*Viburnum acerifolium*), and sheep laurel (*Kalmia angustifolia*). Oak – Hickory Forests are primarily found in the north and western part of the state.

Condition is described above; refer to the narrative at the beginning of the section on forest habitats and in more detail in Butler and Wharton (2002).

GCN Species:Butterflies / Moths*Satyrrium caryaevorum***Inventory / Research / Monitoring Needs and Conservation Actions**

For all GCN species:

- Identify priority parcels to retain as core forest areas with minimal management.
Measure: # of parcels identified and mapped and % incorporated into existing digital databases.
- Research additional habitat use issues. Existing RIGIS data layers do not allow identification of this habitat type, so additional field surveys and identification of key habitat parcels containing this species are desirable.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- Determine metapopulation structure.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- Initiate monitoring of species at breeding sites.
Measure: # of sites with monitoring and % incorporated into existing databases. Periodic site visits are desirable to ascertain continuance of populations, but annual counting of individuals is not practical.

4) Deciduous Forest Oak - Holly [DFH]

Description and Location: Another more restricted forest type, Oak – Holly Forest is found primarily near the coast, especially in the towns of Tiverton and Little Compton in Newport County, and South Kingstown and Richmond in Washington County. These are oak-dominated forests with a prominent understory of American holly (*Ilex opaca*), and generally found on moister, moderately well-drained soils, often topographically situated between poorly drained forested wetlands and drier Oak – Heath forests. The principle trees of the Oak-Holly type are black and/or scarlet oaks, with red maple as a co-dominant. Other associates include white oak, American beech, serviceberry (*Amelanchier* spp.) and American hornbeam. The understory includes highbush blueberry (*Vaccinium corymbosum*), sweet pepperbush (*Clethra alnifolia*), wild grape (*Vitis* spp.), and greenbriers (*Smilax* spp.).

Condition: There are only two main areas of the state that support this forest type in Rhode Island, so its overall acreage is fairly small. Good representatives of this forest type occur on conservation lands, but further evaluation is needed to determine if this is sufficient to meet GCN species needs. A number of examples are intersected with roads and trails, so fragmentation may be an issue. This forest type already falls largely within existing conservation parcels, although some outlying patches of it are unprotected in the towns of Richmond, South Kingstown, Tiverton and Little Compton. Because the GCN species here are Lepidoptera, aerial spraying, release of parasitoids and general issues of forest health and disease may threaten habitats.

GCN Species:**Butterflies / Moths***Callophrys henrici**Thysanopyga intractata**Metaxaglaea violacea***Inventory / Research / Monitoring Needs and Conservation Actions**

For these GCN species:

- o Identify priority parcels to retain as core forest areas with minimal management.
Measure: # of parcels identified and mapped and % incorporated into existing digital databases.
- o Research additional habitat use issues. Existing RIGIS data layers do not allow identification of this habitat type, so additional field surveys and identification of key habitat parcels containing this species are desirable.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Determine metapopulation structure.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Initiate monitoring of species at breeding sites.
*Measure: # of sites with monitoring and % incorporated into existing databases.
Periodic site visits are desirable to ascertain continuance of populations, but annual counting of individuals is not practical.*

5) Deciduous Forest Unspecified [DF]

Description and Location: The principal species of conservation concern associated with deciduous forests are birds. The GCN species in this category are in general not obligated to any particular deciduous forest cover type. However, because they are sensitive to patch size and are found primarily in larger contiguous forest tracts, they are especially vulnerable in Rhode Island. Several studies, including Robbins et al. (1989), Hunter et al. (2001) and Litvaitis (2003), have shown how the fragmentation of forests by human development patterns contributes to a decline in nesting bird diversity as the average size of remaining forest tracts becomes smaller. Priority bird species that have been identified by Partners in Flight for northeastern deciduous and mixed forests include cerulean warbler, wood thrush, worm-eating warbler, Baltimore oriole, black-billed cuckoo, black-throated blue warbler, Louisiana waterthrush, scarlet tanager, rose-breasted grosbeak, eastern wood-pewee, black-and-white warbler, hairy woodpecker, purple finch, northern goshawk, red-shouldered hawk, sharp-shinned hawk, Cooper's hawk, and barred owl (Dettmers and Rosenberg 2000, Hodgman and Rosenberg 2000, Rosenberg 2004).

Also included in this forest habitat, are some early successional forest species with different vegetation structure or area requirements from those of mature, interior forest birds (DeGraaf and Yamasaki 2003). The American Woodcock Management Plan – USFWS Region 5 (1996) identified the woodcock as a species in decline primarily due to the decline in the quality and

quantity of early successional forest habitat. Other GCN bird species such as ruffed grouse, field sparrow and brown thrasher share similar habitat requirements as the woodcock.

Condition is described above; refer to the narrative at the beginning of the section on forest habitats and in more detail in Butler and Wharton (2002).

GCN Species:

Birds

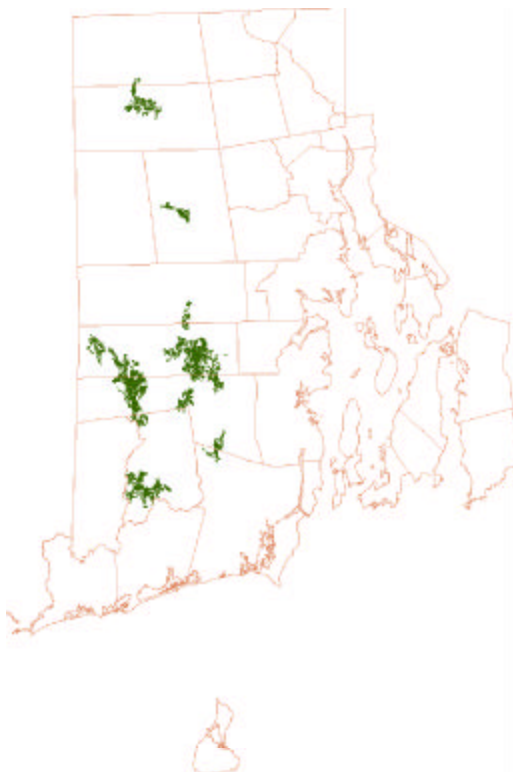
Acadian flycatcher	cerulean warbler	rose-breasted grosbeak
American woodcock	field sparrow	ruffed grouse
Baltimore oriole	great crested flycatcher	wood thrush
barred owl	hairy woodpecker	worm-eating warbler
black-and-white warbler	hooded warbler	yellow-billed cuckoo
blue-winged warbler	Louisiana waterthrush	yellow-throated vireo
broad-winged hawk	northern flicker	
brown thrasher	northern parula	<u>Reptiles</u>
	pileated woodpecker	eastern box turtle

Inventory / Research / Monitoring Needs and Conservation Actions

- o Research additional habitat use issues. (All GCN)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Identify priority parcels to retain as core forest areas with minimal management. (Birds*)
Measure: # of parcels identified and mapped and % incorporated into existing digital databases.
- o Control public access at certain priority sites. (Birds)
Measure: # of sites with restricted public access. Process for determining extent and volume of public access at priority species sites.
- o Initiate monitoring of species at breeding sites. (Birds*)
Measure: # of sites with monitoring and % incorporated into existing databases.
- o Develop strategy to maintain successional vegetation.
Measure: # of management plans developed
- o Identify parcels needing seral-stage management
Measure: Process and justification to identify parcels
- o Manage important habitats as appropriate
Measure: # of parcels or acreage of habitat maintained per year
- o Develop fire prescriptions for priority parcels. (eastern box turtle, ruffed grouse, American woodcock, brown thrasher, blue-winged warbler, field sparrow)
Measure: # of parcels with fire plans developed.
- o Implement burn management on priority parcels. (eastern box turtle, ruffed grouse, American woodcock, brown thrasher, blue-winged warbler, field sparrow)
Measure: # of parcels with fire plan implemented.
- o Expand public relations for fire management. (eastern box turtle, ruffed grouse, American woodcock, brown thrasher, blue-winged warbler, field sparrow)
Measure: # of public relations materials developed and distributed concerning fire management.

- o Evaluate need for nesting structures/boxes and identify priority sites for management. (hairy woodpecker, northern flicker, great-crested flycatcher)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Evaluate need for nesting substrate and identify priority sites for management. (eastern box turtle)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Identify concentration areas for non-breeding populations. (eastern box turtle, American woodcock)
Measure: # of sites identified and mapped and % incorporated into existing digital databases.
- o Evaluate use of migratory stopover/winter habitat. (eastern box turtle, American woodcock)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Determine metapopulation structure. (eastern box turtle)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Initiate monitoring of species at non-breeding sites. (eastern box turtle)
Measure: # of sites with monitoring; % incorporated into existing databases.

Evergreen Forest



Description and Location: Evergreen forests include all forested areas in which the trees are predominantly those that remain green throughout the year; these include both coniferous and broad-leaved evergreens (Anderson et al. 1976). In Rhode Island, evergreen forests are coniferous forest types characterized by hemlock (*Tsuga canadensis*) white pine (*Pinus strobus*), and/or pitch pine (*Pinus rigida*). (Pitch Pine Communities are described in the next section.)

Condition: Evergreen forests are described above in the narrative at the beginning of the section on forest habitats and in more detail in Butler and Wharton (2002).

Threats to Species and Habitat

- Habitat loss of critical micro-features
- Lack of information from research to address habitat and taxonomic issues
- Lack of information for monitoring and on-going assessment
- Habitat loss and demographic changes from invasive species (vegetation and animal)
- Habitat fragmentation and degradation from human disturbance
- Demographic changes from excessive predation (animal)
- Lack of research to guide threat assessment and prioritization of conservation planning

6) Evergreen Forest Hemlock [EFH]

Description and Location: This is represented by the Hemlock – Hardwood Forest type in Enser and Lundgren (2005), which ranges from pure stands of hemlock to mixed hemlock – hardwood forest. Hemlock occurs as a dominant or co-dominant tree in forest that are typically found on middle to lower slopes of ravines, on cool mid-elevational slopes, and in moist uplands on the edges of swamps. Associates include American beech (*Fagus grandifolia*), sugar maple (*Acer saccharum*), red maple (*Acer rubrum*), yellow birch (*Betula alleghaniensis*), black birch (*Betula lenta*), and red oak (*Quercus rubra*). Tuliptree (*Lireodendron tulipifera*) may also be locally present. The relative cover of hemlock is highly variable, ranging from nearly pure stands to as little as 20% of the canopy. In pure stands the closed canopy results in shrub and herbaceous layers that are sparsely vegetated. As with white pine, mature stands of hemlock may provide unique nesting opportunities for some birds (e.g., winter wren), but the diversity of breeding birds is relatively low. Nevertheless, conservation of large stands of this forest type is necessary to the overall goal of species conservation in Rhode Island. Hemlock Forests are located primarily in the northern and western parts of the state.

Condition: Hemlock is a species that is highly intolerant of fire, and therefore may have modestly increased during the past several decades with the advent of more coordinated forest fire suppression. However, in recent years this species has declined significantly as a result of infestation by the hemlock wooly adelgid. This insect pest is not only the cause of widespread mortality, but its threat has also been the impetus for some landowners to harvest stands of hemlock while they are still in marketable condition. Hemlock forests were always limited in this state, but in recent years entire stands have died (as at Long Pond/Ell Pond, where a formerly stately glade, dubbed the “cathedral” is totally dead). There is presently much concern for the future of this community type in Rhode Island. As noted above, Rhode Island’s

Hemlock forests are facing tremendous pressure from woolly adelgid infestation, and the future of this community type in Rhode Island is dubious. However, most GCN species that are found in Hemlock can also use other stands of mature conifer, so there are few (known) species completely dependent on Hemlock. The porcupine is the only such animal identified in the GCN process: they rely on hemlock browse for winter food

GCN Species:Mammals

porcupine (*Erethizon dorsatum*)

Inventory / Research / Monitoring Needs and Conservation Actions

- o Identify priority parcels to retain as core forest areas with minimal management.
Measure: # of parcels identified and mapped and % incorporated into existing digital databases.
- o Evaluate existing significant hibernacula.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Research additional habitat use issues.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.

7) Evergreen Forest Pine [EFP]

Description and Location: This includes White Pine – Oak Forest (Enser and Lundgren 2005) and White Pine Plantation. Generally, white pine does not occur naturally in pure stands, but is a common constituent in most upland Rhode Island forests in varying levels of dominance. White pine may be the predominant species in mixed deciduous/coniferous stands along with oaks (*Quercus* spp.) and a mix of other species including hickories (*Carya* spp.), hemlock (*Tsuga canadensis*), red maple (*Acer rubrum*), beech (*Fagus americana*) and other species. Pitch pine may be present as a minor component. Stands comprised of 90-100% white pine are prevalent on the Rhode Island landscape as the result of planting around reservoirs and within state forests and management areas. Without management these monotypic stands mature with closed canopies that greatly reduce light reaching the forest floor, nearly eliminating shrub and herbaceous plant growth. Although mature white pine stands provide nesting habitat for some uncommon birds (e.g., blackburnian warbler, yellow-rumped warbler), generally the diversity of breeding birds is low because of the absence of ground cover.

Condition: Rhode Island has many examples of pine forest, including several large tracts protected on public lands. Like all forested habitats, fragmentation and encroachment of undesirable matrix conditions are shrinking and isolating patches of quality forest. Although there are many areas with pine trees in the state, there are very few patches that are large enough and which have sufficient protected core areas to function as high quality forests. The GCN species identified as requiring this habitat type need large stands of mature white pine. The least flycatcher is a very localized nesting species in Rhode Island. They require large, widely-spaced pines with an open under-story. Nests are placed on

horizontal branches about 10-15 feet high. Brown creepers are less localized than least flycatchers, but they also require large pines. In fact, they require large *dead* pines whose bark has begun to exfoliate, because they build their nests behind slabs of loose bark.

GCN Species:

Birds

brown creeper

least flycatcher

Inventory / Research / Monitoring Needs and Conservation Actions

For all GCN species:

- o Identify priority parcels to retain as core forest areas with minimal management.
Measure: # of parcels identified and mapped and % incorporated into existing digital databases.
- o Research additional habitat use issues.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Control public access at priority sites.
Measure: # of sites with restricted public access.
- o Initiate monitoring of species at breeding sites.
Measure: # of sites with monitoring and % incorporated into existing databases.

8) Evergreen Forest Red Cedar [EFR]

Description and Location: Enser and Lundgren (2005) title this habitat as Red Cedar Rocky Summit community. It is a naturally occurring red cedar woodland on warm, dry, rocky ridges and summits. Vegetation may be patchy with areas of exposed bedrock. Eastern red cedar (*Juniperus virginiana*) is the characteristic tree, with understory vegetation dependent on site conditions. Sparse shrubs may include scrub oak (*Quercus ilicifolia*) or lowbush blueberries. Herbaceous plants include hairgrass (*Deschampsia flexuosa*), oat grass (*Danthonia spicata*) and Pennsylvania sedge. At inland sites, little blue stem (*Schizachyrium scoparius*), ebony spleenwort (*Asplenium platyneuron*), and a sedge (*Carex eburnea*) are common. There are also woodlands that are primarily a product of past land use, where red cedars seed in following clearing or agriculture use. This type is a successional stage and typically converts to other forest types if not subject to natural disturbance or active management.

Condition: The Red Cedar Rocky Summit community is generally widespread in Rhode Island but occurs as very small patches such as at Diamond Hill and Miller's Oak in Cumberland. Old field red cedar woodlands are found throughout the state. In many situations Red Cedar Rocky Summit is a transitional habitat, colonizing after abandonment of agricultural fields and eventually becoming overshadowed by oak and pine tree canopy. Because of the transient nature of this forest type, management may be required to maintain it. The Red Cedar Rocky Summit type is generally self-sustaining due to thin soils and exposure.

GCN SpeciesButterflies / Moths*Callophrys gryneus***Inventory / Research / Monitoring Needs and Conservation Actions**

- o Develop fire prescriptions for priority parcels.
Measure: # of parcels with fire plans developed.
- o Implement burn management on priority parcels.
Measure: # of parcels with fire plan implemented.
- o Expand public relations for fire management.
Measure: # of public relations materials developed and distributed concerning fire management.
- o Research additional habitat use issues.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Determine metapopulation structure.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.

9) Evergreen Forest Spruce (Plantation) [EFS]

Description and Location: Several non-native coniferous tree species have historically been employed in plantings around reservoirs and in state management areas. These tend to occur in monotypic plantations and include red pine (*Pinus resinosa*), spruces (*Picea* spp.), larch (*Larix decidua*), and less commonly Scotch pine (*Pinus sylvestris*). In general, these stands provide habitat for conifer generalists that also are found in other cover types such as White Pine or Hemlock. However, in rare instances, these plantations provide a unique habitat opportunity, exemplified by golden-crowned kinglets nesting in spruce stands.

Condition: Stands of planted spruce large enough to serve as habitat for golden-crowned kinglets and other conifer-obligate species are very uncommon and found primarily on reservoir properties and State Management Areas. Red pine, the most common species, has undergone widespread mortality due to infestation by a turpentine beetle, and managing agencies are currently removing stands of dead pines for regeneration with other species. Two spruce stands in the Burlingame Management Area suffered severe blow-down after recent hurricanes and in general, because these tree species do not reproduce in Rhode Island, eventually these stands will disappear.

GCN Species:Birdsgolden-crowned kinglet**Inventory / Research / Monitoring Needs and Conservation Actions**

- o Identify priority parcels to retain as core forest areas with minimal management.
Measure: # of parcels identified and mapped and % incorporated into existing digital databases.

- o Research additional habitat use issues.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Initiate monitoring of species at breeding sites.
Measure: # of sites with monitoring and % incorporated into existing databases.

10) **Evergreen Forest Unspecified [EF]**

Description, Location: As discussed under deciduous forests, nearly all of Rhode Island's pre-settlement forest was eliminated from the landscape by the early 1800's, but the abandonment of farmland and subsequent reversion to forest by the early 1900's resulted in nearly 70% of the state being forested by 1960. Since that time there has been a gradual but steady decline in the state's forest land to 59% in 1998.

All of the GCN species in this category are birds that require large areas of generally mature conifers for nesting. However, these species nest in a variety of coniferous cover types as long as the structure is suitable. Therefore they are retained in a more general forest category. For example, the blackburnian warbler utilizes mature stands of white pine within the Arcadia Management Area, but in northern Rhode Island it typically is found in mature groves of hemlock (Enser 1992). All of these species are area sensitive, i.e., they occur only in the largest forest tracts in western Rhode Island. Some, as northern goshawk, are very susceptible to disturbance around the nest and require remote forest tracts without extensive human activity.

Condition: According to the USDA Forest Service inventory of 1998 (Alerich 2000) the volume of white pine in Rhode Island forests has increased from 7% to 18% since 1953, whereas oaks have declined from 50% to 43% during the same period. This volume increase reflects the maturation of white pine stands as identified by the acreage figures in the oldest (saw timber) class. In 1985, there were 14,000 acres of white pine forest in the saw timber class and by 1998 this figure had increased to more than 24,000 acres (Alerich 2000, Butler and Wharton 2002).

GCN Species:

Birds

blackburnian warbler	long-eared owl	red-breasted nuthatch
Black-throated green warbler	northern goshawk	winter wren
blue-headed vireo	purple finch	yellow-rumped warbler

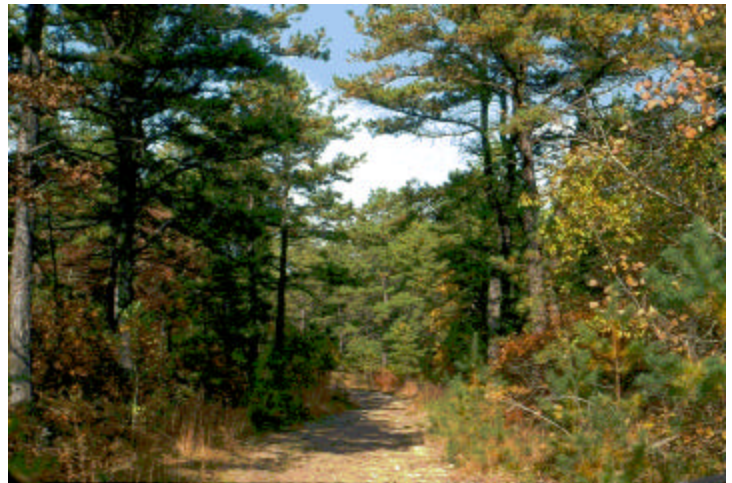
Inventory / Research / Monitoring Needs and Conservation Actions

- o Identify priority parcels to retain as core forest areas with minimal management- (All GCN)
Measure: # of parcels identified and mapped and % incorporated into existing digital databases.
- o Control public access at priority sites. (All GCN)
Measure: # of sites with restricted public access.
- o Research additional habitat use issues. (All GCN)

- Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.*
- o Initiate monitoring of species at breeding sites. (blackburnian warbler, black-throated green warbler, blue-headed vireo, purple finch, red-breasted nuthatch, winter wren, yellow-rumped warbler)
- Measure: # of sites with monitoring and % incorporated into existing databases.*

Pitch Pine Communities [EFPS, EFPO]

Description and Location: Pitch pine-dominated communities are dependent on the recurrent natural disturbance of fire to prevent succession to oak-dominated forests, and to stimulate the reproduction of fire-adapted plants, including pitch pine. Although pitch pine is always the dominant component of the canopy, the form of the canopy and the presence of other species in the understory depend on the specific fire history of the site. Where fires are frequent the canopy may consist of few individual trees within a matrix of scrub oak (*Quercus ilicifolia* and *Q. prinoides*). There may be occasional patches of bare sand with islands of low vegetation. Where fire has been precluded, pitch pine may form an almost closed canopy with a tall shrub understory and little ground cover.



Pitch pine dominated communities were historically widespread predominantly in Kent and Washington Counties on light, sandy soils of outwash and glaciofluvial origin. One estimate of the original coverage of pitch pine communities in Rhode Island is 30,000 acres (Bromley 1935). Following settlement, these woodlands were exploited for agriculture and later residential development, disappearing over a considerable portion of the former range. Also,

in areas where fire has been controlled pitch pine communities are slowly being replaced with oak-dominated forests. Today, pitch pine barrens cover less than a quarter of their original extent, the best examples occurring within two linear bands across southern Rhode Island; one along the northern edge of the Charlestown recessional moraine, the second extending from the Arcadia Management Area in Exeter, across West Greenwich to Warwick and Prudence Island.

Pitch pine communities support an assemblage of priority butterfly and moth species, many of which depend on a single food plant. Examples include the frosted elfin and persius duskywing which depend on wild lupine, and the barrens buck moth which utilizes scrub oak. Tiger beetles (*Cicindela* spp.) are a characteristic group that requires open sandy areas for hunting and burrowing. Embedded within some pitch pine areas are vernal ponds and other shallow wetlands that contribute a microhabitat supporting a unique fauna that includes the uncommon eastern spadefoot. Young, fire-maintained pitch pine woodlands provide nesting habitat for priority birds including whip-poor-will, prairie warbler, eastern towhee, and field sparrow.

Pitch pine communities also occur in small patches on rocky summits, but have a slightly different ecology and are less vulnerable to land use changes. This plan focuses on the sandplain pine barrens which are the major barrens type in the state and which support the GCN species below.

Condition: Pitch pine-dominated communities have been lost from more than 75% of their historic range in Rhode Island because of two factors. First, the level topography and well-drained soils characteristic of pitch pine communities are conducive to urban and suburban development, which has included the creation of large sand and gravel extraction operations. Also, continued development on lands adjacent to these communities increases the potential for conflicts with neighboring landowners regarding management by controlled burning.

Secondly, suppression of wildfire has prevented the natural maintenance of these communities and allowed natural succession to oak-dominated types that do not support the diversity of microhabitats required by the unique barren fauna. Succession results in canopy closure with an increase in shrub dominance and reduction in grasses, forbs, and other groundcovers.

Threats to Species and Habitat: (In addition to the above general forest threats, these apply to pitch pine communities)

- Fire suppression and lack of fire resulting in canopy closure and loss of groundcover component.
- Conversion to oak-dominated forests within which there is no development of open, sandy patches, and consequent loss of the associated fauna.
- Suburban development and habitat fragmentation; creation of sand and gravel extraction facilities.
- Habitat loss affecting bird species requiring specific understory characteristics.

11) Pitch Pine – Oak [EFPO]

Description and Location: Enser and Lundgren (2005) describe the Pitch Pine – Oak Forest as mixed coniferous/deciduous forest community that typically occurs on well drained, sandy soils of glacial outwash plains and moraines, and also on thin, rocky soils of ridge tops. Dominant trees are pitch pine (*Pinus rigida*), comprising over 25% cover, mixed with one or more oaks including scarlet oak (*Quercus coccinea*), white oak (*Q. alba*), and black oak (*Q. velutina*). The relative proportions of oak and pine are highly variable within this type. Shrub layer is well- developed with scrub oak (*Quercus ilicifolia*), blueberry, and black huckleberry (*Gaylussacia baccata*). The herb layer is generally sparse, characteristic plants including bracken fern (*Pteridium aquilinum*), wintergreen, a sedge (*Carex pensylvanica*), and pink lady's-slipper. This community usually develops in the absence of fire as a transition type between pitch pine/scrub oak barren and forest types dominated by oaks. Pitch Pine – Oak Barrens are located in portions of Providence, Kent, and Washington Counties.

Condition: See above general condition for Pitch Pine Communities

GCN Species:Beetles*Cicindela patruela**Cicindela tranquebarica*Birds

black-billed cuckoo

whip-poor-will

Reptiles

eastern hognose snake

Inventory / Research / Monitoring Needs and Conservation Actions

- o Research additional habitat use issues. Continue to protect, through acquisition and easement, large tracts of current and potential pitch pine habitat, including buffer lands needed to prevent conflicts with neighboring landowners over the use of controlled burning. Work with USFWS, TNC and other land conservation partners to identify, conserve and restore such tracts. Tracts containing isolated wetlands (i.e., vernal ponds, bogs) and/ or priority species should receive special attention. (All GCN)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Develop fire prescriptions for priority parcels. (All GCN)
Measure: # of parcels with fire plans developed.
- o Implement burn management on priority parcels. (All GCN) Restore pitch pine-dominated communities through the use of prescribed burning. In areas where burning is prohibitive, investigate other techniques to restore and maintain pitch pine-dominated communities at the successional stage most conducive to the specialized fauna.
Measure: # of parcels with fire plan implemented.
- o Expand public relations for fire management. (All GCN) Allow wildfires to burn where safety and property protection allow by identifying such areas with RI DEM Division of Forest Environment. Promote acceptance of controlled burning through education; establish cooperative burning program with USFWS, RIDEM, TNC, and other organizations.
Measure: # of public relations materials developed and distributed concerning fire management.

- o Control public access at priority sites. (Birds, Beetles)
Measure: # of sites with restricted public access.
- o Initiate monitoring of species at breeding sites. (Birds, Beetles) **Spadefoot toad:** Location and assessment of known breeding sites; continued surveys in other appropriate areas.
- o **Other Insects:** Conduct inventories of other insect groups (Hymenoptera, Diptera, Coleoptera) that occupy open sand barrens.
Measure: # of sites with monitoring and % incorporated into existing databases.
- o Identify concentration areas for non-breeding populations. (eastern hognose snake)
Measure: # of sites identified and mapped and % incorporated into existing digital databases.
- o Evaluate existing significant hibernacula. (eastern hognose snake)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Expand public relations for snakes. (eastern hognose snake)
Measure: # of educational programs developed and delivered concerning snakes.
Measure: # of parcels identified and mapped and % incorporated into existing digital databases.
- o Determine metapopulation structure. (eastern hognose snake)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Evaluate use of migratory stopover/winter habitat. (eastern hognose snake)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Initiate monitoring of species at non-breeding sites. (eastern hognose snake) **Butterflies and Moths:** Monitor populations of frosted elfin; intensive surveys are needed to determine if the *Persius duskywing* is still present in Rhode Island; continue inventory of moth fauna; conduct monitoring of buck moth populations. **Tiger beetles:** Monitor populations of resident tiger beetles, primarily *Cicindela formosa*, *C. purpurea*, and *C. tranquebarica*; intensive surveys are needed to determine if the barrens tiger beetle (*C. patruela*) is still present in Rhode Island.
Measure: # of sites with monitoring; % incorporated into existing databases.
- o Develop strategy to maintain early successional vegetation.
Measure: # of management plans developed
- o Identify parcels needing seral-stage management
Measure: Process and justification to identify parcels
- o Manage important habitats as appropriate. **Breeding Birds:** Define key sites and management needs for priority regional species: prairie warbler, whip-poor-will, eastern towhee, pine warbler, field sparrow.
Measure: # of parcels or acreage of habitat maintained per year

12) **Pitch Pine / Scrub Oak Barrens [EFPS]**

Description and Location: This is a forest community typically found on well-drained, usually level, sandy soils of outwash plains. As described by Enser and Lundgren (2005), pitch pine (*Pinus rigida*) is the dominant tree varying from 25-60% cover, and the shrub layer is dominated by scrub oaks (*Quercus ilicifolia*, *Q. prinoides*) that often form dense

thickets. The low shrub canopy may include sweetfern (*Comptonia peregrina*), early blueberry, and black huckleberry (*Gaylussacia baccata*). Sandy openings within the woodland may be sparsely vegetated with lichens and mosses and sedges (*Carex pensylvanica* and others), and may also include patches of bearberry (*Arctostaphylos uva-ursi*) and heather (*Hudsonia ericoides* and *H. tomentosa*). Fauna of this community includes several lepidopterans (moths and butterflies) dependent on specific food plants such as buck moth (*Hemileuca maia*), frosted elfin (*Incisalia irus*), and hoary elfin (*Incisalia polios*). This community is typically maintained by periodic fire, which reduces competing woody species and stimulates reproduction of pitch pine. Pitch Pine – Scrub Oak Barrens are located in Kent and Washington Counties and include such sites as the Nicholas Farm in Coventry and in the Arcadia Management Area in Exeter.

Condition: See above condition for general pitch pine communities.

GCN Species:

Birds

Nashville warbler

Callophrys niphon

Callophrys polios

Catocala antinympha

Nepytia sp 1

Satyrrium edwardsii

Sideridis maryx

Butterflies / Moths

Apharetra dentate

Chaetagnela tremula

Xylotype capax

Aplectoides condita

Erynnis brizo

Zale curema

Argyrostromis anilis

Erynnis persius

Zale sp 1

Callophrys irus

Fixsenia favonius ontario

Zale submediana

Hemileuca maia

Zanclognatha Martha

Beetles

Alobates morio

Amara chalcea

Anaedes brunneus

Inventory / Research / Monitoring Needs and Conservation Actions

- o Develop fire prescriptions for priority parcels. (All GCN)
Measure: # of parcels with fire plans developed.
- o Implement burn management on priority parcels. (All GCN)
Measure: # of parcels with fire plan implemented.
- o Expand public relations for fire management. (All GCN)
Measure: # of public relations materials developed and distributed concerning fire management.
- o Research additional habitat use issues. (All GCN)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Initiate monitoring of species at breeding sites. (All GCN)
Measure: # of sites with monitoring and % incorporated into existing databases.
- o Evaluate nutritional value of exotic fruit-bearing plants. (Butterflies/Moths)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.

- o Determine metapopulation structure. (Butterflies/Moths)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Control public access at priority sites. (Beetles)
Measure: # of sites with restricted public access.
- o Develop strategy to maintain successional vegetation.
Measure: # of management plans developed
- o Identify parcels needing seral-stage management
Measure: Process and justification to identify parcels
- o Manage important habitats as appropriate
Measure: # of parcels or acreage of habitat maintained per year

Mixed Forests

Description and Location: Mixed Forest Land is defined by Anderson et al. (1976) as forest areas containing both deciduous and evergreen trees but with neither type dominating. A minimum of one-third of the forest area must be mixed deciduous and evergreen in order to be classified as Mixed Forest (Anderson et al. 1976). In Rhode Island, higher representation in the over-story of otherwise deciduous forest by white and/or pitch pine can result in stands being typed as Mixed Forests. Mixed forests are located throughout Rhode Island.



Condition: Mixed coniferous/deciduous forests are impacted by the same detrimental factors as described under deciduous forests; the most crucial factor impacting forest wildlife is the fragmentation of habitats into smaller tracts, a process principally caused by suburban sprawl and roads. More detailed information on condition can be found in Butler and Wharton (2002).

Threats to Species/Habitat

- Lack of information from research to address habitat and taxonomic issues
- Lack of information for monitoring and on-going assessment
- Loss of habitat from plant succession
- Habitat loss of critical micro-features
- Habitat fragmentation and degradation from human disturbance
- Demographic changes from excessive predation (animal)
- Demographic changes from incidental take (human)
- Lack of research to guide threat assessment and prioritization of conservation planning
- Habitat loss and demographic changes from invasive species (vegetation and animal)
- Lack of information from research to address habitat and taxonomic issues

13) Mixed Forest Deciduous Unspecified [MFD]

Description and Location: Mixed deciduous forests are those forests so classified by Anderson et al. (1976) that have a preponderance (more than 50%) of deciduous trees.

Condition: Mixed coniferous/deciduous forests are impacted by the same detrimental factors as described under deciduous forests; the most crucial factor impacting forest wildlife is the fragmentation of habitats into smaller tracts, a process principally caused by suburban sprawl and roads.

GCN Species:

Birds

black-throated blue warbler ovenbird
chestnut-sided warbler prairie warbler
indigo bunting scarlet tanager

Mammal

New England cottontail

Inventory / Research / Monitoring Needs and Conservation Actions

- Research additional habitat use issues. (All GCN)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- Initiate monitoring of species at breeding sites. (All GCN)
Measure: # of sites with monitoring and % incorporated into existing databases.
- Develop fire prescriptions for priority parcels. (chestnut-sided warbler, prairie warbler, indigo bunting, New England cottontail)
Measure: # of parcels with fire plans developed.
- Implement burn management on priority parcels. (chestnut-sided warbler, prairie warbler, indigo bunting, New England cottontail)
Measure: # of parcels with fire plan implemented.

- o Expand public relations for fire management. (chestnut-sided warbler, prairie warbler, indigo bunting, New England cottontail)
Measure: # of public relations materials developed and distributed concerning fire management.
- o Control public access at priority sites. (All GCN)
Measure: # of sites with restricted public access.
- o Identify priority parcels to retain as core forest areas with minimal management. (black-throated blue warbler, ovenbird, scarlet tanager)
Measure: # of parcels identified and mapped and % incorporated into existing digital databases.
- o Protect individual nests from predation. (Birds)
Measure: # of individual nests protected.
- o Determine metapopulation structure. (Mammals)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Develop strategy to maintain successional vegetation.
Measure: # of management plans developed
- o Identify parcels needing seral-stage management
Measure: Process and justification to identify parcels
- o Manage important habitats as appropriate
Measure: # of parcels or acreage of habitat maintained per year

14) **Mixed Forest Evergreen Unspecified [MFE]**

Description and Location: Mixed deciduous forests are those forests so classified by Anderson et al. (1976) having a preponderance (more than 50%) of evergreen (usually pine) trees.

Condition: Mixed coniferous/deciduous forests are impacted by the same detrimental factors as described under deciduous forests; the most crucial factor impacting forest wildlife is the fragmentation of habitats into smaller tracts, a process principally caused by suburban sprawl and roads. The single bird species included in this habitat category is extremely area-sensitive in Rhode Island. It does not occur on any dry forests within the Narragansett Bay Islands, or in similar patches near the coast. Therefore, the hermit thrush is an appropriate species to use as a coarse filter with which to measure forest integrity; it requires large tracts of un-fragmented mixed forests.

GCN Species:

Birds
hermit thrush

Inventory / Research / Monitoring Needs and Conservation Actions

- o Identify priority parcels to retain as core forest areas with minimal management.
Measure: # of parcels identified and mapped and % incorporated into existing digital databases.
- o Research additional habitat use issues.

- Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.*
- o Control public access at priority sites.
Measure: # of sites with restricted public access.
 - o Initiate monitoring of species at breeding sites.
Measure: # of sites with monitoring and % incorporated into existing databases.
 - o Identify priority parcels to retain as core forest areas with minimal management.
Measure: # of parcels identified and mapped and % incorporated into existing digital databases.

15) **Forest Unspecified [F]**

Definition and Location: Some GCN species require forested habitat but are not obligated to a particular forest cover type. There are three loose categories of such species. Some species (smoky shrew, black rat snake) require microhabitats or soil types that are only partly related to the vegetative canopy (as long as there is one). Others (black bear, bobcat) are wide-ranging species that pass through several forest types in the course of their daily or annual cycles. The third category involves species that may be reasonably assigned to forested habitats but for which more specific requirements are not precisely known (red bat).

Condition: Detailed information on status and condition of Rhode Island forests is found in Butler and Wharton (2002) as well as in Chapter 2 and the introductory section above on Forest. Although there are more areas with trees in Rhode Island than were present 100 years ago, there are today few areas that have large enough core areas to contain the full complement of expected species and concomitant ecosystem processes. According to Rosenberg et al. (2003), some key characteristics that determine a forest's quality as breeding bird habitat include its size and shape, degree of isolation from other forests, and surrounding land use. Rhode Island forest patches are becoming smaller and more isolated by fragmentation features, including roads and development. A recent report by Ewing and Kostyack (2005) identifies how suburban sprawl is one of the key causes of forest fragmentation, and that this development pattern is proceeding unchecked in many communities.

GCN Species:

<u>Beetles</u>	<u>Mammals</u>	<u>Reptiles</u>
<i>Calathus ingrates</i>	smoky shrew	black rat snake
	black bear	
<u>Birds</u>	bobcat	
sharp-shinned hawk	eastern red bat	

Inventory / Research / Monitoring Needs and Conservation Actions

- o Research additional habitat use issues. (All GCN)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Identify priority parcels to retain as core forest areas with minimal management. (Beetles, Birds, Mammals)

- Measure: # of parcels identified and mapped and % incorporated into existing digital databases.*
- o Initiate monitoring of species at breeding sites. (Beetles, Birds, Mammals)

Measure: # of sites with monitoring and % incorporated into existing databases.
- o Identify concentration areas for non-breeding populations. (black rat snake, smoky shrew, eastern red bat)

Measure: # of sites identified and mapped and % incorporated into existing digital databases.
- o Evaluate existing significant hibernacula or winter hibernation areas. (black rat snake, black bear, eastern red bat)

Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Determine metapopulation structure. (black rat snake, smoky shrew, black bear, bobcat)

Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Evaluate use of migratory stopover or winter habitat. (black rat snake, black bear, eastern red bat)

Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Initiate monitoring of species at non-breeding sites. (black rat snake, sharp-shinned hawk, eastern red bat)

Measure: # of sites with monitoring; % incorporated into existing databases.
- o Evaluate need for nesting structures/boxes and identify priority sites for management. (eastern red bat)

Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Expand public relations for amphibians and reptiles, primarily. (black rat snake)

Measure: # of educational programs developed and delivered concerning herpetofauna.
- o Develop fire prescriptions for priority parcels. (Beetles)

Measure: # of parcels with fire plans developed.
- o Implement burn management on priority parcels. (Beetles)

Measure: # of parcels with fire plan implemented.
- o Expand public relations for fire management. (Beetles)

Measure: # of public relations materials developed and distributed concerning fire management.
- o Control public access at priority sites. (sharp-shinned hawk, bobcat)

Measure: # of sites with restricted public access.
- o Evaluate nutritional value of exotic fruit-bearing plants. (black bear)

Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Protect individual nests from predation. (sharp-shinned hawk)

Measure: # of individual nests protected.

Non-forested Terrestrial Habitats

Rhode Island's non-forested terrestrial habitats include early successional / managed habitats, agricultural communities, and sparsely vegetated communities. Key early successional / managed habitats include maritime shrublands and maritime grasslands, while agricultural communities include artificial grasslands – hayland, pastureland, old fields – idle agriculture, and other agricultural land. Sparsely vegetated communities that have been selected as being in greatest need of conservation include barrens, rock outcrops, dunes, freshwater beaches, and the artificial habitats created by gravel pits and quarries. They are organized and presented in this order:

Agricultural and Maintained Open Lands (Managed Communities)

- Agricultural Cropland Hay
- Agricultural Grazing
- Idle Agriculture
- Agricultural Land Unspecified

Early Successional Habitats (Non-agricultural Habitats /Natural Communities)

- Maritime Grassland
- Coastal Shrubland

Sparsely Vegetated Habitats

- Barren Land Unspecified
- Beach Grass Dune
- Freshwater Beaches
- Gravel Pits and Quarries
- Inland Dune / Cobble
- Inland Dune/ Sand Barren
- Natural Quartz Rock Outcrops

It is important to recognize that, in order to avoid redundancy and to present these conservation strategies most efficiently and logically, this CWCS is organized so that threats and conservation actions are placed in only one tier and presented once, generally at the broadest level. For a detailed list of all actions for each habitat, please see Appendix 4. Due to the significant overlap of threats, they are presented at the habitat category level, but a detailed list of threats to each key habitat can be found in Appendix 3. Please note for each specific habitat, additional GCN species also occur, but are not listed here because they occur in additional habitats and were addressed in the coarse filter of statewide, taxa, or more broad habitat category. The GCN species listed in the finer filter, specific habitats use this habitat as its primary habitat. Conservation actions focused on these species also conserve the key habitat and the broader array of species associated with it.

Agricultural Habitats

Description and Location: Rhode Island's agricultural grassland habitats are classified into ten Anderson et al. and RIGIS vegetative communities, of which the following four have been selected as key habitats. NRCS recognizes these same agricultural grassland habitats by definition, however they have different titles.

RI GIS

Agricultural Cropland Hay
Agricultural Grazing
Idle Agriculture
Agricultural Land Unspecified

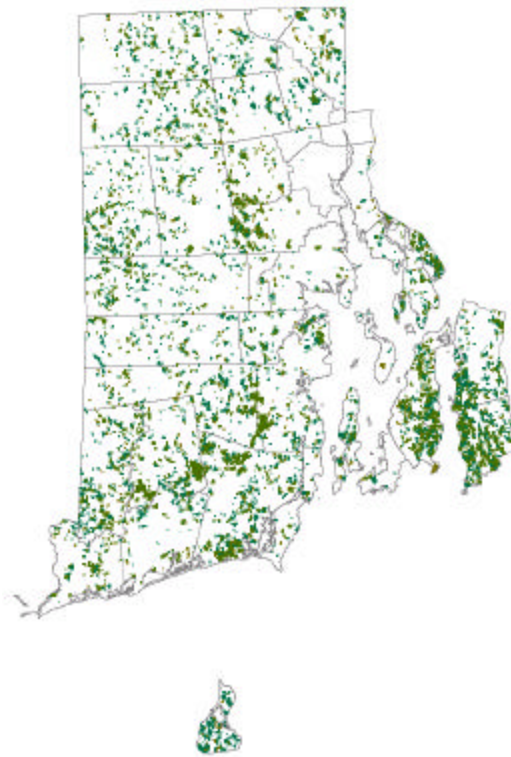
NRCS NRI

Hayland
Pastureland
Old Field – Idle Agriculture
Other Agricultural Land

Agricultural grasslands provide a unique habitat type that supports a distinct assemblage of field-nesting birds and a diverse invertebrate community. Although the origin and history of this fauna in southern New England before European settlement is conjectural, the conversion of most of Rhode Island to agriculture by 1850 created significant acreages of grassland habitat, and consequent increases in grassland-adapted species. However, unlike the natural prairies and grasslands found elsewhere in the Northeast and Midwest, most of the habitats in Rhode Island used by grassland species are artificial (Askins 1997). As such, the decline in agriculture has resulted in an accompanying decline in grassland-dependent species. This dilemma is reflected in the number of grassland birds listed by the RI DEM Endangered Species Program, including: northern harrier (State Endangered), upland sandpiper (State Endangered); barn owl (State Endangered), grasshopper sparrow (State Threatened), and horned lark (Concern). The Henslow's sparrow and vesper sparrow are two grassland birds that have been extirpated as nesters in Rhode Island. In addition, there is concern throughout the region about the general decline of other grassland-nesting birds including savannah sparrow, bobolink, and eastern meadowlark.

Agricultural Land is defined by Anderson et al. (1976) as land used primarily for production of food and fiber. Today in Rhode Island, agricultural grasslands are widely scattered throughout the state, although most are concentrated in coastal communities. Grassland birds listed as State Endangered and Threatened (northern harrier, barn owl, upland sandpiper, and grasshopper sparrow) are most prevalent on Block Island where there are large patches of open habitat, and where nesting birds also benefit from the lack of mammalian predators. The barn owl also nests on Aquidneck Island in Narragansett Bay where some larger farms are still maintained, but also where others have been lost to housing and golf course development. The grasshopper sparrow nests at two additional mainland locations; one is an airport and the other a restored grassland on a TNC preserve. Eastern meadowlark, bobolink, and savannah sparrow may be found throughout the state, but there are probably no more than 20-30 sites where these species nest. Most hayfield nesting birds are prairie-adapted and require relatively large areas of contiguous habitat.

Condition: The Rhode Island landscape has undergone many alterations during the past 350 years. From the time of initial European settlement the primeval forest was gradually cleared for lumber and other wood products, and to create open fields for agriculture. It has been estimated that by the year 1850 over 80% of the state was devoted to farming (Griffiths 1965). Agriculture in the colonies sustained the early settlements, but as the fertile lands of the Midwest were opened to expansion, farming became less attractive in the East, and in Rhode Island the populace began concentrating at the developing industrial centers near the coast. Inland, abandoned farm fields reverted to forest through natural succession, and although farming continued extensively on lands nearer the coast, in recent years there has been a continual conversion of farmland for residential and commercial development.



In 1908, there were more than 250,000 acres of farmland in Rhode Island, but by 1985 this figure had declined to less than 50,000 acres. In 2003, the RI DEM Division of Agriculture inventoried 33,072 farm acres, with about half in actual farming use (RI DEM 2003t). According to these acreage figures, the most important farm types/products in order of predominance are vegetables, dairy, turf, Christmas trees, sheep, beef cattle, nursery stock, orchards, and horse farms. The wildlife habitat values associated with each type of farming practice are highly variable. In general, intensive agriculture uses for row crop and turf production provide little benefit for wildlife, whereas the maintenance of fields for hay production and pasturage can support a unique suite of grassland species.

The loss of grassland habitat has also negatively impacted several invertebrates. The regal fritillary butterfly (*Spyeria idalia*) was extirpated from southern New England during the early 1990's after its population was relegated to a few isolated island sites (the last observation was recorded from Block Island). Recent inventories have also identified several species of

Coleoptera and Lepidoptera that are dependent on grassland habitats. These include two species of dung beetle (*Copris fricator* and *Dichotomius carolinus*), several species of moths (*Crymodes burgessi*, *Cynia inopinatus*, *Faronata rubripennis*, and *Orosagrotis perpolita*), and butterflies (Baltimore and dusted skipper). In addition, the only known natural population of the federally endangered American burying beetle (*Nicrophorus americanus*) in the eastern US is found on Block Island, the primary vegetative habitat component being the extensive grazed and mowed open fields on the southwest corner of the island.

Grassland species have declined because much of the original farmland was abandoned and reverted to forest, or more recently sold and converted to other land uses, and because remaining farmland is now managed more intensively to maximize agricultural production. For example, hayfields are less suitable as nesting habitat for bobolink, eastern meadowlark, and other species because they are mowed earlier in the summer (before the end of the nestling season) and because they are rotated more frequently (Askins 1997). As with forest-nesting birds the amount of available habitat in contiguous blocks is critical in determining the value of a specific tract of land to grassland-nesting birds. Some species (e.g., upland sandpiper and grasshopper sparrow) will not inhabit grasslands of less than 50 acres in size, and today these size restrictions limit these birds to larger non-agricultural grasslands found at airports and military reservations.

Threats:

- Lack of GCN species and key habitat data incorporated into comprehensive strategy
- Lack of research to guide threat assessment and prioritization of conservation planning
- Habitat fragmentation from lack of conservation planning capabilities and coordination
- Habitat fragmentation from lack of focal area approach to conservation
- Habitat loss from inadequate sized preserves
- Loss of habitat from plant succession
- Lack of management and restoration of degraded Lepidoptera and/or Mussel habitat
- Habitat loss of critical micro-features
- Demographic changes from excessive predation (animal)
- Habitat fragmentation and degradation from human disturbance
- Demographic changes from incidental take (human)
- Habitat loss and demographic changes from invasive species (vegetation and animal)
- Demographic changes from aquatic invasives
- Habitat loss and demographic changes from invasive species (vegetation and animal)
- Habitat degradation from impairment of water quality
- Habitat fragmentation and degradation from chemical contaminants and disease
- Habitat fragmentation from road effects
- Lack of strategy to support priority research
- Lack of information from research to address habitat and taxonomic issues
- Habitat fragmentation and degradation from chemical contaminants and disease
- Lack of strategy to implement landscape-level monitoring to support planning and assessment
- Lack of information for monitoring and on-going assessment
- Lack of advocacy for comprehensive wildlife conservation

16) **Agricultural Cropland Hay [AGH]**

Description and Location: The Natural Resources Inventory (NRI) of the Natural Resources Conservation Service (NRCS) defines hayland as a type of cultivated cropland that is managed for the production of forage crops, which are machine harvested. This habitat may consist of grasses, legumes, or a mixture of both. This community type may be in rotation with row or other close-grown crops, or be permanent and non-cultivated (USDA 2004a). In 2002, there were an estimated 7,417 acres of hayland in the state (USDA 2004b).

Condition: See narrative in the previous section. Not only are hayfields shrinking in size and declining state-wide, but remaining hayfields are less suitable as nesting habitat for bobolink, eastern meadowlark, and other species because they are mowed earlier in the summer (before the end of the nestling season) and because they are rotated more frequently (Askins 1997). As with forest-nesting birds the amount of available habitat in contiguous blocks is critical in determining the value of a specific tract of land to grassland-nesting birds. Some species (e.g., upland sandpiper and grasshopper sparrow) will not inhabit grasslands of less than 50 acres in size, and today these size restrictions limit these birds to larger non-agricultural grasslands found at airports and military reservations.

GCN Species:

Birds

bobolink	savannah sparrow
eastern meadowlark	upland sandpiper

Inventory / Research / Monitoring Needs and Conservation Actions

- o Research additional habitat use issues. (All GCN)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Initiate monitoring of species at breeding sites. (All GCN)
Measure: # of sites with monitoring and % incorporated into existing databases.
- o Control public access at priority sites. (All GCN)
Measure: # of sites with restricted public access.
- o Protect individual nests from predation. (All GCN)
Measure: # of individual nests protected.
- o Evaluate use of migratory stopover/winter habitat. (upland sandpiper)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Identify concentration areas for non-breeding populations. (upland sandpiper, eastern meadowlark)
Measure: # of sites identified and mapped and % incorporated into existing digital databases.
- o Develop fire prescriptions for priority parcels. (upland sandpiper)
Measure: # of parcels with fire plans developed.
- o Implement burn management on priority parcels. (upland sandpiper)
Measure: # of parcels with fire plan implemented.
- o Expand public relations for fire management. (upland sandpiper)

Measure: # of public relations materials developed and distributed concerning fire management.

17) **Agricultural Grazing [AGP]**

Description and Location: The NRI defines pastureland as land with a vegetative cover of grasses, legumes, and/or forbs primarily used as forage plants for livestock grazing. This community type may have a single vegetative species in a pure stand, a mixture of grasses, or a grass-legume mixture. Some low shrubs may also occur in grazing communities (USDA 2004a).

Condition: As with most forms of active agriculture, the amount of land devoted to grazing animals has been steadily declining for several decades (see introduction narrative). In 2002, there were an estimated 2,934 acres of pastureland in the state (USDA 2004b).

Grazing lands are shrinking in size and declining statewide, primarily because of the reduction of milk and beef production in this area. As with forest-nesting birds the amount of available habitat in contiguous blocks is critical in determining the value of a specific tract of land to grassland-nesting birds. Two of the GCN species in this habitat type are dung-rolling scarab beetles that actually depend on fresh cow manure for their reproduction. The American burying beetle depends on fresh carrion in this same habitat. There are significant research questions and conservation tasks that should be undertaken for the scarab and silphid beetle communities because both species groups appear to be collapsing.

GCN Species:

Beetles

Copris fricator

Dichotomius carolinus

Nicrophorus americanus

Birds

grasshopper sparrow

Inventory / Research / Monitoring Needs and Conservation Actions

- o Develop fire prescriptions for priority parcels. (All GCN)
Measure: # of parcels with fire plans developed.
- o Implement burn management on priority parcels. (All GCN)
Measure: # of parcels with fire plan implemented.
- o Expand public relations for fire management. (All GCN)
Measure: # of public relations materials developed and distributed concerning fire management.
- o Research additional habitat use issues. (All GCN)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Initiate monitoring of species at breeding sites. (All GCN)
Measure: # of sites with monitoring and % incorporated into existing databases.
- o Protect individual nests from predation. (*Nicrophorus americanus*)
Measure: # of individual nests protected.
- o Initiate monitoring of species at non-breeding sites. (*Nicrophorus americanus*)
Measure: # of sites with monitoring; % incorporated into existing databases.

- o Control public access at priority sites. (grasshopper sparrow)
Measure: # of sites with restricted public access.

18) **Idle Agriculture [AF]**

Description and Location: A community of agricultural land such as agricultural cropland hay or agricultural grazing that is idle (not in cultivation or active management) or has been abandoned. Natural succession of the vegetation in this community may succeed from meadow to shrubland to forest if left unmanaged.

Condition: Most forms of agriculture, including this one, have declined dramatically, a process that has been ongoing for over 100 years but which accelerated after World War II. The 2002 federal agricultural census found 2,167 acres of idle agricultural fields (USDA 2004b). The location and extent of abandoned old fields is unknown. Idle agriculture presents a “rough” semi-grassland community, interspersed with shrubs, that supports several invertebrate and vertebrate species. These habitats often materialize in a sort of vacant land use – either a change of ownership or a change in management strategy. When acquired for conservation they are usually left unmanaged or overly manicured for public parks and playgrounds etc. When not acquired for conservation they are usually converted into developments. Without aggressive management they will either succeed to forest or be overrun by invasive species.

GCN Species:

<u>Birds</u>	<u>Butterflies/Moths</u>	<u>Mammals</u>
American kestrel	<i>Atrytonopsis hianna</i>	Block Island meadow vole
barn owl	<i>Crymodes burgessi</i>	
northern bobwhite	<i>Euphydryas phaeton</i>	<u>Beetles</u>
	<i>Faronata rubripennis</i>	<i>Thanatophilus lapponicus</i>
	<i>Orosagrotis perpolita</i>	

Inventory / Research / Monitoring Needs and Conservation Actions

- o Develop fire prescriptions for priority parcels. (All GCN)
Measure: # of parcels with fire plans developed.
- o Implement burn management on priority parcels. (All GCN)
Measure: # of parcels with fire plan implemented.
- o Expand public relations for fire management. (All GCN)
Measure: # of public relations materials developed and distributed concerning fire management.
- o Research additional habitat use issues. (All GCN)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Initiate monitoring of species at breeding sites. (All GCN)
Measure: # of sites with monitoring and % incorporated into existing databases.
- o Evaluate need for nesting structures/boxes and identify priority sites for management. (American kestrel, barn owl)

- Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.*
- o Determine metapopulation structure. (Block Island meadow vole, Butterflies/Moths)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Evaluate nutritional value of exotic fruit-bearing plants. (Butterflies/Moths)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Control public access at priority sites. (Birds)
Measure: # of sites with restricted public access.
- o Identify concentration areas for non-breeding populations. (American kestrel)
Measure: # of sites identified and mapped and % incorporated into existing digital databases.
- o Initiate monitoring of species at non-breeding sites. (American kestrel)
Measure: # of sites with monitoring; % incorporated into existing databases.

19) **Agricultural Land Unspecified [AG]**

Description and Location: Anderson et al. (1976) define Agricultural Land Unspecified habitats as including farmsteads, livestock holding areas (e.g., corrals), breeding and training facilities on horse farms, farm roads and lanes, small farm ponds, ditches and canals, and other similar uses. These communities are generally quite small in area and patchily distributed.

Condition: Areas supporting mixed agricultural practices are certainly fewer than in number than early in this century. The GCN species in this category usually require some care and shepherding from sympathetic landowners. Both GCN species compete with English sparrows, and nest-box programs and registries (as has been attempted for purple martin) are required for long-term persistence.

GCN Species
Birds
purple martin
cliff swallow

Inventory / Research / Monitoring Needs and Conservation Actions

All GCN

- o Evaluate need for nesting structures/boxes and identify priority sites for management.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Research additional habitat use issues.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Initiate monitoring of species at breeding sites.
Measure: # of sites with monitoring and % incorporated into existing databases.
- o Control public access at priority sites.

- Measure: # of sites with restricted public access.*
- o Protect individual nests from predation.
Measure: # of individual nests protected.

Early Successional Habitats (Non-Agricultural)

Description and Location: Early successional habitats in the U.S. are defined by Anderson et al. (1976) as upland where the potential natural vegetation is predominantly grasses, grass - like plants, forbs, or shrubs and where natural herbivory was an important influence in its pre-civilization state. Locally, other natural processes can maintain the open condition of this habitat. Two natural early successional habitats in Rhode Island based on Enser and Lundgren (2005) have been selected as key habitats for GCN species: Maritime Grassland and Maritime Shrubland (also known as Coastal Shrubland).

Communities are dominated by forbs and grasses, which, without disturbance, will succeed further to one dominated by shrubs, and eventually to shrub/sapling and young forest sequences. Early successional habitats are maintained along the coast where exposure to wind, salt spray, storm events, droughty soils and other natural factors prevent succession to forest cover. These conditions are geographically restricted so these habitats occur in a relatively small zone along the coast and vegetation may fluctuate from herbaceous to shrub cover over time. Each stage supports a characteristic animal community. Typical bird species of this open to shrub habitat include brown thrasher, blue-winged warbler, common yellowthroat, eastern towhee, song sparrow, and indigo bunting.



Condition: Maritime grasslands and shrublands are naturally restricted to a relatively small area of the state, right along the coastal edge. They have been severely reduced in area due to development and invasive species have also altered many of these habitats dramatically.

Management of early successional animal species in Rhode Island should be reevaluated to incorporate the role of agricultural and managed lands (described in section above) and for natural habitats address the following: (1) focus direct management on existing habitats within highly fragmented areas, (2) insure the protection and maintenance of naturally occurring coastal shrubland communities, and (3) recognize that isolated successional habitats within contiguous forests should be allowed to revert to forest and managed according to guidelines recommended within the forest habitat descriptions within this document.

Threats:

- Lack of GCN species and key habitat data incorporated into comprehensive strategy
- Lack of research to guide threat assessment and prioritization of conservation planning
- Habitat fragmentation from lack of conservation planning capabilities and coordination
- Habitat fragmentation from lack of focal area approach to conservation
- Habitat loss from inadequate sized preserves
- Loss of habitat from plant succession
- Lack of management and restoration of degraded Lepidoptera and/or Mussel habitat
- Habitat loss of critical micro-features
- Demographic changes from excessive predation (animal)
- Habitat fragmentation and degradation from human disturbance
- Demographic changes from incidental take (human)
- Habitat loss and demographic changes from invasive species (vegetation and animal)
- Habitat loss and demographic changes from invasive species (vegetation and animal)
- Habitat fragmentation and degradation from chemical contaminants and disease
- Habitat fragmentation from road effects
- Lack of strategy to support priority research
- Lack of information from research to address habitat and taxonomic issues
- Habitat fragmentation and degradation from chemical contaminants and disease
- Lack of strategy to implement landscape-level monitoring to support planning and assessment
- Lack of information for monitoring and on-going assessment
- Lack of advocacy for comprehensive wildlife conservation

20) Maritime Grassland [BRG]

Description and Location: A sparsely vegetated community on rolling morainal topography of Block Island, generally on areas exposed to periodic wind and salt spray. This community is dominated by grasses and forbs and is generally found on upper slopes and crests of hills. Examples are relatively small in area (<1 acre) and tend to be surrounded on downslope sides by maritime shrubland communities. Characteristic plant species include field goldenrods (*Euthamia graminifolia* and *E. tenuifolia*), bitter milkwort (*Polygala polygama*), white-topped aster (*Aster paternus*), rush (*Juncus greenii*), and grasses. Also, several rare species including bushy rockrose (*Helianthemum dumosum*), northern blazing-star (*Liatris scariosa* var. *novae-*

angliae), Maryland golden aster (*Chrysopsis mariana*), and purple three-awn (*Aristida purpurescens*). (Enser and Lundgren 2005).

Condition: The historical occurrence of natural grassland communities in southern New England is difficult to ascertain as much of the descriptive information available prior to European settlement in the region is anecdotal, generally unscientific observations or recollections how the landscape appeared. It is apparent that Native Americans maintained extensive fields for agriculture by cutting and burning, based on evidence seen along the coast, and it may be assumed that these clearings extended inland during the period when population densities among Native Americans were higher before contact with Europeans. However, any natural grasslands were quickly adapted for agriculture by the colonists, permanently altering the native species component. Truly natural grasslands in Rhode Island form in a limited area along the immediate coast where the influence of wind and salt spray reduces competition with woody species. Many of these small patches of open habitat have been taken advantage of for coastal development. The best remaining examples are found on Block Island where they are defined as morainal grasslands, occurring as patches of 5 acres or less on tops of hills and edges of bluffs. Some management is required to maintain these small grasslands.

GCN Species

Butterflies / Moths

Abagrotis crumbi benjamini

Cynia inopinatus

Speyeria idalia

Inventory / Research / Monitoring Needs and Conservation Actions

All GCN

- o Develop fire prescriptions for priority parcels.
Measure: # of parcels with fire plans developed.
- o Implement burn management on priority parcels.
Measure: # of parcels with fire plan implemented.
- o Expand public relations for fire management.
Measure: # of public relations materials developed and distributed concerning fire management.
- o Evaluate nutritional value of exotic fruit-bearing plants.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Research additional habitat use issues.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Determine metapopulation structure.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Initiate monitoring of species at breeding sites.
Measure: # of sites with monitoring and % incorporated into existing databases.

21) Coastal Shrubland [BRS]

Description and Location: Coastal Shrublands, also known as Maritime Shrublands (Enser and Lundgren 2005) are dominated by woody shrubs on dry seaside bluffs and headlands exposed to ocean winds and salt spray, and adjacent inland areas that receive wind and spray during storm events. Exposed areas are vegetated with shorter, more compact shrubs of bayberry (*Myrica pensylvanica*), wild rose (*R. virginiana*), beach plum (*Prunus maritima*), and poison ivy (*Toxicodendron radicans*). Inland, shrubs and saplings grow to 2+ meters and also include arrowwood (*Viburnum dentatum*), shadbush (*Amelanchier* spp.), black cherry (*Prunus serotina*), eastern red cedar. Non-native invasive species are often present, such as multiflora rose (*Rosa multiflora*), oriental bittersweet (*Celastrus orbiculatus*), and honeysuckles (*Lonicera* spp.). The tight, closed canopy of the dominant shrubs typical of these habitats restricts herbaceous growth in the understory and ground layers.

The principal wildlife value associated with coastal shrublands is as nesting habitat for birds of shrubland and early successional habitats, including gray catbird, eastern towhee, brown thrasher, white-eyed vireo, common yellowthroat, and song sparrow. The yellow-breasted chat is notable as a species of conservation concern that nests exclusively in these habitats in Rhode Island. In addition, coastal shrublands provide important feeding areas for migrant songbirds, with studies indicating that these habitats may be critical for birds to accumulate nutrients before undertaking long migration flights. This habitat is also important for some invertebrates including the bayberry-feeding moth (*Catocala muliercula*), and the purse-web spider (*Sphodros rufipes*).

This community was formerly found along the entire Rhode Island coast, to a lesser extent on the shores of upper Narragansett Bay where maritime influences are reduced. Today, it is best developed in undeveloped portions of the coast, especially the islands in Narragansett Bay (e.g., Prudence, Patience, and Hope), sections of Newport County primarily in the town of Little Compton, and Block Island.

Condition: As this community predominates along the Rhode Island coastline, it is difficult to assess its historic distribution and quality because this region of the state was widely converted to other human uses quickly after European settlement. At that time, large tracts of coastal habitat were cleared for farming (crops and grazing), and when the agricultural era began to wane the open lands became valuable for other uses. The military first exploited these areas for construction of gun batteries, air bases, and ammunition dumps, and other sites were developed for residential and commercial uses. In addition, many fields that reverted naturally have been overwhelmed by invasive species. Because these habitats occur primarily in the immediate coastal zone, they are under severe pressure from residential development. Protection and long-term management (i.e. to control non-native invasive plants) will be required to maintain these Shrublands.

GCN Species		
<u>Birds</u>	Migratory Songbirds	<u>Butterflies / Moths</u>
common yellowthroat	gray catbird	<i>Catocala muliercula</i>
eastern towhee	yellow warbler	
	yellow-breasted chat	

Inventory / Research / Monitoring Needs and Conservation Actions

- o Develop fire prescriptions for priority parcels. (All GCN)
Measure: # of parcels with fire plans developed.
- o Implement burn management on priority parcels. (All GCN)
Measure: # of parcels with fire plan implemented.
- o Expand public relations for fire management. (All GCN)
Measure: # of public relations materials developed and distributed concerning fire management.
- o Research additional habitat use issues. (All GCN)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Initiate monitoring of species at breeding sites. (All GCN)
Measure: # of sites with monitoring and % incorporated into existing databases.
- o Control public access at priority sites. (Birds)
Measure: # of sites with restricted public access.
- o Evaluate nutritional value of exotic fruit-bearing plants. (Migratory Songbirds, Butterflies/Moths)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Identify concentration areas for non-breeding populations. (Migratory Songbirds)
Measure: # of sites identified and mapped and % incorporated into existing digital databases.
- o Evaluate use of migratory stopover/winter habitat. (Migratory Songbirds)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Initiate monitoring of species at non-breeding sites. (Migratory Songbirds)
Measure: # of sites with monitoring; % incorporated into existing databases.
- o Determine metapopulation structure. (Butterflies/Moths)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.

Sparsely Vegetated Habitats

Description and Location: Sparsely vegetated habitats may be natural or artificial (man-made) and are noted for their lack of vegetation. These communities are generally composed of thin soils, rock or sand. Six sparsely vegetated habitats have been selected as key habitats in Rhode Island:

Barren Land Unspecified
Beach Grass Dune
Freshwater Beaches
Gravel Pits and Quarries
Inland Dune / Cobble
Inland Dune/ Sand Barren
Natural Quartz Rock Outcrops

Condition: Information is generally lacking on the conditions of these habitats. Freshwater Beaches appear to be in good condition, Gravel Pits and Quarries suitable for GCN species appear to be stable, while Beach Grass Dune and Natural Quartz Rock Outcrops habitats are believed to be in fair condition but restricted distribution in the state. Inland dune/cobble and sand barren habitats are in poor condition with restricted and small occurrence in the state.



Threats:

- Lack of GCN species and key habitat data incorporated into comprehensive strategy
- Lack of research to guide threat assessment and prioritization of conservation planning
- Habitat fragmentation from lack of conservation planning capabilities and coordination
- Habitat fragmentation from lack of focal area approach to conservation
- Habitat loss from inadequate sized preserves
- Loss of habitat from plant succession
- Lack of management and restoration of degraded Lepidoptera and/or Mussel habitat
- Habitat loss of critical micro-features
- Demographic changes from excessive predation (animal)
- Habitat fragmentation and degradation from human disturbance
- Habitat loss and demographic changes from invasive species (vegetation and animal)
- Habitat loss and demographic changes from invasive species (vegetation and animal)
- Habitat degradation from impairment of water quality
- Habitat fragmentation and degradation from chemical contaminants and disease
- Habitat fragmentation from road effects
- Lack of strategy to support priority research

- Lack of information from research to address habitat and taxonomic issues
- Habitat fragmentation and degradation from chemical contaminants and disease
- Lack of strategy to implement landscape-level monitoring to support planning and assessment
- Lack of information for monitoring and on-going assessment
- Lack of advocacy for comprehensive wildlife conservation

22) **Barren Land Unspecified [B]**

Description and Location: Anderson et al. (1976) define Barren Land as sparsely vegetated habitats (less than one-third vegetated or otherwise covered) that have limited capacity to support life. Where vegetation is present, it tends to be widely spaced and scrubby. Unusual conditions (e.g., heavy rainfall) may temporarily result in more abundant vegetation. Barren habitats are lacking in vegetation because the substrate does not support plant growth or because of frequent disturbance such as scouring or flooding that inhibits the growth of plants (USDA 2004a). Additional inventory and research is needed to determine the distribution and abundance of barren land communities.

Condition: Barren land communities can be vulnerable to natural succession, development, human disturbance and other sources of habitat loss and conversion. Inadequate management affecting the natural disturbances that maintain barren land communities also influence the condition of this habitat. Additional inventory and research is needed to determine the status and condition of barren land communities in Rhode Island.

GCN Species

Birds

horned lark

Inventory / Research / Monitoring Needs and Conservation Actions

All GCN

- Develop fire prescriptions for priority parcels.
Measure: # of parcels with fire plans developed.
- Implement burn management on priority parcels.
Measure: # of parcels with fire plan implemented.
- Expand public relations for fire management.
Measure: # of public relations materials developed and distributed concerning fire management.
- Research additional habitat use issues.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- Initiate monitoring of species at breeding sites.
Measure: # of sites with monitoring and % incorporated into existing databases.
- Identify concentration areas for non-breeding populations.
Measure: # of sites identified and mapped and % incorporated into existing digital databases.
- Control public access at priority sites.
Measure: # of sites with restricted public access.

- o Protect individual nests from predation.
Measure: # of individual nests protected.
- o Initiate monitoring of species at non-breeding sites.
Measure: # of sites with monitoring; % incorporated into existing databases.

23) **Beach Grass Dune [BR]**

Description and Location: (also known as Estuarine Unconsolidated Sand [EUS])

This is a sparse to densely vegetated community on the active portions of primary dunes where sand shifting is the greatest. Beach grass (*Ammophila breviligulata*) is dominant and associates include dusty-miller (*Artemisia stellariana*), beach-pea (*Lathyrus japonicus*), seaside goldenrod (*Solidago sempervirens*), and the non-native sand rose (*Rosa rugosa*) are typical. Beach Grass Dunes are restricted to barrier beaches along the south shore and Block Island and include Moonstone Beach in South Kingstown and Goosewing Beach in Little (Enser and Lundgren (2005) define this as Maritime Dune community, Beach Grass Association).

Condition: Beach grass dunes are affected by development, shoreline stabilization projects, and landscaping with monotypic stands and/or non-native species. Additional inventory and research is needed to determine the status and condition of this community.

GCN Species

Birds

piping plover
short-eared owl

Inventory / Research / Monitoring Needs and Conservation Actions

- o Identify concentration areas for non-breeding populations. (All GCN)
Measure: # of sites identified and mapped and % incorporated into existing digital databases.
- o Control public access at priority sites. (All GCN)
Measure: # of sites with restricted public access.
- o Protect individual nests from predation. (All GCN)
Measure: # of individual nests protected.
- o Research additional habitat use issues. (All GCN)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Evaluate use of migratory stopover or winter habitat. (piping plover)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Initiate monitoring of species at breeding sites. (piping plover)
Measure: # of sites with monitoring and % incorporated into existing databases.
- o Initiate monitoring of species at non-breeding sites. (piping plover)
Measure: # of sites with monitoring; % incorporated into existing databases.

24) Freshwater Beaches [BF]

Description and Location: A sparsely-vegetated community that occurs on unstable sand, gravel, or cobble beaches along freshwater lakes, ponds or large rivers, where the shore is modified by storm waves and wind erosion. Vegetation may be scarce and ephemeral due to the instability of substrates. Freshwater beaches are located along the shores of larger rivers and lakes throughout Rhode Island. In general, however, this state does not have the well-developed river beaches and bars typical of the Connecticut River or similar large systems.

Condition: This community is affected by shoreline stabilization and development, artificially managed water levels, and especially human disturbance. Additional inventory and research is needed to determine the status and condition of the state's freshwater beaches. The condition of this habitat is threatened by human disturbance to species and habitats along with the accompanying habitat degradation from human access.

GCN Species

Birds

solitary sandpiper

Inventory / Research / Monitoring Needs and Conservation Actions

- o Research additional habitat use issues.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Identify concentration areas for non-breeding populations.
Measure: # of sites identified and mapped and % incorporated into existing digital databases.
- o Control public access at priority sites.
Measure: # of sites with restricted public access.
- o Evaluate use of migratory stopover/winter habitat.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Initiate monitoring of species at non-breeding sites.
Measure: # of sites with monitoring; % incorporated into existing databases.

25) Gravel Pits and Quarries [BA]

Description and Location: A sparsely-vegetated to un-vegetated community that occurs where mining activities have removed the natural vegetative cover and overburden to extract gravel or stone. Mining activities may result in large, open surface pits. Abandoned or unused pits or quarries may be flooded with water, reclaimed with various cover types, or left to revert naturally (Anderson et al. 1976). Gravel pits and quarries are located throughout the state where suitable substrates exist.

Condition: NRCS (1981) identified 4,365 acres of pits and quarries throughout Rhode Island and believed to provide suitable habitat conditions for the associated GCN species.

GCN Species**Birds**

belted kingfisher

bank swallow

Inventory / Research / Monitoring Needs and Conservation Actions

For all GCN species:

- o Research additional habitat use issues.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Initiate monitoring of species at breeding sites.
Measure: # of sites with monitoring and % incorporated into existing databases.
- o Control public access at priority sites.
Measure: # of sites with restricted public access.

26) Inland Dune / Cobble [IDC]

Description and Location: Sparsely vegetated community on gravel or cobble substrates. These usually occur as small patches imbedded within Red Cedar glades or other dry forest types. Vegetation is patchy, usually on less than 75% of the surface area, consisting of lichens (primarily *Cladonia* spp.), heather (*Hudsonia tomentosa*), little bluestem (*Schizachyrium scoparius*), umbrella sedge (*Cyperus filiculmis*), and sand jointweed (*Polygonella articulata*). Characteristic insects include tiger beetles (*Cicindela* spp.) and various Hymenoptera. These barrens usually occur in the vicinity of Narragansett Bay and on the larger bay islands, including Prudence Island and Conanicut Island (Jamestown).

Condition: These habitats are very small, discrete patches that were formerly maintained by fire. As fire suppression allowed coastal areas to re-vegetate, the open barren habitat required for tiger beetles has declined. At the present time the last known populations of *C. purpurea* occur on those Narragansett Bay Islands with a relatively recent fire history. This habitat needs periodic disturbance but can be, ironically, vulnerable to chronic disturbance such as that caused by off road vehicle traffic because priority species have larvae that live in the soil.

GCN Species**Beetles***Cicindela purpurea***Inventory / Research / Monitoring Needs and Conservation Actions**

- o Develop fire prescriptions for priority parcels.
Measure: # of parcels with fire plans developed.
- o Implement burn management on priority parcels.
Measure: # of parcels with fire plan implemented.
- o Expand public relations for fire management.
Measure: # of public relations materials developed and distributed concerning fire management.
- o Control public access at priority sites.
Measure: # of sites with restricted public access.

- o Research additional habitat use issues.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Initiate monitoring of species at breeding sites.
Measure: # of sites with monitoring and % incorporated into existing databases.

27) **Inland Dune / Sand Barren [IDS]**

Description and Location: Sparsely vegetated community similar to previous habitat except that it occurs as patches of fine shifting sands and is usually found imbedded within pitch pine forests. Patches are small, generally less than 2 acres in extent. Vegetation is sparse, usually on less than 75% of the surface area, and consists of lichens (primarily *Cladonia* spp.), heather (*Hudsonia tomentosa*), little bluestem (*Schizachyrium scoparius*), umbrella sedge (*Cyperus filiculmis*), and sand jointweed (*Polygonella articulata*). The sand star fungus (*Geaster hygrometricus*) is typically present. Characteristic insects include tiger beetles (*Cicindela* spp.) and sand-burrowing Hymenoptera. Inland dune / sand barrens are located away from the coast in Washington and Kent Counties. One example is the Pawcatuck River Barrens in Hopkinton (description based on Enser and Lundgren 2005).

Condition: With recent fire suppression and increasing maturation of Rhode Island woodlands, this habitat type has become very scarce and localized. This habitat needs periodic disturbance but can be, ironically, vulnerable to chronic disturbance like that caused by ORV traffic because priority species have larvae that live in the soil. Several sites are at risk because of unrestrained human activity and vegetation succession. The condition of this habitat is threatened by human disturbance (ORV traffic) and lack of periodic natural disturbance

GCN Species:

Beetles

Cicindela formosa

Geospinus incrassatus

Inventory / Research / Monitoring Needs and Conservation Actions

- o Research additional habitat use issues.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Develop fire prescriptions for priority parcels.
Measure: # of parcels with fire plans developed.
- o Implement burn management on priority parcels.
Measure: # of parcels with fire plan implemented.
- o Expand public relations for fire management.
Measure: # of public relations materials developed and distributed concerning fire management.
- o Initiate monitoring of species at breeding sites.
Measure: # of sites with monitoring and % incorporated into existing databases.
- o Control public access at priority sites. (*Cicindela formosa*)
Measure: # of sites with restricted public access.

28) Natural Quartz Rock Outcrops [ROQ]

Description and Location: A sparsely-vegetated or un-vegetated community that occurs on exposed areas of quartz bedrock. The occurrence and abundance of this community is limited by the distribution and exposure of quartz bedrock. Natural quartz rock outcrops are located in small patches in the northern part of the state in Lincoln, Cumberland, Johnston, North Providence, West Warwick and Warwick.

Condition: NRCS (1981) identified 235 acres of rock outcrops in Rhode Island including intertidal rocky shores (see Marine / Estuarine section of this chapter). A relatively small but unknown number of these outcrops are formed of quartz. The limited geologic extent and patchy nature of this community generally makes it vulnerable to habitat loss and conversion. More inventory and research is needed to determine the status and condition of this community type.

GCN Species:Beetles*Cicindela rufiventris***Inventory / Research / and Monitoring Needs and Conservation Actions**

- o Research additional habitat use issues.

Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.

- o Initiate monitoring of species at breeding sites.

Measure: # of sites with monitoring and % incorporated into existing databases.

Wetland Habitats

Description and Location: Anderson et al. defines wetlands as those areas where the water table is at, near, or above the land surface for a significant part of the year (1976). The hydrologic regime is such that aquatic or hydrophytic vegetation usually is established, although alluvial and tidal flats may be nonvegetated. Wetlands frequently are associated with topographic depressions. Examples include marshes, mudflats, and swamps situated on the shallow margins of bays, lakes, ponds, streams, and manmade impoundments such as reservoirs. They include wet meadows or perched bogs and seasonally wet or flooded basins with no surface-water outflow (Anderson et al. 1976).

Level II categories for Wetlands are Emergent Wetland, Shrub Wetland, and Forested Wetland. These categories were derived from Anderson et al. (1976) Level II classification of Forested and Nonforested Wetlands, and Cowardin et al. (1979) eight Palustrine system classes, and in the following text, each has a description and location, list of GCN species, threats to these wetlands, and proposed conservation actions. Enser and Lundgren (2005) further classify Rhode Island's wetlands into 19 community types (with additional variants) that correspond to Level III key habitats selected below.

Emergent Wetlands

- Emergent Fen/Bog
- Coastal Plain Quagmire
- Emergent Marsh Deep
- Emergent Marsh Shallow/ Wet Meadow
- Freshwater Wetland Unspecified
- Coastal Plain Pondshore

Shrub Wetlands

- Shrub Bog Unspecified
- Shrub Swamp Alder
- Shrub Swamp Water Willow

Forested Wetlands

- Forested Coniferous Wetland White Cedar
- Forested Coniferous Wetland Unspecified
- Forested Deciduous Red Maple Swamp
- Forested Deciduous Wetland Unspecified

Deciduous forested wetlands, or forested swamps, are by far the most abundant freshwater water wetland types; they account for over 50% of the state's freshwater wetland area. Forested wetlands and shrub wetlands together account for over 70% (RI DEM 2005d). Lakes are also abundant and add nearly 16% of the total. At the other extreme, riverine wetlands and fens and bogs are rare; combined they account for less than 4% of the state's total freshwater wetland area. Marshes and ponds fall in the middle; they each account for approximately 4%

of the total area. This pattern in the statewide data is generally maintained when the data are broken down by river basin. Swamps and lakes are often the most abundant wetlands; bogs, fens, and riverine wetlands remain the scarcest.

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, The Nature Conservancy, and the Audubon Society of Rhode Island. The federal government owns approximately 240 acres of the state's freshwater wetlands (less than 1%). These wetlands are concentrated in coastal watersheds (i.e., the Coastal basin, Narragansett Bay Basin, and Point Judith sub-basin of the Saugatucket River basin). The state owns 60% of all protected wetlands (approximately 10,900 acres); 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.

Condition: Unfortunately, there are no existing databases or programs that adequately monitor the condition of wetlands in Rhode Island. There is no obvious reason to suspect that any of the below mentioned wetlands suffer from negative impacts differentially. With the exception that based on the geology and landscape positioning of some wetlands they may be more greatly buffered from these impacts. For example, bogs are often located within a wetland complex therefore, they may exhibit a lesser degree of degradation than the wetland types encompassing it and on the periphery. Other isolated wetlands (e.g., seasonally flooded ponds/vernal pools) may exhibit an increased degree of degradation because of the lack of buffer and increased surface area adjacent to the disturbance.

In general, all wetland types in Rhode Island suffer similar pressures resulting primarily in the degradation and loss of wetland habitat. The greatest threat to wetlands in Rhode Island is degradation resulting from residential and commercial development. Although, current state regulations are effective in protecting wetlands they do not effectively protect the adjacent uplands, which are critical in protecting the quality of the wetland. For example, while current regulations do provide protection to seasonally flooded ponds they most often do not provide any protection to the adjacent upland. As a result, a vernal pool may be entirely encompassed by development.

In addition, and not independent of development, the integrity and quality of wetlands in Rhode Island are compromised by loss of habitat, degradation of habitat, sedimentation, erosion, point (e.g., sewage treatment plants) and non-point source pollution (e.g., lawn fertilizers), and nutrient enrichment. As a result, of current regulations most permitted development must make every effort to maintain existing water quantities on site. However, many projects redirect surface water towards the periphery of a site therefore, redirecting the location of infiltration. How this effects the underlying aquifer is not well understood however, increased concern has recently mounted over the lack of regulation and monitoring on the loss or redirection of infiltration to aquifers due to increased impervious area.

Overall, the condition of wetlands in Rhode Island has suffered considerably despite more stringent state regulations. Enforcement of these regulations is difficult and undocumented impacts are thought to be significant. It is evident that relying solely on current federal and state regulations will not adequately protect the integrity and quality of wetlands in Rhode Island. As a result, many facultative and obligate species will continue to decline. Consequently, land acquisition and preservation is critical to the longevity of these species populations.

It is important to recognize that, in order to avoid redundancy and to present these conservation strategies most efficiently and logically, this CWCS is organized so that threats and conservation actions are placed in only one tier and presented once, generally at the broadest level. For a detailed list of all actions for each habitat, please see Appendix 4. Due to the significant overlap of threats, they are presented at the habitat category level, but a detailed list of threats to each key habitat can be found in Appendix 3. Please note for each specific habitat, additional GCN species also occur, but are not listed here because they also occur in additional habitats and were addressed in the coarse filter of statewide, taxa, or more broad habitat category. The GCN species listed in the finer filter, specific habitats use this habitat as its primary habitat. Conservation actions focused on these species also conserve the key habitat and the broader array of species associated with it.

Emergent Wetlands

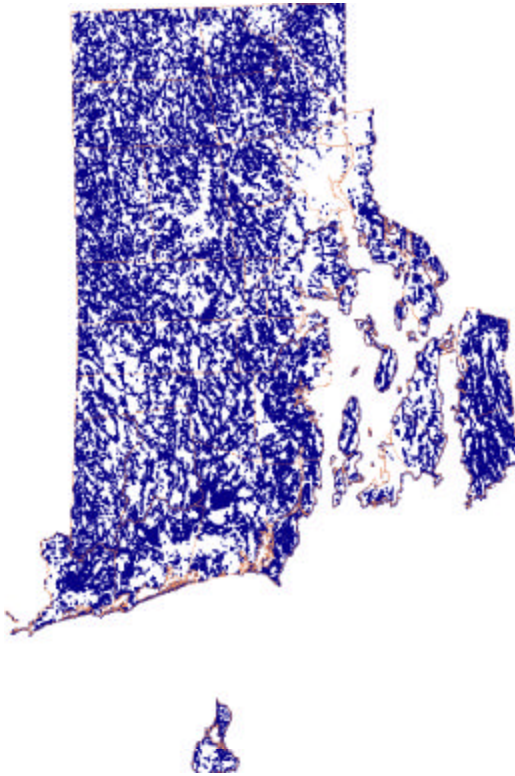
Description and Location: Emergent wetlands are characterized by erect, rooted, herbaceous hydrophytes occurring in all water regimes except sub-tidal and irregularly exposed. This vegetation is present for most of the growing season (Cowardin et al. 1979). Most communities are dominated by perennial plants.

Freshwater emergent wetlands of Rhode Island are dominated by non-persistent grasses, sedges, rushes, forbs, and other grass-like plants, with minimal representation by woody trees or shrubs. These communities are primarily non-tidal, freshwater habitats known as marshes, wet meadows, pond shores, bogs, and fens, the one exception being the freshwater tidal marsh, which is a rare type in Rhode Island.

Emergent wetlands are typically distinguished by substrate type of the wetland. Marshes and pond shores generally occur on mineral soil or bedrock, whereas bogs and fens develop on peat-based substrates. Emergent wetlands include some of the more unique wetland communities in the state, but most are small (less than 25 acres). As such, emergent wetlands tend to be widespread but their total acreage accounts for only 3% of the state's freshwater wetlands.

Statewide data on historic freshwater or coastal wetland loss are not complete and are subsequently a research need. Although Rhode Island has not monitored historic wetland loss, the U.S. Fish and Wildlife Service (USFWS) tracks national wetland loss trends (e.g. Dahl

1990, 2000). According to the USFWS analysis, Rhode Island has lost approximately 37% of its wetlands (Dahl 1990, RI DEM 2004p). In the Providence metropolitan area, urbanization is the dominant cause of major historic wetland loss, while transportation projects and residential development are the leading contributors to wetland loss in rural areas of the state. Loss of wetlands to agriculture is relatively minor when compared to national trends (RI DEM 2004p).



Condition: Of the more than 127,000 acres of total wetlands in Rhode Island, emergent wetlands comprise over 4,000 acres. Sixteen percent of all wetlands are protected by federal, state, or municipal governments or by non-governmental conservation organizations such as land trusts, The Nature Conservancy, and the Audubon Society of Rhode Island. The Federal government owns approximately 240 acres of the state's freshwater wetlands (less than 1%). These wetlands are concentrated in coastal watersheds (i.e., the Coastal basin, Narragansett Bay Basin, and Point Judith sub-basin of the Saugatucket River basin). Additional information on the condition of these wetlands is needed.

Threats to Species/Habitat:

- Lack of information from research to address habitat
- Lack of information for monitoring and on-going assessment
- Loss of habitat from plant succession
- Habitat loss of critical micro-features
- Demographic changes from aquatic invasives
- Habitat loss and demographic changes from invasive species (vegetation and animal)
- Demographic changes from excessive predation (animal)
- Lack of research to guide threat assessment and prioritization of conservation planning
- Habitat fragmentation and degradation from human disturbance

29) Emergent Fen / Bog [EMB]

Description and Location: Bogs and fens, the two open peatland communities found in Rhode Island, are differentiated by hydrology (source of water) and vegetative composition. The mainstay of both is a variably-thick layer of *Sphagnum* peat that supports a vascular plant community dominated by herbaceous species. Note that this is slightly different than the terminology in Enser and Lundgren (2005) where bogs include shrub-dominated communities as well.

Bogs receive water primarily from direct rainfall, with little or no influence of groundwater or runoff. Peat mosses can form a nearly continuous carpet across the bog surface, which in deeper basins results in the characteristic “quaking bog” condition. As it develops the *Sphagnum* mat is vegetated with characteristic plants, bog sedge (*Carex trisperma*), cottongrasses (*Eriophorum* spp.), beaked sedges (*Rhynchospora*), and cranberry (*Vaccinium macrocarpon* and *oxycoccus*). The nutrient-poor conditions benefit the establishment of carnivorous plants including sundews (*Drosera intermedia* and *rotundifolia*), pitcherplant (*Sarracenia purpurea*), and bladderworts (*Utricularia* spp.). As a bog matures the peat substrate becomes thicker and more stable, and may develop a dense layer of low (≤ 1 meter) compact shrubs dominated by leatherleaf (*Chamedaphne calyculata*) [See Shrub Fen/ Bog description below under Shrub Wetlands].

Fens also receive and accumulate rainfall, but are principally fed by groundwater or surface drainage. Consequently, there is a slow but constant influx of water and nutrients into the system, thus supporting a richer graminoid plant community. Fens occur within spring-fed basins and the drainages of surface-flowing streams, but larger examples are found in sections of old, abandoned stream channels. In these situations a reduced layer of peat overlies a solid layer of sandy mineral soils that formed the old streambeds. *Sphagnum* moss does not occur as a quaking mat, but in scattered clumps amongst the dominant sedges and forbs including sedges (*Carex exilis*, *C. lasiocarpa*, *C. striata*), twig-rush (*Cladium mariscoides*), beakrushes (*Rhynchospora alba* and *fusca*), cottongrass (*Eriophorum virginicum*), meadowbeauty (*Rhexia virginica*), cranberry, and sundews. Older fens, and the edges of open fens, may succeed to a chiefly shrub community of low-growing species that includes sweet gale (*Myrica gale*), leatherleaf, and steplebush (*Spiraea tomentosa*). Stunted individuals of Atlantic white cedar and red maple (*Acer rubrum*) may also be present. Sites with >50% shrub cover are treated under Shrub Wetlands below.

Fauna of conservation concern that inhabit open peatlands are primarily invertebrates, primarily members of the orders Odonata (dragonflies and damselflies) and Lepidoptera (moths and butterflies). Within the latter group are several species that utilize specific food plants found in these habitats, including bog copper butterfly (*Lycaena epixanthe*), a cranberry feeder, and the pitcherplant stem borer (*Papaipema apassionata*). Where Atlantic white cedar is a component the Hessel's hairstreak (*Mitoura hesseli*) butterfly may be found. Dragonflies of conservation concern found in bogs and fens include the ringed boghaunter (*Williamsonia lintneri*). Two reptiles of conservation concern are the spotted turtle (*Clemmys guttata*) and the eastern ribbon snake (*Thamnophis sauritus*).

A variant Emergent Fen/ Bog Habitat type is Sedge – *Sphagnum* Fen variant. This habitat type is a discrete variant of the previous bog/fen category. These are usually very small, often

seasonally-flooded wetlands, sometimes imbedded within larger wetland complexes. Many of the same plants are present as mentioned above in the broader Fen/ Bog habitat. Three-square sedge (*Dulichium arundinaceum*) is characteristic and, rather than having a thick Sphagnum substrate, this variant features a “soupy” Sphagnum substrate suspended within the water column. (See “Three-way sedge/ Sphagnum Association” in Enser and Lundgren (2005) and Lundgren (1999).

Bogs and fens generally occur at small, isolated sites in Rhode Island with best examples in Providence, Kent and Washington counties. They are rare or absent from Newport and Bristol counties.

Condition: Bog and fen habitats in Rhode Island are in relatively good condition compared to freshwater marshes, although many examples are small (< 1 acre) and filling and disturbance from roads and other development has impacted many. Historically, those peat-lands supporting cranberry were exploited for this resource, but most have remained fairly intact. Tree cutting also occurred in Atlantic white cedar swamps adjacent to some peat-lands, but probably not with a major impact on the Emergent Fen/ Bog habitats. On Block Island, where peat mining was practiced to supply heating fuel, some bogs may have been lost historically; however, records are inadequate to assess this impact.

Peatland habitats are protected under the Rhode Island Freshwater Wetlands Act which also provides for a 50-foot buffer. Although these wetlands are essentially protected from conversion, these buffers do not fully protect against water withdrawal or runoff within the watershed. And buffer accommodations are probably inadequate in protecting surrounding uplands that may be important in the life cycles of some invertebrate species, reptiles, and amphibians of conservation concern.

GCN Species:

<u>Butterflies / Moths</u>	<i>Lycaena epixanthe</i>	<u>Dragonflies / Damselflies</u>
<i>Exyra fax</i>	<i>Metarranthis pilosaria</i>	<i>Gomphaeschna antilope</i>
<i>Fagitana littera</i>	<i>Oligia minuscule</i>	
<i>Grammia speciosa</i>	<i>Papaipema appassionata</i>	<u>Reptiles</u>
<i>Homophoberia cristata</i>	<i>Scopula purata</i>	eastern ribbon snake
<i>Iodopepla u-album</i>	<i>Williamsonia lintneri</i>	spotted turtle

Inventory / Research / Monitoring Needs and Conservation Actions

- o Research additional habitat use issues. (All GCN)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Determine metapopulation structure. (All GCN)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Initiate monitoring of species at breeding sites. (spotted turtle, Butterflies/Moths, Dragonflies/Damselflies)
Measure: # of sites with monitoring and % incorporated into existing databases.

- o Evaluate need for nesting substrate and identify priority sites for management. (spotted turtle)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Expand public relations for snakes. (eastern ribbon snake)
Measure: # of educational programs developed and delivered concerning snakes.
- o Initiate monitoring of species at non-breeding sites. (Reptiles)
Measure: # of sites with monitoring; % incorporated into existing databases.
- o Identify concentration areas for non-breeding populations. (Reptiles)
Measure: # of sites identified and mapped and % incorporated into existing digital databases.
- o Enhance regulations to protect habitat.
Measure: # of new regulations established or existing regulations modified to improve protection.

30) **Coastal Plain Quagmire [EMBQ]**

Description: Coastal Plain Quagmires (Enser & Lundgren 2005) are a variant of habitat (#34) Seasonally flooded coastal plain pondshores that retain standing water (several inches to 1-2 feet) for longer periods and are characterized by a mucky substrate formed from the accumulation of decaying plant material. Coastal plain quagmires are uncommon, occurring primarily in the Wood/Pawcatuck Watershed in southern Rhode Island, and also in a band running east along the Charlestown Recessional Moraine in South Kingston. Initially, some GCN species appeared to be specific to this type, but on further review were more appropriately captured by the broader Coastal Plain Pondshore habitat type #34.

Condition: see Condition section for (#34) Coastal plain pondshores

GCN Species: see GCN species section for (#34) Coastal plain pondshores

Inventory, Research, Monitoring Needs and Conservation Actions: See section for (#34) Coastal plain Pondshores

31) **Emergent Marsh Deep [EMAD]** and (32) **Emergent Marsh Shallow / Wet Meadow [EMAS]**

Description and Location: Emergent marshes are open wetlands (< 50% cover of trees and shrubs) with substrates ranging from mineral soils or bedrock to well-decomposed organic soils (muck). Plant composition varies with depth of water during the growing season. Deep marshes have water depths ranging from 6 inches to 6.6 feet (15 cm to 2 m) and levels may fluctuate seasonally, but the substrate is rarely dry and there is usually standing water in the fall. In shallow marshes water depths range from 6 inches to 3.3 feet (15 cm to 1 m) during flood stages, but the level usually drops by mid to late summer, exposing the substrate during most years.

The most abundant emergent aquatic plants in both marsh types are cattails (*Typha angustifolia* and *latifolia*) with a varying mixture of other herbaceous species depending on water depth. In deeper marshes associates include bur-reeds (*Sparganium* spp.), bulrushes (*Scirpus pungens* and *tabernaemontani*), arrowhead (*Sagittaria latifolia*), arrowleaf (*Peltandra virginica*), and bayonet rush (*Juncus militaris*). Also in deep marshes, permanent pools of water support floating-leaved and submerged aquatic plants including water lily (*Nymphaea odorata*), duckweeds (*Lemna* spp.), pondweeds (*Potamogeton* spp.), spatterdock (*Nuphar variegata*), coontail (*Ceratophyllum demersum*), water-milfoils (*Myriophyllum* spp.), waterweed (*Elodea canadensis*), and bladderworts (*Utricularia* spp.).

Shallow marshes support a higher percentage of graminoid species and sedges such as bluejoint grass (*Calamagrostis canadensis*), manna grasses (*Glyceria* spp.), rice cutgrass (*Leersia oryzoides*), wool grass (*Scirpus cyperinus*), rushes (*Juncus effusus*, *J. canadensis*), three-way sedge (*Dulichium arundinaceum*), tussock sedge (*Carex stricta*), and other sedges (*Carex* spp.). In degraded marshes, reed canary grass (*Phalaris arundinacea*), purple loosestrife (*Lythrum salicaria*), or tall reed (*Phragmites australis*) may become abundant. Shallow marshes may also have scattered shrubs including alders (*Alnus* spp.), dogwoods (*Cornus amomum* and *sericea*), meadow sweet (*Spiraea alba*), and buttonbush (*Cephalanthus occidentalis*).

Emergent marshes support diverse avian communities, the most widespread members being mallard, American black duck, Virginia rail, red-winged blackbird, swamp sparrow, and common yellowthroat, but several species of conservation concern are also dependent on these wetlands. In Rhode Island, rare nesters include pied-billed grebe, American bittern, least bittern, sora, common moorhen, and marsh wren. Historically, both green-winged teal and blue-winged teal were also uncommon nesters in emergent marshes. Near the coast, emergent marshes are important wintering areas for some birds, including Wilson's snipe.

In Rhode Island, shallow and deep marshes typically occur along the margins of pond basins chiefly near the coast, and range inland along the floodplains of major river systems, primarily the Blackstone, Pawtuxet, and Pawcatuck Rivers. The two types often intergrade, along with shrub swamps, occurring together in a complex mosaic in larger wetlands. Best examples of these mixed habitats are found at the Valley Marshes along the lower Blackstone River and Newton Swamp along the lower Pawcatuck River, Westerly.

Condition: It is difficult to evaluate the historic extent of freshwater emergent marshes in Rhode Island. Areas of this habitat type were likely lost during the early industrial era when factories and supporting infrastructure were developed on and adjacent to the floodplains of major river systems. On the other hand, the construction of dams at numerous locations along the same rivers provided opportunities for the development of emergent marshes within the created impoundments behind these dams.

Historically, emergent marshes along rivers were degraded to varying degrees by contamination by pollutants, which is particularly notable in some impounded areas where there are high accumulations of heavy metals and other contaminants in bottom sediments. More recently, the invasion of non-native plant species (*Phragmites* and purple loosestrife) has

been implicated in the degradation of emergent marsh habitats. Although there is as yet little direct evidence concerning the negative impact to wildlife habitat caused by the spread of these plants, some anecdotal evidence is available. For example, at the Valley Marshes along the lower Blackstone River, purple loosestrife has supplanted a majority of the former coverage of cattails, which may be responsible for the loss of the marsh wren and other nesting birds at this location.

Emergent marshes are protected under the Rhode Island Freshwater Wetlands Act, which recognizes a minimum regulated size for this habitat type at 1 acre, with an additional 50-foot buffer. Although these wetlands are essentially protected from direct filling and conversion, buffer accommodations are probably inadequate in preventing disturbance to some species of wildlife and are ineffective at preventing degradation of these systems.

Emergent Marsh Deep:

GCN Species

Birds

American bittern	common moorhen	marsh wren
American black duck	green-winged teal	pied-billed grebe
blue-winged teal	least bittern	sora

Inventory / Research / Monitoring Needs and Conservation Actions

- o Research additional habitat use issues. (All GCN)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Initiate monitoring of species at breeding sites. (All GCN)
Measure: # of sites with monitoring and % incorporated into existing databases.
- o Control public access at priority sites. (All GCN)
Measure: # of sites with restricted public access.
- o Identify concentration areas for non-breeding populations. (American black duck, blue-winged teal, green-winged teal, pied-billed grebe)
Measure: # of sites identified and mapped and % incorporated into existing digital databases.
- o Initiate monitoring of species at non-breeding sites. (American black duck, blue-winged teal, green-winged teal, pied-billed grebe)
Measure: # of sites with monitoring; % incorporated into existing databases.

Emergent Marsh Shallow:

GCN species:

Butterflies / Moths

Boloria bellona

Lycaena hyllus

Macrochilo louisiana

Meropleon diversicolor

Poanes massasoit

Satyrium acadicum

Mammals

southern bog lemming

Birds

Wilson's snipe

Inventory / Research / Monitoring Needs and Conservation Actions

- o Research additional habitat use issues. (All GCN)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Determine metapopulation structure. (Butterflies/Moths, Mammals)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Initiate monitoring of species at breeding sites. (Butterflies/Moths, Mammals)
Measure: # of sites with monitoring and % incorporated into existing databases.
- o Evaluate nutritional value of exotic fruit-bearing plants. (Butterflies/Moths)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Identify concentration areas for non-breeding populations. (Wilson's snipe)
Measure: # of sites identified and mapped and % incorporated into existing digital databases.
- o Control public access at priority sites. (Wilson's snipe)
Measure: # of sites with restricted public access.
- o Evaluate use of migratory stopover/winter habitat. (Wilson's snipe)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Initiate monitoring of species at non-breeding sites. (Wilson's snipe)
Measure: # of sites with monitoring; % incorporated into existing databases.

33) **Freshwater Wetland Unspecified [FW]**

Description and Location: In this hierarchical classification scheme this habitat category is necessary in order to capture GCN species that are found in wetlands but whose specific habitat requirements are unknown or are not specific to wetland type.

Condition: See section narrative. Wetlands are vulnerable to human impacts from a wide range of sources resulting in habitat loss and degradation. More detailed information can be found in Rhode Island Wetland Monitoring and Assessment Plan (RIDEM 2005d)

GCN Species:

Butterflies / Moths

Capis curvata

Cepphis decoloraria

Conservula anodonta

Inventory / Research / Monitoring Needs and Conservation Actions

For all GCN species:

- o Evaluate nutritional value of exotic fruit-bearing plants.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Research additional habitat use issues.

- Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.*
 - o Determine metapopulation structure.
 - Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.*
 - o Initiate monitoring of species at breeding sites.
 - Measure: # of sites with monitoring and % incorporated into existing databases.*

34) **(Seasonally flooded) Coastal Plain Pondshores [EMAC] also incorporates (30) Quagmires [EMBO]**

Description and Location: Although all fresh, open water bodies (ponds and lakes) maintain shores of varying extent, shoreline communities associated with so-called coastal plain ponds are considered unique ecosystems in New England for several reasons. Most lakes and ponds in Rhode Island are artificially created for water supply and recreation, or as the result of quarrying for sand/gravel or rock. Coastal plain ponds are naturally formed (or slightly altered by man) as the remnants of glacial lakes in outwash deposits (e.g. Worden Pond) or in kettle holes. They feature a complex hydrology that occasionally exposes large patches of the pond bottoms. A diverse plant community grows on these ephemeral shores, arising from a dormant seed bank. This community supports several rare plants and animals more typical of the Atlantic coastal plain of North America.

Dragonflies (Odonata) account for the majority of rare animal species identified from various types of coastal plain ponds. Ponds with sandy, gravelly or rocky margins, which also undergo the greatest variation in water level, support the pine barrens bluet (*Enallagma recurvatum*), scarlet bluet (*Enallagma pictum*), and Common Sanddragon (*Progomphus obscurus*). A variant of this type is the Coastal Plain Quagmire (Enser and Lundgren 2005) that retains standing water (several inches to 1-2 feet) for longer periods and is characterized by a mucky substrate formed from the accumulation of decaying plant material. Coastal plain ponds and quagmires are most prevalent within the Wood/Pawcatuck Watershed in southern Rhode Island, and also in a band running east along the Charlestown Recessional Moraine in South Kingstown.

Condition: In general, these unique habitats have been conservation priorities for state and local agencies for more than two decades, and there has been a high degree of protective action already taken. In southeastern Massachusetts, including Cape Cod, where there is a greater concentration of coastal plain ponds, human impacts to these habitats have been noted. These include off-road vehicle use of open shorelines, disrupted hydrology from water removal, contamination from road drainage, and nutrient loading from residential runoff.

In Rhode Island, these more severe impacts have not been commonly encountered. Most examples in this state occur on ponds that are undeveloped or have few residences and recreational impacts are fairly low. In several isolated instances, small patches of the invasive *Phragmites australis* have been noted, but these are mostly small populations that can be easily controlled. In general, coastal plain pond shore communities remain poorly studied, and

intensive inventory of other terrestrial and aquatic invertebrate groups at these habitats would likely confirm the presence of other rare species.

GCN Species:

Dragonflies / Damselflies

Nehalennia integricollis

Aeshna mutata

Leucorrhinia glacialis

Inventory / Research / Monitoring Needs and Conservation Actions for (34) Coastal Plain Pondshores and (30) Quagmires

- o Research additional habitat use issues.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Determine metapopulation structure.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Initiate monitoring of species at breeding sites.
Measure: # of sites with monitoring and % incorporated into existing databases.
- o Research additional habitat use issues. (All GCN)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Determine metapopulation structure. (All GCN)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Initiate monitoring of species at breeding sites.
Measure: # of sites with monitoring and % incorporated into existing databases.
- o Enhance regulations to protect habitat.
Measure: # of new regulations established or existing regulations modified to improve protection.

Shrub Wetlands

Description and Location: Cowardin et al. defines Scrub-Shrub Wetlands as areas dominated by woody vegetation less than 6 m (20 feet) tall occurring in all water regimes except sub-tidal, with species including true shrubs, young trees, and trees or shrubs that are small or stunted because of environmental conditions. Scrub-Shrub Wetlands – or Shrub Wetlands – may represent a successional stage leading to Forested Wetland, or they may be relatively stable communities (Cowardin et al. 1979).

Freshwater (palustrine) shrub wetlands of Rhode Island are characterized by a dominance of shrubs or tree saplings (less than 20 feet tall). In general, there are two types present in Rhode Island: (1) a deciduous shrub type that occurs on mineral soils or mucks along the margins of ponds and rivers, in isolated depressions or valleys, or as a transition community between an

emergent marsh and a terrestrial community; and (2) an evergreen shrub type found in depressions on peat substrates, often referred to as dwarf shrub bogs. These two types are captured under the “Shrub Swamp” and “Dwarf Shrub Fen/ Bog” Communities in Enser and Lundgren (2005).



Deciduous shrub wetlands are highly variable, with the dominant shrub species dictated by local conditions including water depth, topographic position, and microclimate. At wetter sites buttonbush (*Cephalanthus occidentalis*) or water willow (*Decodon verticillatus*) may be the dominant species with over 90% cover, often in shallow water along the shores of lakes, ponds, or rivers. In seasonally flooded wetlands a mix of shrubs may be present including highbush blueberry (*Vaccinium corymbosum*), sweet pepperbush (*Clethra alnifolia*), winterberry (*Ilex verticillata*), alders (*Alnus* spp.), silky dogwood (*Cornus amomum*), maleberry (*Lyonia ligustrina*), spicebush (*Lindera benzoin*), meadowsweet (*Spiraea alba*), steeplebush (*Spiraea tomentosa*), swamp azalea (*Rhododendron viscosum*), swamp rose (*Rosa palustris*), and saplings of red maple (*Acer rubrum*).

The most common form of evergreen shrub wetlands is dominated by leatherleaf (*Chamaedaphne calyculata*). Although other shrubs may be present, including sheep laurel (*Kalmia angustifolia*), black huckleberry (*Gaylussacia baccata*), and dwarf huckleberry (*Gaylussacia dumosa*), leatherleaf often forms the complete shrub cover. Other associated species include cranberry (*Vaccinium macrocarpon*), pitcher plant (*Sarracenia purpurea*), and cotton-grasses (*Eriophorum* spp.). Uncommon variations of the evergreen shrub wetland type are Atlantic white cedar (*Chamaecyparis thyoides*) sapling swamps, and black spruce (*Picea mariana*) sapling bogs. In both situations, the dominant trees are less than 20 feet tall. Generally found on the edges of swamps or in isolated depressions, these sapling wetlands also rarely occur as floating peat-mat islands in lakes.

The various types of deciduous shrub wetlands often intergrade, and many also intermix with emergent wetland types to form diverse wildlife habitats. Such wetlands support many of the nesting birds identified for emergent marshes, along with other shrub specialists such as willow flycatcher. Two invertebrate species dependent on shrub wetlands are the harvester (*Feniseca tarquinius*), a butterfly that feeds on alders, and the hydrangea sphinx moth (*Darapsa versicolor*), a feeder on buttonbush and water willow. The flowers of both plants also provide nectaring sources for a wide variety of butterflies, bees, and beetles.

Shrub wetlands account for about 10 percent of the freshwater wetlands in Rhode Island, with more than 90 percent being the deciduous shrub type. The largest examples of this type are generally found within the floodplains of major rivers, including the Blackstone, Pawtuxet, and Pawcatuck systems. Evergreen shrub wetlands occur as small, widely scattered habitats in Providence, Kent, and Washington counties, including Block Island.

Condition: Historically, it is likely that the total acreage of all wetland types in Rhode Island was greater than it is today. Prior to wetlands protection legislation, first passed in 1971, wetlands were generally considered to be waste areas that could be filled for urban development, utilized as landfills, or flooded for water supply reservoirs. Although most of these practices have been curbed, regulations account for a limited buffer (50 feet) around most wetlands, and in some cases development and other land conversion occurs up to the wetland edge, creating increased disturbance and decreased wildlife values. Additional impacts from these development patterns include increased runoff that may carry pollutants, and the opening of avenues for spread of invasive plants.

Threats:

- Lack of information from research to address habitat issues
- Lack of information for monitoring and on-going assessment
- Loss of habitat from plant succession
- Habitat fragmentation and degradation from human disturbance
- Habitat loss and demographic changes from invasive species (vegetation and animal)
- Demographic changes from excessive predation (animal)

35) Shrub Bog Unspecified [SSB]

Description and Location: This habitat category contains only one species that is known to inhabit bogs but for which other habitat requirements are unknown. Shrub Bogs (see Enser & Lundgren 2005) are dominated by peat moss (*Sphagnum* spp.) and shrubs, particularly those in the heath family such as leatherleaf (*Chamaedaphne calyculata*), sheep laurel (*Kalmia angustifolia*), highbush blueberry (*Vaccinium corymbosum*), cranberry (*Vaccinium macrocarpon*), black huckleberry (*Gaylussacia baccata*), and dwarf huckleberry (*G. dumosa* var. *bigeloviana*). Scattered small trees may be present, typically white cedar (*Chamaecyparis thyoides*) and/or red maple (*Acer rubrum*). For GCN species of more specific bog type, see (29) Emergent Fen/Bog.

Condition: See section narrative. Wetlands are vulnerable to human impacts from a wide range of sources resulting in habitat loss and degradation. As with open fens and bogs, Shrub

Bogs are not abundant, but are in relatively good condition and protected by wetlands regulations. It is difficult to evaluate the threat to this GCN species without additional habitat requirements and inventory.

GCN Species:

Beetles

Agonum darlingtoni

Inventory / Research / Monitoring Needs and Conservation Action:

- o Research additional habitat use issues.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Initiate monitoring of species at breeding sites.
Measure: # of sites with monitoring and % incorporated into existing databases.
- o Control public access at priority sites.
Measure: # of sites with restricted public access.

36) Shrub Swamp Alder [SSAA]

Description and Location: This habitat is a subset of the Shrub Wetlands category that features alder (*Alnus* spp.) as the dominant vegetation. Such wetlands often occur along the floodplains of major rivers and around the margins of permanent ponds and lakes. Wetlands of this type occur throughout Rhode Island, including on Block Island. Several examples of this wetland type are found on protected lands, especially on Block Island.

Condition: Like all wetlands, shrub swamp alder wetlands are vulnerable to several types of traumas, including run-off from roads and infiltration by invasive species.

GCN Species:

Birds

willow flycatcher

Butterflies

Feniseca tarquinius

Inventory / Research / Monitoring Needs and Conservation Actions:

- o Control public access at priority sites.
Measure: # of sites with restricted public access.
- o Evaluate nutritional value of exotic fruit-bearing plants. (*Feniseca tarquinius*)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Research additional habitat use issues. (All GCN)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Determine metapopulation structure. (*Feniseca tarquinius*)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Initiate monitoring of species at breeding sites. (All GCN)
Measure: # of sites with monitoring and % incorporated into existing databases.

37) Shrub Swamp Water Willow [SSAD]

Description and Location: This habitat is a subset of the shrub swamp category that is dominated by water willow (*Decodon verticillatus*), the primary food plant for the GCN species below. These wetlands are usually small and have deep mucky substrates. This wetland type is scattered throughout Rhode Island, primarily on the mainland and on Block Island. Several examples of this wetland type are found on protected lands, primarily on Block Island.

Condition: Like all wetlands, shrub swamp water willow wetlands are vulnerable to several types of traumas, including run-off from roads and infiltration by invasive species.

GCN Species:Butterflies / Moths*Darapsa versicolor***Inventory / Research / Monitoring Needs and Conservation Actions:**

- o Evaluate nutritional value of exotic fruit-bearing plants.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Research additional habitat use issues.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Determine metapopulation structure.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Initiate monitoring of species at breeding sites.
Measure: # of sites with monitoring and % incorporated into existing databases.

Forested Wetlands

Description and Location: Palustrine (freshwater) forested wetlands are characterized by woody vegetation that is 6 m tall or taller found within all water regimes, except sub-tidal. They possess an over-story of trees, an understory of young trees or shrubs, and a herbaceous layer.

Forested wetlands are Rhode Island's most abundant wetland type, representing about 73 percent of the state's wetlands, and 83 percent of the non-tidal wetlands (Tiner 1989). These wetlands, which are characterized by a dominance of trees 20 feet or taller, are found along rivers and streams, in isolated depressions, and in hillside drainages. Three general types of forested wetlands are found in Rhode Island: (1) deciduous forested wetlands, of which the majority are red maple swamps; (2) coniferous forested wetlands, dominated by Atlantic white cedar, white pine, or hemlock; and (3) mixed forested wetlands of deciduous and coniferous trees.



Condition: Wetland Types Deciduous forested wetlands, or forested swamps, are by far the most abundant freshwater water wetland types; they account for over 50% of the state's freshwater wetland area. Forested wetlands and shrub wetlands together account for over 70% (RI DEM 2005d). Many are in good condition, but fragmentation, altered hydrology and invasive species are problems in many areas.

Threats to Species/Habitat

- Hydrologic alterations
- Potential impact on invertebrates of conservation concern by use of insecticides to control mosquitoes and other insect pests.
- Fragmentation/conversion of swamps (primarily Atlantic white cedar) by suburban development patterns, road construction, and other developments.
- Flooding of some Atlantic white cedar stands by beaver.
- Succession of some Atlantic white cedar stands to red maple-dominated swamp
- Lack of information from research to address habitat and taxonomic issues
- Lack of information for monitoring and on-going assessment
- Loss of breeding habitat for amphibians
- Loss of habitat from plant succession
- Habitat loss of critical micro-features
- Habitat loss and demographic changes from invasive species (vegetation and animal)
- Lack of information from research to address habitat and taxonomic issues
- Demographic changes from excessive predation (animal)
- Demographic changes from incidental take (human)

- Demographic changes from aquatic invasives
- Habitat fragmentation and degradation from human disturbance
- Lack of research to guide threat assessment and prioritization of conservation planning

38) **Forested Coniferous Wetland White Cedar [FOAC]**

Description and Location: As identified in the National List of Plant Species that Occur in Wetlands, Atlantic white cedar (*Chamaecyparis thyoides*) is the only tree in Rhode Island that is considered an obligate wetland plant; i.e., a plant that occurs almost always (>99%) in wetlands under natural conditions. Atlantic white cedar can dominate extensive forested swamps on nutrient-poor, organic soils (usually peat) in poorly drained depressions, along pond edges or streams, and at the edges of bogs or fens. Associated tree species may include red maple (*Acer rubrum*), black gum (*Nyssa sylvatica*), yellow birch (*Betula alleghaniensis*), and hemlock (*Tsuga canadensis*). Characteristic small trees and shrubs are winterberry (*Ilex verticillata*), highbush blueberry (*Vaccinium corymbosum*), rosebay (*Rhododendron maximum*), swamp azalea (*Rhododendron viscosum*), and sweet pepperbush (*Clethra alnifolia*). In dense stands where little light reaches the forest floor, groundcover is predominantly *Sphagnum*. Herbaceous plants that tend to appear in sunny openings include several species of ferns, skunk cabbage (*Symplocarpus foetidus*), and wild calla (*Calla palustris*).

Atlantic white cedar often forms continuous, even-aged stands over dozens of acres. Forest floors lush with bright green mosses, liverworts, and scattered herbs contribute to a primeval atmosphere in these cool, dark wetlands. However, Atlantic white cedar does not germinate in dense shade, and the seedlings do not grow well under dense canopies. Therefore, regeneration depends on openings created in the canopy by disturbances such as blowdown or fire.

In Rhode Island, Atlantic white cedar swamps are found in Providence, Kent, and Washington Counties, and are absent in the counties of Bristol and Newport, except for the northern part of the town of Tiverton. They are also absent from the islands of Narragansett Bay and Block Island. Largest examples are in southern Rhode Island at the Great Swamp (South Kingstown), Eppley Wildlife Refuge (South Kingstown), Indian Cedar Swamp (Charlestown), Diamond Pond (Richmond), Crandall's Swamp (Westerly), and Whitford Pond/Great Cedar Swamp (Coventry, Greene County).

Atlantic white cedar swamps harbor several insect species of conservation concern, chiefly in the order Lepidoptera. Included is the Hessel's hairstreak (*Mitoura hesseli*) butterfly, which relies solely on white cedar for the larval food plant, and several moths within the genus *Lithophane*.

Condition: Atlantic white cedar swamps are increasingly rare wetlands that are vulnerable and not very resilient to human disturbance. It has been estimated that more than 78% of the world's Atlantic white cedar swamps have already been eliminated through two historic circumstances. The naturally decay-resistant wood of cedar trees makes them valuable for timber and other wood products. This value has caused extensive harvesting in many swamps.

Logged areas of white cedar may regenerate if seed trees are present; otherwise these swamps generally succeed to red maple vegetation. Some cedar swamps have also been eliminated by human-constructed dams; the elevated water levels cause mortality of the white cedar trees. Beaver dams may cause similar but less permanent alteration of the swamps. Atlantic white cedar swamps have also been affected by human activities in surrounding uplands, such as road construction, development, logging, gravel mining, and landfill operations. These activities impact wetlands by input of excess sedimentation, nutrients, and pollutants, and also provide disturbed conditions benefiting the spread of invasive plants.

GCN Species:Butterflies / Moths*Callophrys hesseli**Lithophane baileyi**Lithophane thaxteri**Lithophane viridipallens***Inventory / Research / Monitoring Needs and Conservation Actions:**

All GCN

- o Identify priority parcels to retain as core forest areas with minimal management.
Measure: # of parcels identified and mapped and % incorporated into existing digital databases.
- o Research additional habitat use issues.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Determine metapopulation structure.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Initiate monitoring of species at breeding sites.
Measure: # of sites with monitoring and % incorporated into existing databases.

39) Forested Coniferous Wetland Unspecified [FOA]

Description and Location: The GCN species categorized by this habitat are not necessarily confined to coniferous wetland cover types. In general, the northern waterthrush tends to occur in large basin swamps that often contain white cedar. Canada warblers also occur in such areas, but both species can also use deciduous swamps.

Condition: The GCN species below are known to be among the most area-sensitive nesting birds in Rhode Island (Miller 1999). Therefore, for the purpose of this plan, these species are being used to represent the largest forested wetlands in the state. Miller (1999) outlined some landscape variables, including distance from road and percent of forest in matrix around a forested wetland, which affected the likelihood that these GCN species were present in a given habitat. These variables should be used in a GIS-based analysis to evaluate the amount of Canada warbler habitat in Rhode Island.

GCN Species**Birds**

northern waterthrush

Canada warbler

Inventory / Research / Monitoring Needs and Conservation Actions**All GCN**

- o Identify priority parcels to retain as core forest areas with minimal management.
Measure: # of parcels identified and mapped and % incorporated into existing digital databases.
- o Research additional habitat use issues.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Initiate monitoring of species at breeding sites.
Measure: # of sites with monitoring and % incorporated into existing databases.
- o Control public access at priority sites.
Measure: # of sites with restricted public access.

40) Forested Deciduous Red Maple Swamp [FOBMA]

Description and Location: The majority of deciduous forested wetlands in Rhode Island are red maple (*Acer rubrum*) swamps, dominated by red maple and often with a smaller percent of other tree species, most commonly black gum (*Nyssa sylvatica*) and/or green ash (*Fraxinus pensylvanica*). Red maple swamps occur in poorly drained depressions, usually on mineral soils. Although the canopy dominant is always red maple, the community is broadly defined as there are many variants described throughout the state. Other tree associates may include white pine (*Pinus strobus*), hemlock (*Tsuga canadensis*) and Atlantic white cedar (*Chamaecyparis thyoides*), yellow birch (*Betula allegheniensis*), white ash (*F. americana*), American elm (*Ulmus americana*), or swamp white oak (*Quercus bicolor*). **Forested deciduous floodplain red maple/green ash** is the key habitat within this category that supports GCN species and is located within the floodplains of Rhode Island's rivers and streams.

Red maple swamps typically have a dense understory shrub layer consisting mostly of highbush blueberry (*Vaccinium corymbosum*), spicebush (*Lindera benzoin*), sweet pepperbush (*Clethra alnifolia*), winterberry (*Ilex verticillata*), swamp azalea (*Rhododendron viscosum*), and fetterbush (*Leucothoe racemosa*). Ground layer herbs most commonly found are skunk cabbage (*Symlocarpus foetidus*), cinnamon fern (*Osmunda cinnamomea*), jewelweed (*Impatiens capensis*) and Turk's-cap lily (*Lilium superbum*). In southern Rhode Island are several red maple swamps that support a dense shrub understory dominated by rose bay (*Rhododendron maximum*), with lesser representation by sweet pepperbush and swamp azalea. The dense, evergreen foliage of rose bay tends to limit growth in the ground layer.

As with upland forests, the wildlife habitat values associated with red maple swamps tend to increase with overall size and type of surrounding land use. The largest tracts of contiguous swamp or mixed swamp/upland forest support such rare nesting birds as Northern saw-whet owl, prothonotary warbler, and Northern parula. Other species typically found in larger red maple swamps include red-shouldered hawk, Canada warbler, northern waterthrush, and veery.

Red maple swamps support a diverse amphibian and reptile community with the most common species being wood frog (*Rana sylvatica*), redback salamander (*Plethodon cinereus*), spring peeper (*Pseudacris crucifer*), and American toad (*Bufo americanus*), and where seasonally flooded ponds provide breeding opportunities the spotted salamander (*Ambystoma maculatum*), marbled salamander (*A. opacum*), and three-toed salamander (*Hemidactylium scutatum*) may be locally common. Although most mammals that utilize red maple swamps may be classified as habitat generalists, the water shrew (*Sorex palustris*) is an uncommon species that is chiefly a swamp dweller.

Condition: Since the passage of wetlands protection legislation, red maple swamps have undergone fewer impacts than upland forest systems. For example, Golet and Parkhurst (1981) found the loss of wetlands in the town of South Kingstown, Rhode Island during the period 1939-1972 to be about 1 percent. In highly urbanized communities red maple swamps often remain as the only locally undeveloped parcels, providing an important wildlife habitat component. However, despite protection of the swamp proper, development often crowds the wetland edge. Conversion of surrounding uplands often leaves isolated tracts of red maple swamp that become islands within a highly incompatible matrix of developed land. In such situations these habitats can suffer from increased runoff from paved surfaces, air and noise pollution, illegal dumping, and spread of invasive plants that may encroach several hundred feet into the swamp. This pattern of development continues in Rhode Island as urban sprawl moves west from the urbanized areas along Narragansett Bay. Although many rural communities require open space easements on varying proportions of subdivided land, these “protected” tracts are typically wetlands that eventually become habitat islands. The condition of this habitat is considered to be fair.

GCN Species:

Birds

prothonotary warbler

Inventory / Research / Monitoring Needs and Conservation Actions

- o Identify priority parcels to retain as core forest areas with minimal management.
Measure: # of parcels identified and mapped and % incorporated into existing digital databases.
- o Evaluate need for nesting structures/boxes and identify priority sites for management.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Research additional habitat use issues.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Control public access at priority sites.
Measure: # of sites with restricted public access.
- o Initiate monitoring of species at breeding sites.
Measure: # of sites with monitoring and % incorporated into existing databases.

41) **Forested Deciduous Wetland Unspecified [FOB]**

Description and Location: The majority of deciduous forested wetlands in Rhode Island are red maple (*Acer rubrum*) swamps, dominated by red maple and often with a smaller percent of

other tree species, most commonly black gum (*Nyssa sylvatica*) and/or green ash (*Fraxinus pensylvanica*).

Condition: This habitat type is believed to be in good to fair condition. Fragmentation, altered hydrology and invasive species are common threats. .

GCN Species	
<u>Amphibians</u>	<u>Butterflies / Moths</u>
four-toed salamander	<i>Enodia anthedon</i>
	<i>Plagodis kuetzingi</i>

Inventory / Research / Monitoring Need and Conservation Actions

- o Identify priority parcels to retain as core forest areas with minimal management. (All GCN)
Measure: # of parcels identified and mapped and % incorporated into existing digital databases.
- o Research additional habitat use issues. (All GCN)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Determine metapopulation structure. (All GCN)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Expand public relations for amphibians and reptiles, primarily snakes. (four-toed salamander)
Measure: # of educational programs developed and delivered concerning herps.
- o Investigate feasibility of altering hydrology of certain wetlands. (four-toed salamander)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Evaluate nutritional value of exotic fruit-bearing plants. (Butterflies/Moths)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Initiate monitoring of species at breeding sites. (Butterflies/Moths)
Measure: # of sites with monitoring and % incorporated into existing databases.
- o Identify concentration areas for non-breeding populations. (four-toed salamander)
Measure: # of sites identified and mapped and % incorporated into existing digital databases.
- o Evaluate feasibility and efficacy of making additional amphibian breeding habitat. (four-toed salamander)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Construct and maintain new amphibian breeding habitat (seasonal pond project). (four-toed salamander)
Measure: # of new ponds constructed and mapped and # of new ponds with GCN species monitored over time.
- o Enhance regulations to protect amphibian breeding habitat. (four-toed salamander)

Measure: # of new regulations established or existing regulations modified to improve protection.

- o Evaluate use of migratory stopover or winter habitat. (four-toed salamander)

Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.

Freshwater Aquatic Communities

This category includes aquatic habitats of freshwater streams, rivers, ponds, lakes, seasonally flooded ponds (including vernal pools), and springs. In general these habitats are of flowing or impounded nontidal waters with persistent emergent vegetation either sparse or lacking, but may include areas with abundant submerged or floating-leaved aquatic plants. The following aquatic habitats are described as supporting GCN species. Several of these are described in Enser and Lundgren (2005).

Springs

Rivers and Streams

- River Blackwater Creek
- River Upper Perennial
- River Lower Perennial

Lakes and Ponds

- Lacustrine Eutrophic Lake/Pond
- Lacustrine Oligotrophic Lake/Pond
- Permanent Fishless Pond
- Seasonally Flooded Pond
- Semi-permanently Flooded Pond

It is important to recognize that, in order to avoid redundancy and to present these conservation strategies most efficiently and logically, this CWCS is organized so that threats and conservation actions are placed in only one tier and presented once, generally at the broadest level. For a detailed list of all actions for each habitat, please see Appendix 4. Due to the significant overlap of threats, they are presented at the habitat category level, but a detailed list of threats to each key habitat can be found in Appendix 3. Please note for each specific habitat, additional GCN species also occur, but are not listed here because they occur in additional habitats and were addressed in the coarse filter of statewide, taxa, or more broad habitat category. The GCN species listed in the finer filter, specific habitats use this habitat as its primary habitat. Conservation actions focused on these species also conserve the key habitat and the broader array of species associated with it.

For example, many anadromous fish that are GCN species are listed under the riverine key habitats due to the importance of protecting their freshwater spawning habitat, even though these species also occur in marine and estuarine habitats. Under the broad marine and estuarine habitat category, anadromous and catadromous species serve as general indicator species and guild-level inventory, research and monitoring needs and conservation actions are therefore listed under the broad marine and estuarine habitat description later in this chapter.

42) Springs [SS]

Description and Location: Springs are aquatic communities of very small, cold stream sources where the flow is perennial. They are characterized by water with constant cold temperatures and rich in dissolved oxygen. These streams are typically very shallow and have short lengths and relatively constant, low discharge. Most springs are typically found in association with headwater streams and may simply originate from below the ground, or often may appear as natural or man-crafted pools from which streams flow. Fish are generally absent, but characteristic amphibians may include the northern spring salamander (*Gyrinophilus porphyriticus*) and dusky salamander (*Desmognathus fuscus*). The arrowhead spiketail (*Cordulegaster obliqua*) is a notable dragonfly of this habitat.

Condition: Springs are uncommon, isolated habitats scattered throughout Rhode Island. Most notable are several in northwestern Rhode Island that support the only known northern spring salamander populations in the state. More inventory and research is needed to document the condition of these habitats.

GCN Species:Amphibians

dusky salamander

spring salamander

Dragonflies / Damselflies*Cordulegaster obliqua***Threats to Springs:**

- o Lack of GCN species and key habitat data incorporated into comprehensive strategy
- o Lack of research to guide threat assessment and prioritization of conservation planning
- o Habitat fragmentation from lack of conservation planning capabilities and coordination
- o Habitat fragmentation from lack of focal area approach to conservation
- o Habitat loss from inadequately sized preserves
- o Loss of habitat from plant succession
- o Lack of management and restoration of degraded Lepidoptera and/or Mussel habitat
- o Demographic changes from incidental take (human)
- o Habitat loss and demographic changes from invasive species (vegetation and animal)
- o Demographic changes from aquatic invasives
- o Habitat loss from impairment of aquatic contiguity
- o Habitat degradation from impairment of water quality
- o Habitat fragmentation from road effects
- o Lack of strategy to support priority research
- o Lack of information from research to address habitat and taxonomic issues
- o Habitat fragmentation and degradation from chemical contaminants and disease
- o Lack of strategy to implement landscape-level monitoring to support planning and assessment
- o Lack of information for monitoring and on-going assessment
- o Lack of advocacy for comprehensive wildlife conservation

Inventory / Research / Monitoring Needs and Conservation Actions:

- o Research additional habitat use issues. (All GCN)

- Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.*
- o Determine metapopulation structure. (All GCN)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
 - o Identify priority parcels to retain as core forest areas with minimal management. (Amphibians)
Measure: # of parcels identified and mapped and % incorporated into existing digital databases.
 - o Expand public relations for amphibians and reptiles, primarily snakes. (Herpetofauna)
Measure: # of educational programs developed and delivered concerning herpetofauna.
 - o Investigate feasibility of altering hydrology of certain wetlands. (Amphibians)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
 - o Identify concentration areas for non-breeding populations. (Amphibians)
Measure: # of sites identified and mapped and % incorporated into existing digital databases.
 - o Evaluate use of migratory stopover or winter habitat. (Amphibians)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
 - o Initiate monitoring of species at breeding sites. (Cordulegaster oblique)
Measure: # of sites with monitoring and % incorporated into existing databases.

Rivers and Streams

Description and Location: There are 1,498 miles of rivers and streams in Rhode Island, on which there are over 520 dams of various ages, condition, and size (RI DEM 2002i, 2004p). The largest river system within the state is the Wood-Pawcatuck, which drains most of the southwestern portion of the state and includes portions of Connecticut. The Blackstone River system dominates the eastern portion of the state, entering Rhode Island from Massachusetts near Woonsocket. The Blackstone River has been designated as a National Heritage Corridor by the U.S. Congress for its natural and cultural heritage. Rhode Island's rivers and streams provide spawning habitat for anadromous species which migrate between marine and estuarine waters to freshwater spawning grounds every year.

Condition: The RI DEM maintains an extensive monitoring network on the state's rivers and streams. Their assessment of river / stream condition is the ability of rivers and streams to support aquatic life, fish consumption, water supply and recreation uses (RI DEM 2004p). The most recent assessment included 38% of total river miles. Three-quarters of the rivers assessed were found to support aquatic life, 13% to partially support aquatic life, and 13% to not support aquatic life (RI DEM 2004p). Only 7.72 miles of river and stream were assessed for fish consumption, a portion of the Woonaquatucket River from below Smithfield to its confluence with the Moshassuck River; the entire 7.72 miles are considered impaired for fish

consumption and the state had issued an advisory to that effect in 2002, and found it to still be impaired for fish consumption two years later (RI DEM 2004p).



Where waters are considered impaired, the RI DEM also analyzes sources contributing to the impairment. Table 2.5 summarizes the identified sources (and their degree) of impairment for the quarter of rivers and streams found to be impaired in the 2004 assessment. Non-point source pollution from urban runoff, septic systems and agriculture are the largest contributors to impairment of Rhode Island's rivers and streams. Point source pollution from municipalities and industry are also sources of major impairment. The Blackstone River has historically been one of the nation's most polluted rivers but several restoration projects are presently underway to improve the health of this important river (RI DA 2004a). The Wood-Pawcatuck River basin is the most pristine system in Rhode Island, and almost one-third of its natural habitat has been preserved by RI DEM and its partners.

Threats to Rivers and Streams:

- o Lack of GCN species and key habitat data incorporated into comprehensive strategy
- o Lack of research to guide threat assessment and prioritization of conservation planning
- o Habitat fragmentation from lack of conservation planning capabilities and coordination
- o Habitat fragmentation from lack of focal area approach to conservation
- o Habitat loss from inadequate sized preserves
- o Loss of habitat from plant succession
- o Lack of management and restoration of degraded Lepidoptera and/or Mussel habitat
- o Habitat loss of critical micro-features
- o Demographic changes from excessive predation (animal)
- o Habitat fragmentation and degradation from human disturbance
- o Demographic changes from incidental take (human)

- o Habitat loss and demographic changes from invasive species (vegetation and animal)
- o Demographic changes from aquatic invasives
- o Habitat loss from impairment of aquatic contiguity
- o Habitat degradation from impairment of water quality
- o Habitat fragmentation and degradation from chemical contaminants and disease
- o Habitat fragmentation from road effects
- o Lack of strategy to support priority research
- o Lack of information from research to address habitat and taxonomic issues
- o Habitat fragmentation and degradation from chemical contaminants and disease
- o Lack of strategy to implement landscape-level monitoring to support planning and assessment
- o Lack of information for monitoring and on-going assessment
- o Lack of advocacy for comprehensive wildlife conservation

Conservation/ Research Action for all Rivers and Streams:

- o Collect physical, chemical, and fishery data every five years at locations that were used during the RI DEM DFW's survey of streams and ponds between 1993 and 2002.
Measure: Data incorporated into existing databases, compare the results of the surveys, and make necessary recommendations.

43) River Blackwater Creek [RBC]

Description and Location: A variation of the lower perennial stream classification (see below) is the so-called blackwater stream (Enser and Lundgren 2005), primarily found in the southern portion of Washington County. This type is an aquatic community of slow-moving, tannin-stained streams, flowing through or originating in acidic shrub swamps or forested swamps. There is usually an abundant growth of submerged vegetation including such plants as pondweeds (*Potamogeton spp.*), waterweeds (*Elodea spp.*), naiads (*Najas spp.*), bladderwort (*Utricularia spp.*), duckweed (*Lemna minor*), and watercress (*Nasturtium officinale*). A characteristic damselfly of this habitat is the blackwater bluet (*Enallagma weewa*).

Condition: Blackwater Creeks are believed to be in fair condition with moderate degree of threat.

GCN Species
Dragonflies / Damselflies
Enallagma weewa
Somatochlora georgiana

Inventory / Research / Monitoring Needs and Conservation Actions

- o Research additional habitat use issues.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Determine metapopulation structure.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.

- o Initiate monitoring of species at breeding sites.

Measure: # of sites with monitoring and % incorporated into existing databases.

44) **River Upper Perennial [RUP]**

Description and Location: Upper perennial streams (Enser and Lundgren 2005) have relatively steep gradients with well-defined riffles and pools. Water flow is constant, fast, and turbulent and the normal water temperature is cold. Streambeds are narrow, shallow, with little floodplain development, and usually represent a network of 1st and 2nd order stream segments. Bottom substrates are composed of bedrock, boulder, cobble, gravel, and sand. Better quality upper perennial streams are surrounded by upland forest that helps to ameliorate fluctuations in water temperature. Such streams have high water clarity and are well oxygenated.

The fish species most characteristic of coldwater streams is the brook trout (*Salvelinus fontinalis*). The anadromous Atlantic salmon (*Salmo salar*) migrate to this habitat to spawn. Other species also occurring in this aquatic community are eurythermal but not true indicators of coldwater such as longnose dace (*Rhinichthys cataractae*), and blacknose dace (*R. corporalis*). Smaller streams may harbor amphibians including northern two-lined salamander (*Eurycea bislineata*) and dusky salamander (*Desmognathus fuscus*). Characteristic macroinvertebrates are riffle and rocky bottom specialists including stoneflies (Plecoptera), mayflies (Ephemeroptera), caddisflies (Trichoptera), midges (Chironomidae), crayfish (Cambaridae), crane flies (Tipulidae), and blackflies (Simuliidae). Dragonflies and damselflies (Odonata) are also represented by several species of conservation concern including American rubyspot (*Hetaerina americana*), delta-spotted spiketail (*Cordulegaster diastatops*) and twin-spotted spiketail (*C. maculata*), spine-crowned clubtail (*Gomphus abbreviatus*), mustached clubtail (*G. adelphus*), southern pygmy clubtail (*Lanthus vernalis*), brook snaketail (*Ophiogomphus asperus*), Maine snaketail (*O. mainensis*), and zebra clubtail (*Stylurus scudleri*). Mollusks are generally lacking or sparse and of low diversity, but the eastern pearlshell (*Margaritifera margaritifera*) is of particular note as a highly localized species in Rhode Island. Bryophytes (mosses) and algae are usually present while rooted vascular plants are very localized and include waterweed (*Elodea* spp.), wild celery (*Vallisneria americana*) and pondweeds (*Potamogeton* spp.).

Upper perennial streams are principally found in higher elevations of the state, chiefly in the central and western portions of Providence, Kent, and Washington counties. These habitats become scarce in Bristol and Newport counties, and are lacking from the islands of Narragansett Bay and Block Island.

Condition: Historically, many upper perennial streams in Rhode Island were dammed to provide power to small mills and the rural communities that formed around them. Today some of the mill ponds, dams, and sluiceways remain, while others have deteriorated and allowed the streams to reestablish normal flows. The RI DEM categorizes stream segments throughout the state as cold/warm water systems based on the presence of characteristic species and other physical parameters. Streams classified as warm water systems may originate in wetlands, artificial ponds, or flow through agricultural and other open lands. In general, because most are no longer used for industrial purposes, most upper perennial streams are free of chemical

pollutants; however, many have above-average pH levels due to acid rain. Lapin (1991) however, found that ponds they sampled in Rhode Island were not affected by acid rain.

GCN Species		
<u>Dragonflies / Damselflies</u>	<u>Freshwater Fish</u>	<u>Mammals</u>
<i>Cordulegaster diastatops</i>	American brook lamprey	common water shrew
<i>Cordulegaster maculata</i>	Atlantic salmon	
<i>Gomphus abbreviatus</i>	blacknose dace	<u>Mollusks</u>
<i>Gomphus adelphus</i>	brook trout	<i>Margaritifera margaritifera</i>
<i>Hetaerina americana</i>	common shiner	
<i>Lanthus vernalis</i>	longnose dace	<u>Reptiles</u>
<i>Ophiogomphus aspersus</i>		wood turtle
<i>Ophiogomphus mainensis</i>		
<i>Stylurus scudderi</i>		

Inventory / Research / Monitoring Needs and Conservation Actions

- o Research additional habitat use issues. (Freshwater fish, Reptiles, Mammals, Dragonflies/Damselflies)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Initiate monitoring of species at breeding sites. (All GCN)
Measure: # of sites with monitoring and % incorporated into existing databases.
- o Determine metapopulation structure. (Reptiles, Mammals, Dragonflies/Damselflies)
Measure: Metapopulation structure determined; completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Identify concentration areas for non-breeding populations. (Atlantic salmon, Mammals, Reptiles)
Measure: # of sites identified and mapped and % incorporated into existing digital databases.
- o Initiate monitoring of species at non-breeding sites. (Atlantic salmon, wood turtle)
Measure: # of sites with monitoring; % incorporated into existing databases.
- o Identify priority parcels to retain as core forest areas with minimal management. (brook trout, common water shrew)
Measure: # of parcels identified and mapped and % incorporated into existing digital databases.
- o Evaluate need for nesting substrate for wood turtle and identify priority sites for management. (Mollusks and wood turtle)
Measure: #priority sites identified and mapped; completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Evaluate existing significant hibernacula or winter hibernation areas. (wood turtle)
Measure: # of sites evaluated; completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Control public access at priority sites. (Mollusks)
Measure: # of sites with restricted public access.

- o Investigate feasibility of altering hydrology of certain wetlands. (wood turtle)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Evaluate use of migratory stopover or winter habitat. (wood turtle)
Measure: # Sites evaluated; completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.

45) **River Lower Perennial [RLP]**

Description and Location: Lower perennial streams and rivers have relatively low gradients and poorly defined riffles and pools. Water flow is constant but sluggish and water temperature fluctuates widely. Streambeds are wide, with substrates composed of finer sands and silts, and there is usually a well-developed floodplain. Lower perennial streams and rivers are often characterized by meanders and levees and represent the lowest reaches of stream systems as 4th and 5th order segments. Although the middle of lower perennial streams and rivers is usually too deep to support aquatic macrophytes, the shallower waters along shores and in backwaters typically have rooted vascular plants including pondweeds (*Potamogeton* spp.), bur-reeds (*Sparganium* spp.), pickerelweed (*Pontedaria cordata*), and wild celery (*Vallisneria americana*). Floating-leaved plants, such as white water-lily (*Nymphaea odorata*) and submerged plants may be common in quieter waters.

Characteristic fish include warm water species such as the native pumpkinseed (*Lepomis gibbosus*), chain pickerel (*Esox niger*), yellow perch (*Perca flavescens*), and introduced species such as largemouth bass (*Micropterus salmoides*), brown bullhead (*Ameiurus nebulosus*), and white sucker (*Catostomus commersoni*). A species of particular concern, which in Rhode Island is only known from one stream system, is the American brook lamprey (*Lampetra appendix*). Also of note are anadromous species including alewife (*Alosa pseudoharengus*), blueback herring (*A. aestivalis*), American shad (*A. sapidissima*), and rainbow smelt (*Osmerus mordax*) which utilize this key habitat for spawning. Lower perennial streams also support diverse reptile and amphibian populations, a species of concern being the wood turtle (*Clemmys insculpta*) that winters submerged in streams and rivers, emerging to spend the rest of the year in adjacent uplands. Macroinvertebrates supported by this habitat include a higher diversity of mollusks with species of particular concern including triangle floater (*Alismodonta undulata*), alewife floater (*Anodonta implicata*), and squawfoot (*Strophitus undulatus*). Dragonflies of concern include the arrow clubtail (*Stylurus piniceps*).

Lower perennial streams and rivers are present throughout the state in lower elevations, and include Rhode Island's larger systems: Blackstone, Moshassuck, Woonasquatucket, and Pawtuxet Rivers that empty into Narragansett Bay, the Pawcatuck and Saugatucket Rivers in southern Washington County, the Moosup River that flows into central Connecticut, and the Adamsville River in Little Compton. These habitats are absent from the islands of Narragansett Bay and Block Island.

Condition: Historically, lower perennial streams and rivers have suffered the brunt of ecological impacts in Rhode Island as many of these systems were the first to be used for industrial purposes in the United States. For example, by the end of the 19th Century, the

Blackstone River was considered to be the most polluted river in the country with more than forty dams constructed along its roughly 45-mile route from Worcester, Massachusetts to Pawtucket, Rhode Island. In addition, the use of rivers for power and other industrial processes stimulated development of floodplains and riverbanks for housing and related infrastructure, a pattern that continued through most of the 20th Century to include shopping malls, recreational facilities, and landfills. Another direct impact to the habitat values of riverine systems was the construction of dams at the mouths of rivers that prevented the passage of anadromous fish. Loss of these fish populations also greatly affected some populations of fresh water mollusks that depend on alewife and other species in the early stages of their life cycles

Today, although water pollution regulations and construction of treatment facilities has greatly improved water quality in many rivers, high levels of toxic materials are still present in the bottom sediments of impoundments created by damming. Wetland regulations have generally precluded the development of floodplains and associated wetlands, and recently there has been increased interest in the restoration of previously developed sites. One example is the acquisition of a 30-acre drive-in theatre along the Blackstone River that was subsequently restored to a combined wetland/upland habitat. In addition, although the construction of fish ladders has reestablished anadromous fish runs along several smaller drainages, most larger rivers remain blocked to fish passage by significant dam/bridge structures.

GCN Species

Birds

eastern kingbird
orchard oriole

Freshwater Fish

alewife
American eel
American shad
blueback herring
creek chubsucker
rainbow smelt
redbreast sunfish
spottail shiner

Mollusks

Alasmidonta undulata
Alasmidonta varicosa
Anodonta implicata
Strophitus undulatus

Dragonflies / Damselflies

Stylurus spiniceps

Inventory / Research / Monitoring Needs and Conservation Actions

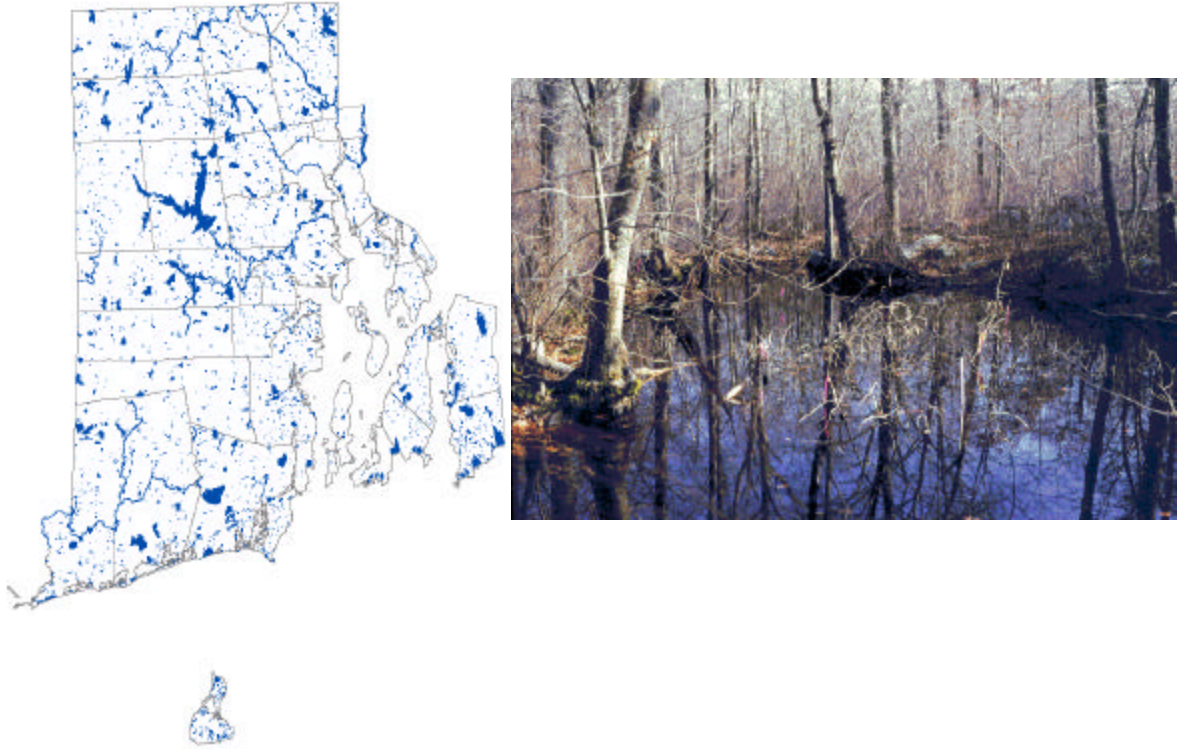
- o Research additional habitat use issues. (Freshwater fish, Birds, Dragonflies/Damselflies)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Initiate monitoring of species at breeding sites. (All GCN)
Measure: # of sites with monitoring and % incorporated into existing databases.
- o Control public access at priority sites. (Birds, Mollusks)
Measure: # of sites with restricted public access.
- o Evaluate need for breeding/nesting substrate and identify priority sites for management. (Mollusks)
Measure: # priority sites and substrates identified and mapped; completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.

- o Identify concentration areas for non-breeding populations. (alewife, American eel, rainbow smelt)
Measure: # of sites identified and mapped and % incorporated into existing digital databases.
- o Initiate monitoring of species at non-breeding sites. (alewife, American eel, rainbow smelt)
Measure: # of sites with monitoring; % incorporated into existing databases.
- o Protect individual nests from predation. (Birds)
Measure: # of individual nests protected.
- o Develop fire prescriptions for priority parcels. (eastern kingbird)
Measure: # of parcels with fire plans developed.
- o Implement burn management on priority parcels. (eastern kingbird)
Measure: # of parcels with fire plan implemented.
- o Expand public relations for fire management. (eastern kingbird)
Measure: # of public relations materials developed and distributed concerning fire management.
- o Determine metapopulation structure. (Dragonflies/Damselflies)
Measure: Metapopulation structure determined; completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Initiate monitoring of species at non-breeding sites. (American shad, blueback herring)
Measure: # of sites with monitoring; % incorporated into existing databases
- o Identify concentration areas for non-breeding populations. (American shad, blueback herring)
Measure: # of sites identified and mapped and % incorporated into existing digital databases

Lakes and Ponds

Definition and Location: There are 20,917 acres of lakes and ponds throughout Rhode Island, most of which are small in size (RI DEM 2004p, Rivers Council 2004). The largest lake is an artificial impoundment – the 13,000 acre Scituate Reservoir on the North Branch of the Pawtuxet River. The Scituate Reservoir is the water supply to nearly half of the state's population (RI DEM 2003n). The state's largest freshwater, natural lake is Worden Pond in the south-central part of the state; Great Swamp is contiguous to Worden Pond, and the entire complex has been preserved by the RI DEM and its partners.

Condition: The RI DEM assesses the water quality and aquatic health of the state's lakes and ponds as well as its rivers and streams and summarizes the data for the state's water quality report (RI DEM 2004p). The most recent bioassessment in 2004 analyzed the health of 80% of the state's lakes and ponds. Most of the lakes surveyed also included data on their ability to support aquatic life. This assessment concluded that 20% of the lakes in Rhode Island do not support aquatic life. In addition, the Rhode Island Department of Health (RI DOH) has designated four ponds impaired for fish consumption and issued an advisory against eating fish from them (RI DEM 2004p).



Most of the state's 45 lakes that are considered impaired suffer from elevated nutrient levels (27 lakes), excess algal growth (17 lakes) and low dissolved oxygen (17 lakes). Metals, elevated pathogen levels and biodiversity impacts also contribute to lake or pond impairment (RI DEM 2004p). Urban runoff and storm sewers contribute to the highest number of acres of impaired lake and pond waters. Sources of impairment and their contribution to lake acres is summarized in Table 2.7. Any lakes or ponds that are considered impaired have been placed on the state's 303(d) List of Impaired Waters, as required by federal regulation.

Threats:

- o Lack of GCN species and key habitat data incorporated into comprehensive strategy
- o Lack of research to guide threat assessment and prioritization of conservation planning
- o Habitat fragmentation from lack of conservation planning capabilities and coordination
- o Habitat fragmentation from lack of focal area approach to conservation
- o Habitat loss from inadequately sized preserves
- o Loss of breeding habitat for amphibians
- o Loss of habitat from plant succession
- o Lack of management and restoration of degraded Lepidoptera and/or Mussel habitat
- o Habitat loss of critical micro-features
- o Demographic changes from excessive predation (animal)
- o Habitat fragmentation and degradation from human disturbance
- o Demographic changes from incidental take (human)
- o Demographic changes from aquatic invasives
- o Habitat loss and demographic changes from invasive species (vegetation and animal)
- o Habitat loss from impairment of aquatic contiguity
- o Habitat degradation from impairment of water quality

- o Habitat fragmentation and degradation from chemical contaminants and disease
- o Habitat fragmentation from road effects
- o Lack of strategy to support priority research
- o Lack of information from research to address habitat and taxonomic issues
- o Lack of strategy to implement landscape-level monitoring to support planning and assessment
- o Lack of information for monitoring and on-going assessment
- o Lack of advocacy for comprehensive wildlife conservation

Conservation / Research Action for all Lakes and Ponds:

- o Collect physical, chemical, and fishery data every five years at locations that were used during the RI DEM DFW's survey of streams and ponds between 1993 and 2002.
Measure: Incorporate data into existing databases, compare the results of the surveys, and make necessary recommendations.

46) Lacustrine Eutrophic Lake/Pond [LE]

Description and Location: As described in Enser and Lundgren (2005) Eutrophic Lakes or Ponds are nutrient-rich ponds that are too shallow to become stratified in the summer. Water clarity is usually reduced due to accumulations of algae, and bottom substrates are usually mucky. Aquatic vegetation is abundant with characteristic submersed species including coontail (*Ceratophyllum demersum*), waterweed (*Elodea canadensis*), duckweed (*Lemna* spp.), and pondweeds (*Potamogeton* spp.). Fish populations are comprised of warm-water species. Eutrophic lakes and ponds are found throughout the state, ranging from completely natural to those formed or enlarged by dams or impoundments.

Condition: Eutrophic lakes and ponds are habitats under moderate stress but in relatively good condition. RI DEM DFW staff observations indicate that eutrophic ponds in urban settings and those ponds where there is a lot of shoreline development tend to be more turbid from plankton blooms, probably the result of being enriched from urban runoff. Eutrophic ponds in rural settings with no development along the shores tend to be more transparent

GCN Species
Freshwater Fish
 banded sunfish
 bridle shiner

Inventory / Research / Monitoring Needs and Conservation Actions

- o Research additional habitat use issues.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Expand public relations for amphibians and reptiles, primarily snakes.
Measure: # of educational programs developed and delivered concerning herps.
- o Initiate monitoring of species at breeding sites.
Measure: # of sites with monitoring and % incorporated into existing databases.

47) Lacustrine Oligotrophic Lake/Pond [LO]

Description and Location: This is a relatively nutrient-poor lake or pond. Waters are typically clear and well-oxygenated and the bottom is sandy or rocky. The larger water bodies (i.e. lakes) have two periods of mixing or turnover (spring and fall) and become thermally stratified in summer, and freeze over and become thermally stratified in winter as well. Ponds are too shallow to become stratified in the summer, but are winter stratified. Aquatic vegetation is sparse and species diversity is low. Pondweeds (*Potamogeton spp.*) and bladderworts (*Utricularia spp.*) are the most common submerged macrophytes. Characteristic floating-leaved plants include water-shield (*Brasenia shreberi*), water-lily (*Nymphaea odorata*, *Nuphar variegatum*). Fish populations are either warm-water or cold-water species, depending on summer temperatures. Characteristic native fishes include yellow perch (*Perca flavescens*), Eastern banded sunfish (*Enneacanthus obesus*), and pumpkinseed (*Lepomis gibbosus*). Introduced fish species include smallmouth bass (*Micropterus dolomieu*) and bluegill (*Lepomis macrochirus*). True oligotrophic lakes of northern New England are not represented in Rhode Island, with the closest examples probably being mesotrophic lakes (i.e., intermediate between oligotrophic and eutrophic). Description based on Enser and Lundgren 2005. Distribution is throughout Rhode Island. Examples are Wallum Lake, Burrillville and Carr Pond, West Greenwich.

Condition: Oligotrophic lakes and ponds are definitely habitats under stress. For the two oligotrophic ponds, Wallum Lake and Beach Pond, recent temperature, oxygen, and pH profile data suggest increased eutrophication (Lapin 1991). For example when vertical profiles of temperature, oxygen, and pH were measured originally in the 1950's and 1960's during summer stratification, the measurements were fairly consistent with depth, however, when measured again in the 1990's these measurements decreased with depth (Guthrie and Stolgitis 1977, A. Libby unpublished).

GCN SpeciesBirds

bald eagle

osprey

Dragonflies / Damselflies*Progomphus obscurus*Mollusks*Lampsilis radiata**Leptodea ochracea**Ligumia nasuta***Inventory / Research / Monitoring Needs and Conservation Actions**

- o Initiate monitoring of species at breeding sites. (All GCN)
Measure: # of sites with monitoring and % incorporated into existing databases.
- o Control public access at priority sites. (Birds, Mollusks)
Measure: # of sites with restricted public access.
- o Research additional habitat use issues. (Birds, Dragonflies/Damselflies)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Evaluate need for nesting structures/boxes and identify priority sites for management. (osprey)
Measure: Priority sites identified; completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.

- o Evaluate need for breeding/nesting substrate and identify priority sites for management. (Mollusks)
Measure: Priority sites identified, substrate identified; completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Identify concentration areas for non-breeding populations. (bald eagle)
Measure: # of sites identified and mapped and % incorporated into existing digital databases.
- o Protect individual nests from predation. (Birds)
Measure: # of individual nests protected.
- o Initiate monitoring of species at non-breeding sites. (Birds)
Measure: # of sites with monitoring; % incorporated into existing databases.
- o Determine metapopulation structure. (Dragonflies/Damselflies)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.

48) Permanent Fishless Pond [PFP]

Description and Location: This habitat code is necessary to represent several species of aquatic invertebrates that depend not upon hydrology or the type of vegetation present but rather are influenced by biotic features of the aquatic feature. Such species are not captured well by vegetation or wetland classifications such as Cowardin et al. (1979). Several lakes and ponds in Rhode Island were created post-glacially when large blocks of exfoliating ice were covered by glacial till. As these ice blocks melted, they left water-filled depressions. Such ponds are located primarily on the Charlestown recessional moraine and in the outwash plains that flank it. Many of these ponds have a seasonal or semi-permanent hydrology (i.e., they dry out at some interval), but others contain water on a permanent basis. Because the basins of these ponds are isolated, they lack stream connections to other systems, and therefore were never naturally colonized by fish. However, many of these were subsequently stocked with fish to provide recreational opportunities or some alleged biological benefits. The fresh water mussel fauna is illustrative in reconstructing which ponds have been stocked and which have fish naturally. Because mussels must colonize wetlands by arriving fish, ponds that presently support fish but lack mussels were probably stocked (because otherwise there would be mussels present). Ponds that lack both fish and mussels are naturally fish-free, and ponds that have mussels and fish were likely colonized, at least in part, through natural pathways. Because fish, as dominant predators, are significant in structuring aquatic systems, ponds that lack them have robust invertebrate communities that often support rare species and huge populations of others. These ponds are clearly landscape-level source populations for such dragonflies as *Anax longipes* and the other odonates mentioned below. Several other invertebrate species also thrive in predator-free systems. Permanent ponds that have never been stocked with fish are exceedingly rare in Rhode Island. The best example of a fishless permanent pond is Plain Pond, within the Black Farm Management Area, Hopkinton. This permanent pond lacks both fish and fresh water mussels and is the exemplary habitat for the GCN species below.

Condition: The primary threat to a permanent fishless pond is the stocking of fish or other “invasive” species. Public assess at such sites should be structured, as it is (albeit

inadvertently) at Plain Pond, so that vehicle access is kept at a distance. This scenario reduces the probability that fish can be carried to the pond and introduced. The RI DEM DFW recognizes the significant wildlife values attached to fishless ponds, and should coordinate internally to identify, maintain and protect these sites before any stocking or development of fishing or other public access at isolated pond habitats is attempted.

GCN Species
Dragonflies / Damselflies
Anax longipes
Enallagma pictum
Enallagma recurvatum

Inventory / Research / Monitoring Needs and Conservation Actions

- o Research additional habitat use issues.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Determine metapopulation structure.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Initiate monitoring of species at breeding sites.
Measure: # of sites with monitoring and % incorporated into existing databases.

49) Seasonally Flooded Pond [SFP]

Description and Location: According to Cowardin et al. (1979) a Seasonally Flooded Wetland means that “Surface water is present for extended periods especially early in the growing season, but is absent by the end of the season in most years. When surface water is absent, the water table is often near the land surface”.

Ponds in this category are sometimes referred to as “vernal ponds or seasonal forest ponds”. They are similar to the following pond categories, except that they are generally smaller, more widespread, and more common on the landscape. These pools are typically flooded in the spring or after a heavy rainfall, but usually dry in the summer. Many are filled again in the fall. The substrate is usually dense leaf litter overlying hydric soils. They can occur in surficial soils and on the bedrock substrates within and east of Narragansett Bay. Plants in these habitats are predominantly hydrophytic, with submerged and floating-leaved species most common, but the composition of the vegetation is highly variable depending on the length of time the pool retains water. Communities of organisms in such ponds also tend to be structured by biotic processes, including predation. However, because these ponds dry out completely on an annual (or nearly so) basis, fish populations cannot remain established and in fact other predators such as invertebrates are also reduced. These ponds typically support significant amphibian populations. Of these, the GCN species below are either rare or vulnerable to habitat fragmentation in the surrounding matrix habitat. Therefore, they are suitable focal species around which to build monitoring programs and with which to design preserves. Some good examples of these ponds are protected on public lands (e.g., Carolina Management Area) and on other preserves.

Condition: Seasonally flooded ponds are found throughout the state in almost every community, although the habitat quality is highly variable. For example, those still present in urban situations no longer support much of the typical fauna. Recently, a remote survey of the Pawcatuck River watershed indicated that more than 1000 potential vernal pools existed in this area; however, field verification has not been completed for all sites, and it is estimated that less than 50 percent of these pools actually support viable populations of the characteristic amphibian species. The best vernal pool habitats exist in isolated situations where development has not reduced or impacted the surrounding uplands, which serve as the primary year-round habitat for the amphibians that utilize pools during the breeding season. Although seasonally flooded ponds are protected by regulation as “special wetland” resources, this designation does not prevent land conversion from occurring up to the edge of the pool.

Existing regulations designed to preserve fresh water features do not effectively protect enough terrestrial habitat to ensure viability of amphibian breeding populations. In many cases these ponds are not considered wetlands at all because they are either too small or have a very ephemeral hydrology. Many examples of these ponds have been filled (legally and illegally), altered by development in the terrestrial matrix, deepened to make fish ponds, and contaminated by silt, chemicals, road salt or other traumas. Because connectivity between small ponds is necessary for long-term viability of amphibian populations, isolation of these ponds by road-building or other landscape lever conversions can eventually lead to population loss, even if the pond and surrounding lands are protected. Of all the amphibian and reptile populations found in these pond habitats, the GCN specie selected demonstrate extreme localization or particular vulnerability to habitat fragmentation. It is critical to protect and manage them in clusters of ponds in close proximity in intact matrices. Introduction of American bullfrogs to Aquidneck Island, Conanicut Island, and Block Island would be particularly damaging. These species definitely require a focal area approach.

GCN Species

Amphibians

eastern spadefoot

marbled salamander

northern leopard frog

wood frog

Inventory / Research / Monitoring Needs and Conservation Actions

- o Research additional habitat use issues. (All GCN)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Determine metapopulation structure. (All GCN)
Measure: Metapopulation structure determined; completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Evaluate feasibility and efficacy of making additional amphibian breeding habitat. (Amphibians)

- Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.*
- o Construct and maintain new amphibian breeding habitat (seasonal pond project). (Amphibians)
Measure: # of new ponds constructed and mapped and # of new ponds with GCN species monitored over time.
- o Enhance regulations to protect amphibian breeding habitat. (Amphibians)
Measure: # of new regulations established or existing regulations modified to improve protection.
- o Expand public relations for amphibians and reptiles, primarily snakes. (Amphibians)
Measure: # of educational programs developed and delivered concerning herpetofauna
- o Investigate feasibility of altering hydrology of certain wetlands. (Amphibians)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Identify priority parcels to retain as core forest areas with minimal management. (eastern newt)
Measure: # of parcels identified and mapped and % incorporated into existing digital databases.
- o Identify concentration areas for non-breeding populations. (Amphibians)
Measure: # of sites identified and mapped and % incorporated into existing digital databases.
- o Evaluate use of migratory stopover or winter habitat.
Measure: # of sites evaluated and mapped; completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Initiate monitoring of species at breeding sites.
Measure: # of sites with monitoring and % incorporated into existing databases.

50) Semi-permanently Flooded Pond [SPP]

Description and Location: According to Cowardin et al. (1979), “Surface water persists throughout the growing season in most years. When surface water is absent, the water table is usually at or very near the land surface.” Ponds in this category include “Coastal Plain Ponds” which are rare in the state (see Enser and Lundgren 2005). Semi-permanently flooded ponds tend to occur in glacial surficial landscapes of western Rhode Island (especially in Washington County) and Block Island, and are less common to absent on the bedrock substrates within and east of Narragansett Bay. Communities of organisms in such ponds also tend to be structured by biotic processes, including predation. However, because these ponds dry out completely on some occasions (but not annually), fish populations cannot remain established. They typically support significant invertebrate populations and also serve as landscape-level source populations for several amphibians. Of these, the red-spotted newt is perhaps the most significant because it is known to be among the amphibians most sensitive to habitat fragmentation (Gibbs 1995, 1998) and therefore might be a suitable focal species around which to build monitoring programs. Some good examples of such pond are protected on public lands (e.g., Carolina Management Area) and on other preserves. Semi-permanently flooded ponds include some coastal plain ponds; see Emergent Wetlands section, Coastal Plain Pondshores habitat for the vegetated shorelines.

Condition: These systems are a relatively scarce wetland type in Rhode Island. Several examples on the Charlestown Moraine and nearby have been degraded by road construction and residential development. A major problem in conserving obligate amphibian species in such ponds is that some species (primarily red-spotted newt) demonstrate strong area-sensitivity – it takes a large amount of surrounding intact landscape to support them. Therefore, it is questionable whether any examples of this wetland type are protected under existing preserve structures. Landscape analyses should be done with target wetlands to investigate the amount and condition of surrounding matrix habitat, as well as the connectivity between ponds. There have been several examples of fish introductions usually involving goldfish (*Carassius auratus*), brown bullhead (*Ameiurus nebulosus*), and other species by nearby landowners. Although such introduced fish populations eventually succumb when the pond eventually dries, the short-term damage to the amphibian population structure is unknown. Introduction of American bullfrog (*Rana catesbeiana*) populations may be a more insidious threat even than fish. Bullfrog tadpoles are routinely sold by mail-order or by water garden companies. Although American bullfrogs are native to western Rhode Island, they do not occur naturally on the large Narragansett Bay islands or on Block Islands, and their arrival in these areas would degrade amphibian populations. The sale and dispersal of nuisance exotic species should be more tightly regulated and enforced in Rhode Island.

GCN Species:Amphibianseastern newt
fowler's toadDragonflies / Damselflies*Lestes unguiculatus***Inventory / Research / Monitoring Needs and Conservation Actions:**

- o Research additional habitat use issues. (All GCN)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Determine metapopulation structure. (All GCN)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Evaluate feasibility and efficacy of making additional amphibian breeding habitat. (Amphibians)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Construct and maintain new amphibian breeding habitat (seasonal pond project). (Amphibians)
Measure: # of new ponds constructed and mapped and # of new ponds with GCN species monitored over time.
- o Enhance regulations to protect amphibian breeding habitat. (Amphibians)
Measure: # of new regulations established or existing regulations modified to improve protection.
- o Expand public relations for amphibians and reptiles, primarily snakes. (Amphibians)
Measure: # of educational programs developed and delivered concerning herpetofauna

- o Investigate feasibility of altering hydrology of certain wetlands. (Amphibians)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Identify priority parcels to retain as core forest areas with minimal management.
Measure: # of parcels identified and mapped and % incorporated into existing digital databases.
- o Identify concentration areas for non-breeding populations. (Amphibians)
Measure: # of sites identified and mapped and % incorporated into existing digital databases.
- o Evaluate use of migratory stopover or winter habitat.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Initiate monitoring of species at breeding sites. (eastern newt, *Lestes unguiculatus*)
Measure: # of sites with monitoring and % incorporated into existing databases.

Marine and Estuarine Habitats

Species found in the marine and estuarine communities of Rhode Island are mobile and often migratory during at least part of their life cycle, using several community types at different life stages. Some species may spawn in the open ocean but use estuaries for nurseries, returning to marine open waters as adults. Anadromous fish rely on the marine waters and estuaries of the state as well as freshwater rivers and streams for spawning habitat; as a result, these species are discussed under both categories – in the former as general indicator species and for guild-level inventory, research and monitoring needs and conservation actions, and in the latter as individual GCN species and conservation actions for their primary habitat. Other species, such as whales, are highly migratory and cross state and national boundaries as they migrate seasonally. On the other hand, several marine and estuarine species are sessile and specialize in specific community niches (i.e. oyster reefs, mussel beds, etc.). The combination of habitat generalists and specialists found in marine and estuarine communities led to the selection of both open water habitats as well as specific communities within the marine and estuarine environment as key habitats in need of conservation.

Cowardin et al. (1979) defines the Marine System as including the open ocean and its associated outer coastline. In general, salinity is greater than 18.0 parts per thousand (ppt) ocean-derived salts. The Estuarine System is characterized by salt marshes and brackish marshes and the area of fresh and salt water mixing. Salinity in estuaries ranges is ≥ 0.5 parts per thousand (ppt). Rhode Island's estuaries include Narragansett Bay and smaller embayments along the entire Rhode Island coastline. These coastal habitats are presented in the following order:

Intertidal (includes both Marine and Estuarine)

- Estuarine Intertidal Emergent Brackish Marsh
- Estuarine Bluff Clay
- Estuarine Rocky Shore Bedrock
- Estuarine Unconsolidated Sand Dune
- Estuarine Unconsolidated Shore Cobble / Shell
- Estuarine Unconsolidated Shore Sand Beach
- Estuarine Beaches Unspecified

Subtidal (includes both Marine and Estuarine)

- Estuarine Subtidal Aquatic Bed Rooted Vascular
- Hard / Rocky Bottom
- Soft Bottom / Unconsolidated Sediments
- Varied Bottom - Invertebrate Beds
- Marine and Estuarine (Open Water)

The Cowardin et al. classification system of wetland systems (1979) was used to classify the habitats and a complete listing and habitat association for each of the marine and estuarine species is found in the RI DEM DFW database developed for this CWCS process. A

comprehensive compilation of all existing species status and ecological parameters was developed during the CWCS process along with a checklist of marine fish and invertebrates.

Because many of these GCN species are highly mobile and utilize a number of marine and estuarine habitats, a broad grouping combining Estuarine and Marine was developed to facilitate conservation planning. Species were grouped according to guild or assemblage by ecological or habitat similarities and focal species were identified (see taxa actions in previous section). Several guilds were identified (pelagic/anadromous, catadromous, demersal fishes; and benthic, estuarine, and habitat specific invertebrates). Focal species were identified according to degree of habitat use by (indigenous) life stages in the Narragansett Bay and coastal waters as an additional step to further target actions and needs (see taxa actions in previous section). It is recognized that actions addressing these focal species will also conserve the many other species in that guild or grouping. Anadromous fish are also listed as GCN species under the riverine key habitats in which they spawn as primary habitats.

It is important to recognize that, in order to avoid redundancy and to present these conservation strategies most efficiently and logically, this CWCS is organized so that threats and conservation actions are placed in only one tier and presented once, generally at the broadest level. For a detailed list of all actions for each habitat, please see Appendix 4. Due to the significant overlap of threats, they are presented at the broader habitat category level, but a detailed list of threats to each key habitat can be found in Appendix 3. Please note for each specific habitat, additional GCN species also occur, but are not listed here because they occur in additional habitats and were addressed in the coarse filter of statewide, taxa, or broader habitat category. The GCN species listed in the finer filter, specific habitats use this habitat as its primary habitat. Conservation actions focused on these species also conserve the key habitat and the broader array of species associated with it.

For example, many anadromous fish that are GCN species are listed under the riverine key habitats due to the importance of protecting their freshwater spawning habitat, even though these species also occur in marine and estuarine habitats. Under the broad marine and estuarine habitat category, anadromous and catadromous species serve as general indicator/focal species and guild-level inventory, research and monitoring needs and conservation actions are therefore listed under this broad marine and estuarine habitat description. **See taxa-focused actions above that address these species guilds as well as in the habitat sections that follow**

Intertidal Habitats (Marine and Estuarine)

Description and Location: This is defined as the area that is regularly flooded by semidiurnal tides, bounded by the spring tide. The sessile organisms that live in this area have adapted to the regime where they face high fluctuations in salinity, moisture, temperature, and wave action. In addition, this region comprises the primary haul out areas for the harbor seal (*Phoca vitulina*) annually from September to April. The ocean beaches and other unconsolidated areas in the littoral zone have their own distinctive community of organisms, which are largely

dependent on the size of the substrate and the energy of the beach. The community types included in the intertidal or littoral zone are:

- Estuarine Intertidal Emergent Brackish Marsh
- Estuarine Bluff Clay
- Intertidal Rocky Shore Bedrock
- Unconsolidated Shore – Sand Dune
- Unconsolidated Shore Cobble / Shell
- Estuarine Beach Unspecified

The community that is landward and adjacent to Unconsolidated Shore – Sand Dune is classified by RIGIS codes as Estuarine Unconsolidated Sand [EUS]; more information on Estuarine Unconsolidated Sand [EUS] can be found earlier in this chapter under (habitat #23) Beach Grass Dune.



Coastal wetlands include salt marshes and freshwater or brackish wetlands continuous to salt marshes or other physiographical features. They are regularly inundated by saltwater through either natural or artificial watercourses. Important community types include Estuarine Intertidal Brackish Marsh, which as broadly defined here, included brackish marshes, salt marshes, salt marsh pannes, salt shrub, and salt marsh creeks that occur within this broader habitat type. Areas of open water within the coastal wetlands are considered part of the wetland. In addition, coastal wetlands also include freshwater and/or brackish wetlands that are directly associated with non-tidal coastal ponds and freshwater or brackish wetlands that occur on a barrier beach or are separated from tidal water by a barrier beach. Tidal rivers and creeks are also important habitats, particularly for anadromous and catadromous fish species, but are

not included as distinct key community types. Anadromous and catadromous GCN species rely upon the entire marine and estuarine system at various stages of their life history and are listed under the riverine key habitats.

Coastal wetlands provide food and shelter for large populations of juvenile finfish. The mudflats and creeks associated with many coastal wetlands are rich in shellfish particularly the ribbed mussel (*Geukensia demissa*), soft shelled clams (*Mya arenaria*), and fiddler crabs (*Uca spp.*). Other characteristic invertebrate species include the ribbon worm (*Cerebratulus lacteus*) and several annelid worms. Coastal wetlands also provide important habitat for shore birds and waterfowl, and many are among the most scenic features of the Rhode Island shore. Coastal wetlands are effective in slowing the erosion along protected shores.

The coastal wetlands habitat and its related parts are the first line of defense for the marine system. They are the buffer zone that slows the impacts of the terrestrial world on the marine environment. This front line defense is under constant pressure from urban development. The physical loss of area due to shoreline development and construction of bulkheads or hardened shoreline reduces the amount of wetlands in the Rhode Island marine environment. This loss is further exacerbated by dredging and other disturbances in this sensitive area. Coastal storms such as hurricanes and nor'easters also threaten developed areas, which can impact coastal wetlands through the accumulation of construction debris from damaged buildings, roadways and other man-made structures, as well as from altered hydrologic and sedimentary processes

Condition: Shoreline stabilization measures have impacted intertidal communities by replacing these dynamic communities with stationary, man-made structures. The abundance and distribution of hardened shorelines (i.e., bulkheads, seawalls, jetties, piers, breakwaters) in the Narragansett Bay estuary were mapped using 1996 aerial photography by the RI DEM (Huber 2000). This analysis indicated that 133 miles (almost one quarter) of the 540 mile Narragansett Bay estuarine shoreline in Rhode Island and Massachusetts were hardened as of 1996 (Tiner et al. 2003 and Huber 2000).

Huber (1999) identified 427.6 acres of brackish marsh and 443.2 acres of low salt marsh in Narragansett Bay in 1999. Nearly half (46%, 195.4 acres) of the brackish marsh were dominated by *Phragmites australis*. Only 0.2% (0.7 acres) of the low salt marsh was found to be ditched and only 0.8% (3.5 acres) impounded. The condition of coastal wetlands within Narragansett Bay (degraded or not) was assessed and mapped using 1996 aerial photography. Rhode Island Coastal Resources Management Council (RI CRMC) et al. (2003) has developed a Salt Marsh Site Selection Tool for restoring salt marshes in Rhode Island, providing technical GIS tools to locate and select restoration sites that meet user-defined criteria.

Threats to Intertidal Habitats:

- o Direct loss and fragmentation of wetlands due to shoreline development, bulkheads, and poor urban development.
- o Direct loss of wetlands through dredging, dredge disposal, ditching and draining, and other benthic disturbances.
- o Changes in the freshwater regime resulting from fresh water diversions, dam removal and waterway restoration, and ditching wetlands

- o Direct contamination of marshes from point source pollution from industrial discharge, heavy metals, sediment, and other contaminants
- o Sedimentation and contamination of marshes from non-point source pollution from erosion, sedimentation, agriculture run off, and septic systems
- o Nutrient loading from sewage pollution (i.e., combined sewage overflow, failing and inadequate systems, boat waste)
- o Temperature changes and regulation
- o Inadequate fisheries management of accidental mortality and where more resources are harvested in an area than the ecosystem can sustain
- o Invasive (alien) species such as *Phragmites* and purple loosestrife that directly effect habitat, competitors, predators, pathogens or parasites, and/or changes in the native species dynamics
- o Direct contaminants into the marsh from oil spills, marine accidents, and ocean dumping
 - o Direct contaminants of littoral zone habitats from oil spills, marine accidents, and ocean dumping
 - o Non point source pollution from erosion, sedimentation, agriculture run off, and septic systems that increases stresses on the area
 - o Invasive (alien) species that directly effect habitat, competitors, predators, pathogens or parasites, and/or changes in the native species dynamics, directly competing with the native species
 - o Nutrient loading from sewage pollution (i.e., combined sewage overflow, failing and inadequate systems, boat waste)
 - o Changes in the water regime resulting from temperature changes and regulation
 - o Loss of riparian vegetation and fringe wetlands due to shore line development, bulkheads, and poor urban development which result in increased nutrient loading and increased sedimentation
 - o Dredging, dredge disposal and other benthic disturbances such as trawling that directly remove habitat and species and increase sedimentation
 - o Changes in the water regime resulting from fresh water diversions, dam removal and waterway restoration
 - o Point source pollution from industrial discharge, heavy metals, sediment, and other contaminants that increases stresses on the area
 - o Inadequate fisheries management of accidental mortality and where more resources are harvested in an area than the ecosystem can sustain, which reduce the spawning populations of fish
 - o Lack of information on historical changes in this habitat type
 - o Incomplete survey information for *Cicindela marginata*
 - o Heavy pesticide spraying
 - o Shoreline stabilization and development
 - o Increasing recreational use of marine shorelines
 - o Contamination by oil spills and other pollutants

51) Estuarine Intertidal Emergent Brackish Marsh [EEBM]

Description and Location: Estuarine Intertidal Brackish Marsh, also commonly referred to as salt marsh or tidal marsh, are wetlands along the coast between the highest and lowest tide levels, where substrates are periodically exposed and flooded by semidiurnal tides. Some areas are only irregularly exposed at low tide, while other areas are only irregularly inundated during high tides. Semidiurnal submergence, warm water, thick deposits of mud, and varying salinity levels make these communities extreme and specialized habitats.

Individual estuarine marshes differ along a salinity gradient depending on the extent of tidal flooding so that different vegetation zones are evident that are occupied by a distinctive flora and fauna. At the lowest extreme, in a zone extending from mean high tide down to mean sea level, is the low salt marsh community that is regularly flooded by diurnal tides. The vegetation in this zone is a nearly monospecific stand of saltmarsh cordgrass (*Spartina alterniflora*), a coarse grass growing up to about three (3) meters. A few species of marine algae may also form dense mats on the sediment surface between the cordgrass stems including knotted sea wrack (*Ascophyllum nodosum*), sea lettuce (*Ulva spp.*) and hollow green weeds (*Enteromorpha spp.*).

Above the low marsh, in a zone extending from mean high tide up to the limit of spring tides, is a high marsh community that is typically dominated by salt-meadow cordgrass (*Spartina patens*), with lesser amounts of spikegrass (*Distichlis spicata*), blackgrass (*Juncus gerardii*), and glassworts (*Salicornia spp.*).

Scattered within these marsh communities are salt pannes; shallow depressions that are poorly drained and tend to concentrate salts from evaporating brackish water with consequent salinity levels that are well above normal salt water. Pannes support only species capable of tolerating high salinity levels, including saltworts, dwarf saltmarsh cordgrass, salt marsh plantain (*Plantago maritima ssp. juncooides*), and salt marsh sand spurrey (*Spergularia marina*).

On higher portions of the salt marsh, at the ecotone between the marsh and upland, or on raised domes within the marsh, a salt shrub community develops. Characteristic shrubs include groundsel-tree (*Baccharis halimifolia*), saltmarsh-elder (*Iva frutescens*), and pasture rose (*Rosa carolina*) and the non-native sand rose (*Rosa rugosa*). This shrub community commonly occurs as a linear feature at the upper edge of the marsh, marking the limit of the highest spring tides, and also on peaty sediments deposited during excavation of manmade ditches dug for mosquito control.

Estuarine marshes provide a unique habitat for a specialized fauna. Breeding birds found exclusively in these habitats include clapper rail (and occasionally the conspecific king rail), willet, saltmarsh sparrow, and seaside sparrow. These communities are also important feeding areas for nesting waders and shorebirds, as stopover and feeding areas for migrant shorebirds, and also wintering areas for American black duck and other water birds.

Condition: According to Cowardin et al. (1979) more than 50% of the estuarine marshes in present in Rhode Island at the time of European colonization have been lost. Historically,

these areas were drained and filled to provide sites for coastal development, including docks, marinas, petroleum and other natural resource storage facilities, industrial parks, junkyards, and landfills. Most salt and brackish marshes have received some degree of human-related degradation. Many sites have been ditched and their water flow altered by constrictions near roads and other processes. Many were sprayed historically with DDT to control mosquitoes. Other sites, especially along the shoreline of Washington County, have been altered by stabilization of the breach-ways connecting the large coastal ponds to the sea. Contamination from road run-off, septic leachate, and other industrial pollution continues to affect these habitats. Oil spills are an omnipresent danger to these coastal habitats. Many brackish marshes are little more than fringes rimming coastal ponds or waterways; it is doubtful if these bands of vegetation contribute meaningful habitat for the GCN species above. Invasive vegetation (primarily the non-native strain of *Phragmites australis*) has claimed much of the salt and brackish marsh vegetation statewide.

GCN Species

Birds

clapper rail	saltmarsh sharp-tailed sparrow
greater yellowlegs	seaside sparrow
king rail	short-billed dowitcher
least sandpiper	whimbrel
lesser yellowlegs	white-rumped sandpiper
pectoral sandpiper	willet

Butterflies / Moths

broad-winged skipper

Reptiles

diamondback terrapin

Inventory / Research / Monitoring Needs and Conservation Actions

- o Research additional habitat use issues. (All GCN)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Identify concentration areas for non-breeding populations. (diamondback terrapin, greater yellowlegs, least sandpiper, lesser yellowlegs, pectoral sandpiper, saltmarsh sharp-tailed sparrow, seaside sparrow, short-billed dowitcher, whimbrel, white-rumped sandpiper, willet)
Measure: # of sites identified and mapped and % incorporated into existing digital databases.
- o Evaluate use of migratory stopover/winter habitat. (diamondback terrapin, greater yellowlegs, least sandpiper, lesser yellowlegs, pectoral sandpiper, saltmarsh sharp-tailed sparrow, seaside sparrow, short-billed dowitcher, whimbrel, white-rumped sandpiper, willet)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Control public access at priority sites. (diamondback terrapin, Birds)
Measure: # of sites with restricted public access.
- o Protect individual nests from predation. (diamondback terrapin)
Measure: # of individual nests protected.
- o Initiate monitoring of species at non-breeding sites. (diamondback terrapin, greater yellowlegs, least sandpiper, lesser yellowlegs, pectoral sandpiper, whimbrel, white-rumped sandpiper, willet)

- Measure: # of sites with monitoring; % incorporated into existing databases.*
- o Initiate monitoring of species at breeding sites. (diamondback terrapin, clapper rail, king rail, saltmarsh sharp-tailed sparrow, seaside sparrow, willet)
Measure: # of sites with monitoring and % incorporated into existing databases.
 - o Evaluate need for nesting substrate and identify priority sites for management. (diamondback terrapin)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
 - o Determine metapopulation structure. (diamondback terrapin, Butterflies/Moths)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
 - o Evaluate nutritional value of exotic fruit-bearing plants. (Butterflies/Moths)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.

52) **Estuarine Bluff Clay [EBC]**

Description and Location: Where substrates of clay are overlain by more recent depositions of glacial till and these deposits are exposed to wave action, tall eroding bluffs can be created. This is a very localized and specialized habitat type in Rhode Island. The GCN species found here, the clay banks tiger beetle (*Cicindela limbalis*) is, as its name implies, a clay soil specialist. While adults prowl the cliffs and adjacent shoreline, larvae occupy horizontal burrows dug into the vertical clay deposits. This habitat type occurs only on Block Island.

Condition: This key habitat appears secure for the present. Excessive take of tiger beetles on Block Island by collectors continues to be a threat to the species

GCN Species

Beetles

clay banks tiger beetle

Inventory / Research / Monitoring Needs and Conservation Actions

- o Research additional habitat use issues.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Initiate monitoring of species at breeding sites.
Measure: # of sites with monitoring and % incorporated into existing databases.

53) **Estuarine Rocky Shore Bedrock [ERSB]**

Description and Location: As described in Enser and Lundgren (2005) the intertidal rocky shore community is exposed to high-energy waves and alternately exposed and submerged by daily tides. Organisms include attached algae, blue mussels (*Mytilus edulis*), sea stars (*Asterias* spp.), sea urchin (*Arabacia punctulata*), northern rock barnacle (*Balanus balanoides*) and little gray barnacle (*Chthamalus fragilis*). Among the mussels, barnacles, and algae, many crabs and fish species find food and shelter, flowing in and out with the

tide. Characteristic algae are *Ascophyllum nodosum*, *Fucus* spp., *Enteromorpha* spp., and *Rhizoclonium* spp. This is important winter foraging habitat for purple sandpiper (*Calidris maritima*) and harlequin ducks (*Histrionicus histrionicus*). Intertidal Rocky Shore communities are found on offshore islands and the shore of lower Narragansett Bay. Example sites include Sachuest Point National Wildlife Refuge in Middletown and Beavertail Point in Jamestown.

Condition: Huber (1999) identified 573.3 acres of rocky shores in Narragansett Bay in 1999, with 61% of those in the marine system and the remaining 39% in the estuarine system. The condition of Rhode Island's Intertidal Rocky Shores is unknown and in need of additional inventory, research and monitoring.

GCN Species

Birds

harlequin duck

purple sandpiper

Inventory / Research / Monitoring Needs and Conservation Actions

- o Identify concentration areas for non-breeding populations. (All GCN)
Measure: # of sites identified and mapped and % incorporated into existing digital databases.
- o Research additional habitat use issues and movement patterns. (All GCN)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Initiate monitoring of species at non-breeding sites. (All GCN)
Measure: # of sites with monitoring; % incorporated into existing databases.
- o Control public access at priority sites. (All GCN)
Measure: # of sites with restricted public access.
- o Protect individual nests from predation. (All GCN)
Measure: # of individual nests protected.
- o Evaluate use of migratory stopover or winter habitat. (purple sandpiper)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.

54) **Estuarine Unconsolidated Shore - Sand Dune [EUSG]**

Description and Location: This community is washed by high-energy waves, with sand and gravel substrates that are well drained at low tide. This community is subject to high fluctuations in salinity and moisture. It is characterized by benthic invertebrate fauna including polychaetes and amphipods. This area is a preferred spawning area for the horseshoe crab (*Limulus polyphemus*). These beaches are an important feeding ground for migratory shore birds, a characteristic species being the sanderling (*Calidris alba*). (Enser and Lundgren 2005).

Condition: The status and condition of the Unconsolidated Shore – Sand Dune key habitat is unknown, but is less than its historical extent due to habitat loss and fragmentation from

waterfront development and associated infrastructure which remain as significant threats to the condition and status of this habitat.

GCN Species

Birds

black-bellied plover	Sanderling
dunlin	semipalmated plover
red knot	semipalmated sandpiper
ruddy turnstone	

Inventory / Research / Monitoring Needs and Conservation Actions

All GCN

- o Identify concentration areas for non-breeding populations.
Measure: # of sites identified and mapped and % incorporated into existing digital databases.
- o Evaluate use of migratory stopover or winter habitat.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Research additional habitat use issues.
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Initiate monitoring of species at non-breeding sites.
Measure: # of sites with monitoring; % incorporated into existing databases.
- o Control public access at priority sites.
Measure: # of sites with restricted public access.
- o Protect individual nests from predation.
Measure: # of individual nests protected.

55) Estuarine Unconsolidated Shore Cobble / Shell [EUC]

Description and Location: This habitat is another type of marine substrate that is usually found on the banks of salt creeks or in certain portions of salt marshes and marine shores. It occurs primarily in Narragansett Bay, where shorelines consist of larger particle sizes and shells interspersed with fine dark muds. Typical vegetation consists of scattered *Spartina alterniflora*, sometimes with flats of pickleweed (*Salicornia* spp.). This habitat type is somewhat uncommon in Rhode Island, but good examples still remain at Potter's Cove and Nags Pond, Prudence Island, Jamestown Brook (Conanicut Island) and at Seapowet Marsh, Tiverton.

Condition: Unconsolidated Shore Cobble / Shell is probably a localized shoreline type in Rhode Island, but certainly many areas featuring patches of this habitat have been degraded by shoreline stabilization.

GCN Species

Beetles

salt marsh tiger beetle

Birds

spotted sandpiper

Inventory / Research / Monitoring Needs and Conservation Actions

- o Research additional habitat use issues. (All GCN)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Identify concentration areas for non-breeding populations. (spotted sandpiper)
Measure: # of sites identified and mapped and % incorporated into existing digital databases.
- o Evaluate use of migratory stopover or winter habitat. (spotted sandpiper)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Initiate monitoring of species at breeding sites. (All GCN)
Measure: # of sites with monitoring and % incorporated into existing databases.
- o Control public access at priority sites. (spotted sandpiper)
Measure: # of sites with restricted public access.
- o Initiate monitoring of species at non-breeding sites. (spotted sandpiper)
Measure: # of sites with monitoring; % incorporated into existing databases.

56) Estuarine Beaches Unspecified [BE]

Description and Location: This habitat type generally is the un-vegetated or sparsely vegetated zone of beach between the mean high tide line and the fore dune. However, a high quality of this habitat is characterized not so much by the physical nature of the substrate or the vegetation, but by the lack of human disturbance and absence of vehicular access. Of the 3 GCN species below, the northeastern beach tiger beetle (*Cicindela dorsalis*) has been extirpated from Rhode Island. The last population occurred on Block Island up until the 1970's. The hairy-necked (or seabeach) tiger beetle (*C. hirticollis*) has similarly declined, but is still locally distributed and has some large populations in the more remote of Rhode Island's beaches. The least tern presently nests at about 10 Rhode Island beaches - they fare very poorly in most years due to high predation of eggs and human disturbance.

The supratidal portion of the beach (between the high tide line and the toe of the primary dune) supports numerous species that live in the beach wrack or roam on the sand (Steinback 1999). Common species include amphipods (e.g., *Talorchestia longicornis*), tenebrionid beetles (e.g., *Phaleria testacea*), flies associated with beach wrack (e.g., Tethinidae), and predators that search the beach for prey (e.g., the wolf spider *Arctosa littoralis*).

Condition: There are very few beaches in Rhode Island that have low enough public use to support robust tiger beetle and tern populations. *Cicindela hirticollis* presently occurs only as a few areas where vehicle access is restricted, as at Napatree Point, Sandy Point Island, Briggs Beach, Trustom Pond NWR, and Quicksand Pond. High levels of human access and off-road

vehicle (ORV) use continue to threaten and degrade beach habitats for tiger beetles, compacting the burrows for larvae

GCN Species

Beetles

northeastern beach tiger beetle
hairy-necked tiger beetle

Birds

least tern

Inventory / Research / Monitoring Needs and Conservation Actions

- o Control public access at priority sites. (All GCN)
Measure: # of sites with restricted public access.
- o Research additional habitat use issues. (All GCN)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Initiate monitoring of species at breeding sites. (All GCN)
Measure: # of sites with monitoring and % incorporated into existing databases.
- o Identify concentration areas for non-breeding populations. (Birds)
Measure: # of sites identified and mapped and % incorporated into existing digital databases.
- o Evaluate use of migratory stopover/winter habitat. (Birds)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Protect individual nests from predation. (Birds)
Measure: # of individual nests protected.
- o Initiate monitoring of species at non-breeding sites. (Birds)
Measure: # of sites with monitoring; % incorporated into existing databases.

Subtidal Habitats

Description and Location: Subtidal habitats include a diversity of vegetated and unvegetated bottom sediments along the coastlines of the Narragansett Bay and Rhode Island's coast. The subtidal key habitats are:

Estuarine Subtidal Aquatic Bed Rooted Vascular,
Hard / Rocky Bottom
Soft Bottom / Unconsolidated Sediments
Varied Bottom - Invertebrate Beds
Marine and Estuarine (Open Water)

Submerged Aquatic Beds include Estuarine Subtidal Aquatic Bed Rooted Vascular as well as the marine equivalent. This marine habitat type is treated as part of type 57 for the purposes of this plan. Submerged Aquatic Beds and macroalgae beds support a diverse aquatic community, including large concentrations of waterfowl and as a nursery area for many finfish

and shellfish. The rooted vascular beds (both estuarine and marine variants) are captured in this plan under the “Estuarine Subtidal Aquatic Rooted Vascular” habitat type 57.

Submerged Aquatic Beds are rooted, vascular, flowering plants that, except for some flowering structures, live and grow below the water surface in coastal and estuarine waters in large meadows or in intermittent vegetated bed, including un-vegetated areas between vegetated beds. In areas of marine salinity, eelgrass (*Zostera marina*) and kelp are characteristic species, and in areas of brackish salinity eelgrass and widgeon grass (*Ruppia maritima*) are the characteristic species along with a variety of macroalgae. Submerged Aquatic Beds and macroalgae beds support a diverse aquatic community, including large concentrations of waterfowl and as a nursery area for many finfish and shellfish.

Kelp beds (one type of subtidal macroalgae bed) are associations of large brown algae. Kelps attach to the substrate via a holdfast, have a stem like stipe, broad flat blades, and a float or pneumatocyst; fronds are defined as a stipe with many leaf-like blades. Kelp beds are rich communities, which include polychaetes, small crustaceans, starfish, bryozoans, sponges, snails, fish, sea urchins and many other organisms (Edwards and Foster 2005). In Rhode Island coastal waters, there is an important natal association with kelp beds for skates (*Raja spp.*), smooth dogfish (*Mustelus canis*) and spiny dogfish (*Squalus acanthias*).



Marine Submerged Aquatic Beds are found in fringing the shores of lower Narragansett Bay and offshore islands. Brackish Submerged Aquatic Beds are located in the permanently flooded portion of salt ponds along the seacoast in Washington and Newport Counties, including Ninigret Pond and Trustom Pond in Charlestown. Huber (1999) identified 99.5 acres of eelgrass beds in Narragansett Bay in 1999. The largest remaining eelgrass bed (25 acres) in

the bay is along the eastern shore of Jamestown (Huber 1999). The distribution of kelp beds is unknown and requires further inventory and monitoring to determine their abundance and condition.

Condition: The eelgrass beds in Ninigret and Quonochontaug Ponds were assessed in 2000 by URI. The extent of eelgrass beds were approximated by RI DEM DFW in 1999-2000 and by the RI CRMC in 1999-2000, both by field observation. The Narragansett Bay Estuary Program mapped eelgrass beds via aerial photography in 1996. The historical extent of eelgrass beds from 1848 to 1994 has been collected from personal accounts, specimens, literature reviews and/or historical NOAA charts of the area. The RI CRMC has created public, online interactive maps of all of these data at <http://www.edc.uri.edu/Eelgrass>. Updated mapping of Submerged Aquatic Beds outside of the bay area (e.g. offshore) is needed. RI CRMC et al. (2003) has developed a Seagrass Site Selection Tool for restoring seagrasses in Rhode Island, providing technical GIS tools to locate and select restoration sites that meet user-defined criteria.

Submerged Aquatic and macroalgae beds are adversely impacted by physical, chemical and mechanical damage from boat propellers, dredging and filling, bottom-disturbing fishing gear, shading (e.g., piers and docks), excess turbidity and nutrient pollution. In Narragansett Bay, eelgrass is generally limited to depths shallower than 10 feet at low tide due to poor water quality (Huber 1999). The majority of the bay's eelgrass beds have been lost, with much of the historic lost likely due to the spread of wasting disease in the 1930s and today's recovery hindered by development and nutrient pollution (Huber 1999). It should be noted that GCN species and threats are similar in Macroalgae beds/ kelp beds not listed separately as a CWCS habitat here, but also in need of further study.

Threats to Subtidal Habitats:

- Dredging, dredge disposal and other benthic disturbances such as trawling that result in the removal and disturbance of the submerged aquatic plants, suspended sediments blocking the light, and physical removal by fishing dredges
- Loss of wetlands due to shore line development, bulkheads, and poor urban development which result in increased sedimentation and reduction of light in the water column
- Point source pollution from industrial discharge, heavy metals, sediment, and other contaminants that increases stresses on the area
- Non point source pollution from erosion, sedimentation, agriculture run off, and septic systems that increases stresses on the area
- Nutrient loading from sewage pollution (i.e., combined sewage overflow, failing and inadequate systems, boat waste)
- Changes in the water regime resulting from temperature changes and regulation
- Changes in the water regime resulting from fresh water diversions, dam removal and waterway restoration
- Invasive (alien) species that directly effect habitat, competitors, predators, pathogens or parasites, and/or changes in the native species dynamics, out competing native species

- Direct contaminants of submerged aquatic vegetation habitats from oil spills, marine accidents, and ocean dumping
- Fisheries management imbalances that lead to harvesting more than the ecosystem in that area can sustain and accidental mortality that lead to reduced spawning populations

57) **Estuarine Subtidal Aquatic Bed - Rooted Vascular [ESARV]**

Description and Location: A community of continuously flooded substrates supporting rooted aquatic vegetation. The water is generally less than 6.6 ft deep at low tide and salinity ranges between 0.5 – 30.0 ppt. The characteristic plant of the higher salinity beds is eelgrass (*Zostera marina*) with associated macro algae including the genera *Enteromorpha*, *Chaetomorpha*, *Gracilaria*, *Agardhiella*, *Ectocarpus* and *Pilayella*. In areas with lower salinity, the beds are characterized by widgeon grass (*Ruppia maritima*), wild celery (*Vallisneria Americana*), horned pondweed (*Zannichellia palustris*), sago pondweed (*Potamogeton pectinatus*), clasping-leaved pondweed (*Potamogeton perfoliatus*), and naiads (*Najas* spp.) along with the algal forms *Enteromorpha*, *Cladopora* and *Chara* (Enser and Lundgren 2005).

Condition: The status and condition of Rhode Island's Subtidal Aquatic Bed habitat is known only in discrete locations such as Narragansett Bay and a statewide assessment is an inventory, research and monitoring need. The beds are likely improving in status as seagrass restoration projects continue and restoration techniques are improved.

GCN Species

Fish

spotfin killifish
smooth dogfish
skates
cunner

Birds

waterfowl concentrations

Mollusks

deep sea scallop

Arthropods

bay shrimp
fiddler crab

Inventory / Research / Monitoring Needs and Conservation Actions

- Research additional habitat use issues. (All GCN)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- Identify concentration areas for non-breeding populations. (Birds)
Measure: # of sites identified and mapped and % incorporated into existing digital databases.
- Evaluate use of migratory stopover or winter habitat. (Birds)
Measure: # of sites evaluated and mapped; completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- Initiate monitoring of species at non-breeding sites. (Birds)
Measure: # of sites with monitoring; % incorporated into existing databases.
- Evaluate nutritional value of exotic fruit-bearing plants. (Birds)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.

- o Control public access at priority sites. (Birds)
Measure: # of sites with restricted public access.
- o Identify excess sedimentation in the watershed that prompts excessive maintenance dredging activities and implement appropriate management techniques to ensure actions are taken to curtail those causes. (All GCN)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o The diking and draining of tidal marshlands and estuaries should not be undertaken unless a satisfactory compensatory mitigation plan is in effect and monitored. (All GCN)
Measure: # of mitigation projects established and monitored.
- o Minimize the loss of riparian habitats as much as possible. (All GCN)
Measure: # of new projects with impacts avoided, minimized and mitigated.
- o Avoid locating roads near wetlands and fish bearing streams. Roads should be sited to avoid sensitive areas such as wetlands, streams, and steep slopes. (All GCN)
Measure: # of new projects with impacts avoided, minimized and mitigated.
- o Avoid placing pipelines and accessory equipment used in conjunction with construction or dredging operations to the maximum extent possible close to kelp beds, eelgrass beds, estuarine / salt marshes and any other high value habitat. (All GCN)
Measure: # of new projects with impacts avoided, minimized and mitigated.
- o Wherever possible, "soft" approaches (such as beach nourishment, vegetative plantings, and placement of large woody debris) to shoreline modifications should be used. (All GCN)
Measure: # of new projects with impacts avoided, minimized and mitigated.
- o Use an adaptive management plan with ecological indicators to oversee monitoring of coastal construction projects and ensure mitigation objectives are met. Take corrective action as needed. (All GCN)
Measure: # of sites with monitoring and % incorporated into existing databases; # of mitigation objectives met.
- o Avoid new dredging to the maximum extent possible. Projects should be permitted only for water dependent purposes and only when no feasible alternatives are available. (All GCN)
Measure: # of new projects with impacts avoided, minimized and mitigated.
- o Undertake multi-season, pre- and post- dredging biological surveys to assess impacts to animal and submerged aquatic vegetation communities. (All GCN)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Address cumulative impacts of past and current dredging operations on fishery resources by considering them as part of the permitting process. (All GCN)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Identify and characterize habitat functions and service in the dredging project area. (All GCN)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Adequate compensatory mitigation should be provided for unavoidable impacts from dredging projects. (All GCN)
Measure: # of mitigation projects established.

58) **Hard / Rocky Bottom [MRB & ERB]**

Description and Location: This estuarine and marine habitat is identified as “areas of rock or consolidated sediments, distinguished from the surrounding unconsolidated sediments, which may or may not be characterized by a thin veneer of live or dead biota” (SAFMC 1998). This includes rock, artificial reefs, piers, wrecks and any other submerged hard substrate. The habitat can be flat, have vertical structure, be crevassed, or smooth. 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.

Typically the hard or rocky substrate will be covered with sessile invertebrates and algae. This may include sponges, bryozoans, corals, anemones, polychaete worms, and mollusks, as well as sea urchins, crustaceans, and amphipods. In turn these sessile invertebrates provide food and shelter for many fish species. For numerous species, this area may also provide nursery habitat. The species that utilize this habitat include the indigenous tautog (*Tautoga onitis*), cunner (*Tautoglabrus adspersus*), and lobster (*Homarus americanus*), as well as migratory species such as scup (*Stenotomus chrysops*), striped bass (*Morone saxatilis*), bluefish (*Pomatomus saltatrix*) and black sea bass (*Centropristis striata*). Subtidal Hard / Rocky Bottom communities are located in the open ocean along the southern coast, around Block Island, and extending into Narragansett Bay.

Condition: The status and condition of Hard / Rocky Bottom habitats is unknown and in need of additional inventory, research and monitoring.

GCN Species

<u>Arthropods</u>	<u>Echinoderms</u>	<u>Tunicates</u>
blue crab	sea star	club tunicate
lobster		golden star tunicate
rock crab	<u>Fish</u>	orange sheath tunicate
	sea raven	sea grapes
		sea vase

Inventory / Research / Monitoring Needs and Conservation Actions

- o Avoid new dredging to the maximum extent possible. Projects should be permitted only for water dependent purposes and only when no feasible alternatives are available. (All GCN)

Measure: # of new projects with impacts avoided, minimized and mitigated.

- o Undertake multi-season, pre- and post- dredging biological surveys to assess impacts to animal and submerged aquatic vegetation communities. (All GCN)

Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.

- o Address cumulative impacts of past and current dredging operations on fishery resources by considering them as part of the permitting process. (All GCN)

Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.

- o Identify and characterize fishery habitat functions and service in the dredging project area. (All GCN)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Adequate compensatory mitigation should be provided for unavoidable impacts from dredging projects. (All GCN)
Measure: # of mitigation projects established.
- o Identify excess sedimentation in the watershed that prompts excessive maintenance dredging activities and implement appropriate management techniques to ensure actions are taken to curtail those causes. (All GCN)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o The diking and draining of tidal marshlands and estuaries should not be undertaken unless a satisfactory compensatory mitigation plan is in effect and monitored. (All GCN)
Measure: # of mitigation projects established and monitored.
- o Minimize the loss of riparian habitats as much as possible. (All GCN)
Measure: # of new projects with impacts avoided, minimized and mitigated.
- o Avoid locating roads near wetlands and fish bearing streams. Roads should be sited to avoid sensitive areas such as wetlands, streams, and steep slopes. (All GCN)
Measure: # of new projects with impacts avoided, minimized and mitigated.
- o Avoid placing pipelines and accessory equipment used in conjunction with construction or dredging operations to the maximum extent possible close to kelp beds, eelgrass beds, estuarine / salt marshes and any other high value habitat. (All GCN)
Measure: # of new projects with impacts avoided, minimized and mitigated.
- o Wherever possible, "soft" approaches (such as beach nourishment, vegetative plantings, and placement of large woody debris) to shoreline modifications should be used. (All GCN)
Measure: # of new projects with impacts avoided, minimized and mitigated.
- o Use an adaptive management plan with ecological indicators to oversee monitoring and ensure mitigation objectives are met. Take corrective action as needed. (All GCN)
Measure: # of sites with monitoring and % incorporated into existing databases; # of mitigation objectives met.
- o Incorporate best management practices to prevent or minimize contamination from ship bilge waters, antifouling paints, shipboard accidents, shipyard work, maintenance dredging and disposal, and non point source contaminants from upland facilities related to vessel operations and navigation. (All GCN)
Measure: # of best management practices established and implemented.
- o Discharges should be treated to the maximum extent practicable, including implementation of up-to-date methodologies for reducing discharges of biocides such as chlorine and other toxic substances. (All GCN)
Measure: # of discharges treated.
- o Improve land use efficiencies for key agricultural inputs including nitrogen, phosphorus, pesticides and irrigation water. (All GCN)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.

- o Locate discharge points in coastal waters well away from shellfish beds, seagrass beds, reefs and other similar fragile and productive habitats. (All GCN)

Measure: # of new projects with impacts avoided, minimized and mitigated.

59) **Soft Bottom / Unconsolidated Sediments [MUB & EUB]**

Description and Location: The composition of aquatic bottom sediment can range from gravel to very fine silt. The bottom is typically gradually sloping with little relief. "Soft bottom habitat is unconsolidated, un-vegetated sediment that occurs in freshwater, estuarine, and marine system" (SAFMC 1998). This community type is unvegetated without visible structure, but hosts abundant microscopic plants and burrowing animals (SAFMC 1998). This key habitat includes all unconsolidated bottoms from soft mud / muck to soft (sand) bottom community types. Due to its extensive nature, it is often overlooked in conservation plans. The soft sediments are easily disturbed and damaged. The species that utilize this habitat include various clams, crabs, lobster and demersal fish.

The Soft Bottom community is a sand and silt mix that is highly productive. The invertebrate species that occur in this sediment may include hard clams (*Mercenaria mercenaria*), soft shell clams (*Mya arenaria*), razor clams (*Tagelus plebeius*), mantis shrimp (*Squilla empusa*), polychaete worms and many other species. The species that occur on the sediment include horseshoe crabs (*Limulus polyphemus*), lobster (*Homarus americanus*), and blue crabs (*Callinectes sapidus*). Many demersal finfish utilize this community through their life history for food, shelter and spawning grounds.

The location and distribution of Soft Bottom habitats has recently been undertaken by the MapCoast Partnership, which has developed a subaqueous soil classification system and has completed a pilot project that mapped the soils distribution in Ninigret Pond (<http://www.ci.uri.edu/Projects/MapCoast/default.html>). Some areas of Narragansett Bay's bottom have been mapped by RI DEM's Narragansett Bay Estuary Program, but the statewide distribution and abundance of this key habitat is currently unknown.

Condition: Soft Bottom / Unconsolidated Sediment habitats are subject to disturbance and alteration by dredging, dredge disposal, marine construction (e.g., pipe and cable lines) and bottom tending fishing gear. The current extent of these habitat alterations is unknown and in need of inventory and monitoring.

GCN Species

Arthropods

horseshoe crab
mantis shrimp
spider crab

Mollusks

quahog
whelk

Fish

American sand lance
Atlantic tomcod
hogchoker
monkfish
oyster toadfish
windowpane
winter flounder
Northern kingfish

Inventory / Research / Monitoring Needs and Conservation Actions

- o Identify excess sedimentation in the watershed that prompts excessive maintenance dredging activities and implement appropriate management techniques to ensure actions are taken to curtail those causes. (All GCN)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o The diking and draining of tidal marshlands and estuaries should not be undertaken unless a satisfactory compensatory mitigation plan is in effect and monitored. (All GCN)
Measure: # of mitigation projects established and monitored.
- o Minimize the loss of riparian habitats as much as possible. (All GCN)
Measure: # of new projects with impacts avoided, minimized and mitigated.
- o Avoid locating roads near wetlands and fish bearing streams. Roads should be sited to avoid sensitive areas such as wetlands, streams, and steep slopes. (All GCN)
Measure: # of new projects with impacts avoided, minimized and mitigated.
- o Avoid placing pipelines and accessory equipment used in conjunction with construction or dredging operations to the maximum extent possible close to kelp beds, eelgrass beds, estuarine / salt marshes and any other high value habitat. (All GCN)
Measure: # of new projects with impacts avoided, minimized and mitigated.
- o Wherever possible, "soft" approaches (such as beach nourishment, vegetative plantings, and placement of large woody debris) to shoreline modifications should be used. (All GCN)
Measure: # of new projects with impacts avoided, minimized and mitigated.
- o Use an adaptive management plan with ecological indicators to oversee monitoring of coastal construction projects and ensure mitigation objectives are met. Take corrective action as needed. (All GCN)
Measure: # of sites with monitoring and % incorporated into existing databases; # of mitigation objectives met.
- o Avoid new dredging to the maximum extent possible. Projects should be permitted only for water dependent purposes and only when no feasible alternatives are available. (All GCN)
Measure: # of new projects with impacts avoided, minimized and mitigated.
- o Undertake multi-season, pre- and post- dredging biological surveys to assess impacts to animal and submerged aquatic vegetation communities. (All GCN)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Address cumulative impacts of past and current dredging operations on fishery resources by considering them as part of the permitting process. (All GCN)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Identify and characterize fishery habitat functions and service in the dredging project area. (All GCN)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Adequate compensatory mitigation should be provided for unavoidable impacts from dredging projects. (All GCN)
Measure: # of mitigation projects established.

60) Varied Bottom – Invertebrate Beds [MRF & ERF]

Description and Location: This is a subtidal estuarine or marine substrate composed of hard sand, rock, shell hash and manmade structures or any combination of these. Community types include sponge, mussel and oyster beds. These are discrete beds, distinguishable from scattered shells. Sponges and mussels are both filter feeders. Their presence and abundance has an effect on the overall water quality.

Sponge beds create another key subtidal habitat. Colonies of the family Porifera form large uneven patches on the bottom and are located throughout Narragansett Bay. The sponge families commonly found in this area are: sulphur sponge (*Cliona celata*), red beard sponge (*Microciona prolifera*), and dead man's fingers (*Haliclona oculata*). Sponge beds are an important habitat for juvenile finfish. The nooks and crannies in the sponge provide much needed shelter for the juveniles. Some species found in the habitat include tautog (*Tautoga onitis*), cunner (*Tautoglabrus adspersus*), and oyster toadfish (*Opsanus tau*).

Mussel beds are an area of forage for many bottom feeding species including the tautog (*Tautoga onitis*). These beds provide food and shelter for numerous invertebrates as well. Typically mussel beds are associated with the higher salinity of the lower bay and coastal waters.

Oyster beds are typically a more estuarine feature. They start on a hard substrate and create a bed of dead and living shell matter. The beds may be colonized by polychaetes, sponges, blue crabs (*Callinectes sapidus*), or many other species that use the structure this provides for shelter and forage.

The abundance and distribution of sponge and mussel beds is unknown and in need of additional inventory and monitoring efforts. Huber (1999) identified only one oyster reef (9.0 acres) in Narragansett Bay in 1999, which was located in Mill Gut.

Condition: The status and condition of varied bottom habitats is not known and additional inventory and research is needed. These sessile communities are subject to disturbance from vessel collisions, dredging and dredge spoil, sedimentation and degradation in water quality.

GCN Species

<u>Mollusk</u>	<u>Sponge</u>	<u>Tunicate</u>
blue mussel	Family Porifera	<i>Applidium</i> spp.

Inventory / Research / Monitoring Needs and Conservation Actions

- o Avoid new dredging to the maximum extent possible. Projects should be permitted only for water dependent purposes and only when no feasible alternatives are available. (All GCN)
Measure: # of new projects with impacts avoided, minimized and mitigated.
- o Undertake multi-season, pre- and post- dredging biological surveys to assess impacts to animal and submerged aquatic vegetation communities. (All GCN)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.

- o Address cumulative impacts of past and current dredging operations on fishery resources by considering them as part of the permitting process. (All GCN)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Identify and characterize fishery habitat functions and service in the project area of dredging, dredge disposal and other benthic disturbance projects. (All GCN)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Adequate compensatory mitigation should be provided for unavoidable impacts from dredging, dredge disposal and other benthic disturbance projects. (All GCN)
Measure: # of mitigation projects established.
- o Study all options for disposal of dredged materials, including disposal sites and methods used. Upland disposal sites should be considered as an alternative to offshore disposal sites. (All GCN)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Increase the number and training of response teams in the event of an accident that releases contaminants into the environment. (All GCN)
Measure: # of response teams and training programs offered.
- o Increase the data bank on species habitat preferences and use for improved oil spill response planning and mapping. (All GCN)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.

61) **Marine and Estuarine Subtidal - Open Water [MOW & EOW]**

Description and Location: The marine subtidal open water habitat is permanently under water. It extends from the open ocean to the lowest tide level along the shore. This community includes all substrate types (ranging from rock bottom to unconsolidated bottom) and has only sparse to no rooted vegetation. Associated fauna includes a large number of fish species and mollusks such as surf clam (*Spisula solidissima*) in near-shore waters and ocean quahog (*Artica islandica*) in deeper waters (Enser and Lundgren 2005). It is located along the open ocean of Rhode Island's southern coast, around Block Island, and extending into Narragansett Bay. Marine mammals, including the seal, dolphin and whale species, as utilize these coastal waters seasonally as an important part of their migratory pattern (Valliere 2003). Anadromous and catadromous fish rely upon marine and estuarine waters as nursery areas, foraging habitat, and in the case of the catadromous American eel (*Anguilla rostrata*), as spawning habitat.

The estuarine subtidal open water habitat is the permanently flooded tidal zone along the shore and in bays, where the ocean water is partially diluted by freshwater influx. This system extends from the upstream limit of tidal influence seaward to an imaginary line closing the mouth of a bay or river. Salinity is ≥ 0.5 parts per thousand. Rhode Island's estuaries are located along the seacoast and in Narragansett Bay.

Condition: Table 1.5 listed the condition of various fishery stocks in the state's marine and estuarine waters. The RI DEM has assessed the condition of 78.62 miles of the marine shoreline, and none of these waters were found impaired for swimming or shellfishing (RI DEM 2004p). The relative condition of waters near Block Island, the state's dominant offshore marine feature and home to some of the state's most valuable ecosystems and habitats (Gibbs et al. 1995), frequently are monitored by the University of Rhode Island (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. Appendix 5 lists the programs that monitor the condition of this habitat. Condition and status of marine mammals is presented in the Rhode Island Large Whale Conservation Plan and Management Plan for Marine Mammals and Sea Turtles (Valliere 2003) and Draft Report on the Status of Marine Fisheries Stocks and Fisheries Management Issues in Rhode Island (Valliere and Murphy 2001) for fishery stocks. Additional details can be found in the numerous NMFS and MAFMC reports in Appendix 1a and 5)

The RI DEM assessment of water quality and health in the state includes the state's estuaries. Of the 156+ square miles of estuarine waters assessed in 2004, almost all (99%) were considered monitored as opposed to evaluated (primarily through the RI DEM Shellfish Monitoring Program). The assessment found that approximately 30% of the estuarine waters monitored are impaired while the remaining ~69% fully support all designated uses (RI DEM 2004p). Table 2.9 summarizes the proportions of estuary that support aquatic life and shellfishing. Over a third (36%) of the 116.41 square miles of estuarine waters assessed for aquatic life support were found to be impaired.

In addition, the state has over 132 square miles, excluding Rhode Island and Block Island Sounds, of estuarine waters designated for shellfishing use. Data are available to monitor 99% of these shellfishing waters, and 79% were found to fully support shellfishing, 16% partially support it, and the remaining ~4.5% do not support shellfishing and have been permanently closed (RI DEM 2004p).

Bacterial contamination, nutrient enrichment and low dissolved oxygen levels are the major threats to the state's estuarine waters. Combined sewer overflows are the major source of bacterial contamination. The Upper Bay and coves are impacted by combined sewer overflows, urban runoff and point source discharges, all of which contribute to nutrient enrichment and low DO levels (RI DEM 2004p). Table 2.10 lists the degree to which various sources contribute to the impairment of the state's estuarine waters.

Narragansett Bay has extensive monitoring data available that RI DEM utilizes to assess the relative condition of its habitats. RI DEM (2004p) summarizes the problems and threats affecting each region of the bay. Several of RI DEM's partners also conduct monitoring and research programs in the bay to continually assess the status and condition of individual species (e.g., lobster, oysters, eelgrass) and habitats. These collaborative partnerships have fostered numerous restoration projects throughout the bay.

GCN Species			
<u>Fish</u>	<u>Reptiles</u>	<u>Marine Mammals</u>	<u>Mollusks</u>
Atlantic menhaden	Atlantic green turtle	Blue whale	long finned
Atlantic sturgeon	Atlantic hawksbill turtle	fin whale	squid
lined seahorse	Kemp's ridley sea turtle	humpback whale	
weakfish	leatherback turtle	minke whale	<u>Tunicates</u>
shortnose sturgeon	loggerhead turtle	North Atlantic right whale	<i>Ascidrella</i>
		sei whale	<i>aspersa</i>
		sperm whale	

Inventory / Research / Monitoring Needs and Conservation Actions: The inventory, research and monitoring needs and conservation actions for marine and estuarine open water habitats are the same as those discussed above for the marine/estuarine focal species at the beginning of this section.

- o Research abundance and distribution of species for which status and habitat can be determined, by including additional data collection in present studies.
Measure: # of areas surveyed, # of species/populations located, GIS maps produced, and new data collected and compiled by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Conduct a literature search to survey life history information, identify what has already been done on the species, how this information can be used to better understand Rhode Island's species, and identify other research needs. Digitize existing information into a central repository.
Measure: measures of life history metrics established/collected, GIS maps produced, and # of research recommendations incorporated into conservation actions.
- o Develop a strategic conservation plan for anadromous fish and eel that will provide needed fish passage locations for shad, which can serve as a representative species.
Measure: conservation plan developed; # of fish ladders established; # of sites with GCN species monitored over time
- o Use gut content analyses to investigate the causes of high mortality after spawning, determining what is preying on species following spawning or if there are environmental causes.
Measure: # of species with gut content analyses completed, # of causes of mortality identified, and # of research recommendations incorporated into conservation actions.
- o Research predator / prey relationships to determine where species are in the food chain by identifying their most common food sources and what preys on them.
Measure: # of species identified in the food chain and # of research recommendations incorporated into conservation actions.
- o Identify and map critical areas in the life history of species, particularly spawning/breeding areas, and determine site fidelity to those areas.
Measure: # of sites identified and mapped and % incorporated into existing digital databases.
- o Begin surveys in Narragansett Bay for pelagic fish earlier in the year to survey spring fish.

- Measure: # of areas surveyed, # of species/populations located, GIS maps produced, and new data collected and compiled by RI DEM or partners and # of research recommendations incorporated into conservation actions.*
- o Determine appropriate indicator species or parameters to monitor water quality for pelagic / anadromous fauna.

Measure: # of indicator species and water quality monitoring parameters identified and implemented, by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Research marine mortality to determine the mortality rate of anadromous fish once they return to the estuary.

Measure: identification of mortality rate and # of research recommendations incorporated into conservation actions.
- o Research environmental sensitivity for slight changes in environmental factors that may lead to large impacts to the resource.

Measure: identification of environmental sensitivity of catadromous species to environmental factor and # of research recommendations incorporated into conservation actions.
- o Follow up the anadromous fish conservation plan by identifying fish ladders in need of retrofits to modify and maintain eel ramps at all fish ladders or dams.

Measure: # of fish ladders established; # of sites with GCN species monitored over time
- o Monitor the population and abundance of eels over their life span, gathering life history data and identifying other research needs.

Measure: # of areas surveyed, # of populations located, measures of life history metrics established/collected, GIS maps produced, and new data collected and compiled by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Assess the recruitment of eels into and out of lakes by monitoring their migration out of freshwater.

Measure: # of lakes surveyed, identification of recruitment rates, and # of research recommendations incorporated into conservation actions.
- o Research environmental sensitivity for slight changes in environmental factors that may lead to large impacts to the resource.

Measure: identification of environmental sensitivity of species to environmental factors and # of research recommendations incorporated into conservation actions.
- o Conduct a literature search to identify key periods of the life history of estuarine invertebrates, gather abundance and distribution data, and identify other research needs.

Measure: measures of life history metrics established/collected, GIS maps produced, and # of research recommendations incorporated into conservation actions.
- o Identify and map critical areas and habitat types in the life history of species, particularly spawning/breeding areas, by incorporating estuarine invertebrates into other surveys.

Measure: # of sites identified and mapped and % incorporated into existing digital databases.
- o Assess competition between species and inter-specific competition to determine if they are competing and, if so, how, where and what the competition is doing to the stocks.

- Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.*
- o Assess which species may be indicators of the health of the marsh / estuarine environment.

Measure: # of indicator species identified and monitored, and # of research recommendations incorporated into conservation actions.
- o Research predator / prey relationships to determine where species are in the food chain by identifying their most common food sources and what preys on them.

Measure: # of species identified in the food chain and # of research recommendations incorporated into conservation actions.
- o Assess the water quality of estuarine invertebrate habitats, identifying the need for additional conservation actions.

Measure: # of indicator species and water quality monitoring parameters identified and implemented, and # of research recommendations incorporated into conservation actions.
- o Research abundance and distribution of species for which status and habitat can be determined, by including additional data collection to existing surveys.

Measure: # of areas surveyed, # of species/populations located, GIS maps produced, and new data collected and compiled and # of research recommendations incorporated into conservation actions.
- o Conduct a literature search to identify and map critical areas in the life history of habitat specific invertebrates and identify other research needs.

Measure: measures of life history metrics established/collected, GIS maps produced, and # of research recommendations incorporated into conservation actions.
- o Assess the length of time for habitat specific invertebrates to reestablish following disturbance.

Measure: # of projects with before, during and after construction monitoring and # of research recommendations incorporated into conservation actions.
- o Research epiphytic growth on plants to determine if they are out-competing other species or if they are in a balance.

Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Identify where habitat specific invertebrates are in the food chain, what they are a food source for, and determine if they are limited or a limiting factor.

Measure: # of species identified in the food chain and # of research recommendations incorporated into conservation actions.
- o Assess whether stocks of marine fish, mammals, reptiles and habitat specific invertebrates are in decline.

Measure: # of species with stock assessments completed and # of research recommendations incorporated into conservation actions.

Other Habitats

Several key habitats are not completely categorized by any one standardized natural vegetation or other classification systems above for a variety of reasons. Since they support GCN species, they are included in this CWCS and listed below. These “other” habitats are listed in the following order:

- Predator-free Islands
- Urban
- Unknown

62) **Predator-free Islands [PFI]**

Description and Location: This category of habitat is necessary to represent those species for which the primary habitat component is not the type of vegetation or substrate but rather the lack of predators. The habitat for such species cannot be identified with vegetation classifications or by remote sensing – it is rather inferred by the presence of the target species. In other words, the habitat is *de facto* present if the species are present.



This category includes several small islands within Narragansett Bay and along the south coast of Rhode Island. These islands serve as predator-free refugia for an array of large ground-nesting birds. All GCN species are very sensitive not only to (primarily) mammalian predation but also to human disturbance at nesting sites. Several of these islands are protected under

existing refuge systems (e.g., Hope Island, part of the Estuarine Reserve System). Others are private but receive virtually no human visitation (e.g., Sakonnet Point Islands). Some islands in this category are not natural islands at all but isolated structures like channel markers or old piers that have suitable substrate for nesting birds. Block Island represents a significant example of a predator-free island – there are no native mammalian predators at all, and so other sensitive ground-nesting (but non-colonial) species nest only here within Rhode Island.

Condition: Many of the most significant nesting islands are in fact protected already, so threats to these sites involve human visitation and the occasional visit by predators. Habitat on some man-made nesting islands could be augmented by providing better substrate, short nesting platforms, or other features. For example, the nesting site at the mouth of Wickford Harbor was made more stable for common tern nesting by adding small nesting places made of loose bricks. A nesting site on an old pier off the shore of East Providence could also be augmented in like fashion.

GCN Species:

Birds

American oystercatcher	gadwall	little blue heron
black skimmer	glossy ibis	northern harrier
black-crowned night heron	great black-backed gull	ring-necked pheasant
cattle egret	great blue heron	roseate tern
common tern	great egret	snowy egret
double-crested cormorant	herring gull	yellow-crowned night heron

Threats to Predator-free Islands

- Lack of information for monitoring and on-going assessment
- Lack of information from research to address habitat and taxonomic issues
- Habitat fragmentation and degradation from human disturbance
- Demographic changes from excessive predation (animal)
- Lack of research to guide threat assessment and prioritization of conservation planning
- Loss of habitat from plant succession
- Habitat loss of critical micro-features

Inventory / Research / Monitoring Needs and Conservation Actions

- Initiate monitoring of species at breeding sites. (All GCN)
Measure: # of sites with monitoring and % incorporated into existing databases.
- Research additional habitat use issues. (All GCN)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- Control public access at priority sites. (All GCN)
Measure: # of sites with restricted public access.
- Initiate monitoring of species at non-breeding sites. (double-crested cormorant, great egret, snowy egret, little blue heron, cattle egret, black-crowned night heron, glossy ibis, gadwall, northern harrier, common tern, black skimmer)
Measure: # of sites with monitoring; % incorporated into existing databases.

- o Identify concentration areas for non-breeding populations. (gadwall, northern harrier, American oystercatcher, roseate tern, common tern, black skimmer)
Measure: # of sites identified and mapped and % incorporated into existing digital databases.
- o Evaluate use of migratory stopover or winter habitat. (American oystercatcher, roseate tern, common tern)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Evaluate need for nesting substrate and identify priority sites for management. (roseate tern, common tern)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Develop fire prescriptions for priority parcels. (northern harrier, ring-necked pheasant)
Measure: # of parcels with fire plans developed.
- o Implement burn management on priority parcels. (northern harrier, ring-necked pheasant)
Measure: # of parcels with fire plan implemented.
- o Expand public relations for fire management. (northern harrier, ring-necked pheasant)
Measure: # of public relations materials developed and distributed concerning fire management.

63) **Urban [U]**

Description and Location: Urban Habitats are defined by Anderson et al. as areas of intensive use with much of the land covered by structures including cities, towns, villages, strip developments along highways, transportation, power, and communications facilities, and areas such as those occupied by mills, shopping centers, industrial and commercial complexes, and institutions that may, in some instances, be isolated from urban areas (Anderson et al. 1976). Rhode Island's urban habitats are classified into the following 23 (Level III) communities:

Airports	Medium Density	Residential
Cemeteries	Medium High Density	Roads
Commercial and Services	Medium Low Density	Transportation and Utilities
Developed Recreational	Mixed Urban	Urban Open Space
High Density	Other	Urban or Built Up Land
Industrial	Other Urban	Waste Disposal Areas
Institutional	Power Lines	Water and Sewage
Low Density	Railroads	

The majority of Rhode Island's urban habitats are concentrated in the densely populated urban centers of Narragansett Bay (cities of Central Falls, Pawtucket, Providence, Cranston, Warwick, East Providence, and Newport) and on the major rivers (Woonsocket on the Blackstone River; Westerly on the Pawcatuck River). Most of these cities were originally formed as industrial and trading centers, and continue today as the primary areas for commerce, industry, finance, and residence, including the infrastructure necessary to support these activities. Although historically the outlying areas supported agriculture and other natural resource uses, in recent decades there has been a continual conversion of these lands to

urban/suburban environments, primarily as housing developments, shopping malls, light industries and warehouses, and supporting facilities.

Condition: Even within the most urbanized parts of the state open green spaces are available in the form of parks, cemeteries, vacant lots, riverbanks, and recreational fields. Although not necessarily supporting unusual wildlife populations, each of these habitats does offer some benefits to wildlife, such as feeding and resting areas for migrating birds. These same areas can support large nesting populations for such species as wood duck, red-tailed hawk, American kestrel, great horned owl, eastern screech-owl, Baltimore oriole, and other songbirds.



Several birds of conservation concern have also adopted urban environments as their primary nesting areas. The common nighthawk, historically a ground nester ground in sparsely vegetated habitats such as pitch pine barrens, has completely abandoned natural sites for the roofs of buildings in downtown Providence and neighboring cities. As its name suggests, the chimney swift nests solely in chimneys, although the loss of older buildings and advent of modern construction is gradually reducing the opportunities for this species. In addition, the recovery of the peregrine falcon has been bolstered by this species' adoption of nest sites on skyscrapers and bridges. Although opportunities for acquisition of open space in urban areas are limited there is some potential for improving wildlife habitats through restoration activities.

GCN Species

Birds

chimney swift
common nighthawk
peregrine falcon

Threats: The peregrine falcon is already getting attention at its known nesting sites on bridges and skyscrapers. Nest boxes have been successfully employed by a consortium of state, federal, and local experts. In general this magnificent raptor is well-cared for and there will likely always be at least some attention paid to it. The same cannot be said for the common nighthawk, a regionally declining and very local nesting species in Rhode Island. Nighthawks nest on flat rooftop in urban areas. This species has never been effectively surveyed in the state, so it is difficult to make inferences about habitat requirements or to develop conservation strategies. A first step with this and the chimney swift would be to solicit survey help from the general public and to employ a “citizen scientist” approach to finding nesting sites and tracking populations. Perhaps some improvements could be made to rooftop nesting sites to augment nesting populations.

Inventory / Research / Monitoring and Conservation Actions:

- o Initiate monitoring of species at breeding sites. (All GCN)
Measure: # of sites with monitoring and % incorporated into existing databases.
- o Research additional habitat use issues. (All GCN)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Identify concentration areas for non-breeding populations. (peregrine falcon, chimney swift)
Measure: # of sites identified and mapped and % incorporated into existing digital databases.
- o Evaluate need for nesting structures/boxes and identify priority sites for management. (peregrine falcon)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Evaluate need for nesting substrate and identify priority sites for management. (common nighthawk)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Control public access at priority sites. (All GCN)
Measure: # of sites with restricted public access.
- o Protect individual nests from predation. (peregrine falcon)
Measure: # of individual nests protected.
- o Initiate monitoring of species at non-breeding sites. (peregrine falcon)
Measure: # of sites with monitoring; % incorporated into existing databases.

64) Unknown Habitats [UNK]

Description and Location: Several species are not well known enough in Rhode Island or elsewhere to make strong inferences about their habitat requirements. For example, of the almost 3000 beetle species thought to occur in Rhode Island (Sikes 2000), only 37 have been selected for conservation action in this plan. These represent the rarest of the rare. In fact, several of these beetles have not even been seen for several decades, so it is questionable whether they are still part of the state’s fauna. For species like these, it may not be efficient or

necessary to attempt inventory work. A reasonable approach would be to glean as much information from other sources as possible regarding its life history, and then assess whether it is necessary to look for it. For example, 3 of the below GCN species are carabid beetles, and scientists in Connecticut have done recent inventory work with this group. Therefore, it may be prudent to consult additional experts before proceeding with conservation planning. If reasonable inferences can be made about habitat needs, then perhaps these species can be captured in a habitat/coarse filter approach. If they are completely unknown or have very specific habitat requirements that can not be readily discerned in the field, then the likelihood of success using such an approach diminishes.

Condition: By definition, it is impossible to evaluate habitat condition at the present time due to insufficient data and knowledge.

GCN Species:		
<u>Beetles</u>		<u>Mammals</u>
<i>Bembidion confusum</i>	<i>Cotalpa lanigera</i>	eastern pipistrelle
<i>Bembidion semicinctum</i>	<i>Cybister fimbriolatus</i>	eastern small-footed myotis
<i>Brachinus cyanipennis</i>	<i>Desmocerus palliatus</i>	hoary bat
<i>Calosoma Wilcox</i>	<i>Hister arcuatus</i>	Indiana bat
<i>Canthon pilularius</i>	<i>Omophron tessellatum</i>	little brown myotis
<i>Canthon vigilans</i>	<i>Phyllotreta chalybeipennis</i>	northern long-eared bat
<i>Carabus serratus</i>	<i>Scaphinotus elevatus</i>	silver-haired bat
<i>Carabus sylvosus</i>	<i>Strategus antaeus</i>	
<i>Carabus vinctus</i>		<u>Dragonflies</u>
<i>Coccinella novemnotata</i>		<i>Neurocordulia obsoleta</i>

Threats: It is impossible to evaluate threats at the present time due to insufficient data and knowledge.

Inventory / Research / Monitoring Needs and Conservation Actions:

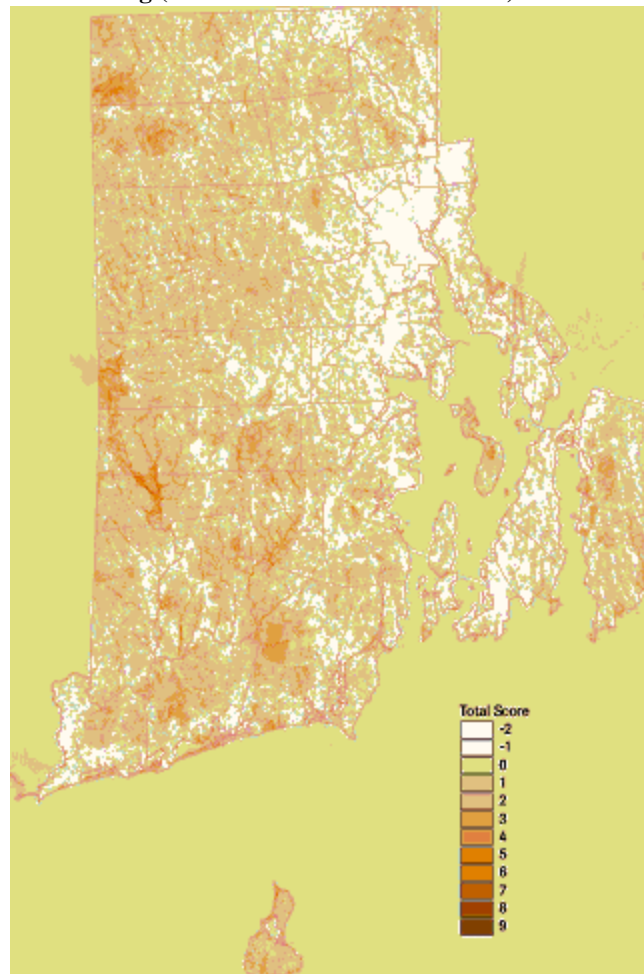
- o Research additional habitat use issues. (All GCN)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Initiate monitoring of species at breeding sites. (All GCN)
Measure: # of sites with monitoring and % incorporated into existing databases.
- o Identify priority parcels to retain as core forest areas with minimal management. (If suitable forest types can be identified- Mammals, Beetles)
Measure: # of parcels identified and mapped and % incorporated into existing digital databases.
- o Identify concentration areas for non-breeding populations. (Mammals- bats)
Measure: # of sites identified and mapped and % incorporated into existing digital databases.
- o Evaluate need for nesting structures/boxes and identify priority sites for management. (Mammals – primarily bats)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.

- o Evaluate existing significant hibernacula or winter hibernation areas. (Mammals)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Develop fire prescriptions for priority parcels. (Beetles)
Measure: # of parcels with fire plans developed.
- o Implement burn management on priority parcels. (Beetles)
Measure: # of parcels with fire plan implemented.
- o Expand public relations for fire management. (Beetles)
Measure: # of public relations materials developed and distributed concerning fire management.
- o Initiate monitoring of species at non-breeding sites. (Mammals)
Measure: # of sites with monitoring; % incorporated into existing databases.
- o Evaluate use of migratory stopover or winter habitat. (Mammals)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.
- o Determine metapopulation structure. (Dragonflies)
Measure: Completion of needed research by RI DEM or partners and # of research recommendations incorporated into conservation actions.

Priority Areas for Key Habitat and GCN Species Conservation in Rhode Island

Chapter 4 to this point has presented habitats separately, listing threats and recommended actions to conserve them and the GCN species they support. This section views those individual habitats now as a composite in a holistic statewide landscape scale context. This section takes the biological information on status and distribution of habitats and species and attempts to put it in a geospatial context for conservation, identifying those areas of the state containing these habitats and species that are determined to be in most need of conservation.

The process of identifying priority areas for conservation began with the review of existing efforts that have identified such areas in Rhode Island. Numerous plans and programs exist for focal areas and watersheds at a smaller scale (i.e. Pawcatuck), but few have identified sites on a statewide scale. Several examples of larger statewide natural resource conservation scale exist and more information about where they can be located is provided in Appendix 1a. They include RI DEM's Land Acquisition and Protection Plan (RI DEM 1996), EPA's 1996 Resource Protection areas (EPA <http://www.epa.gov/region01/soe/resprot.html>), Forest Legacy Program (USFS <http://www.fs.fed.us/spf/coop/programs/loa/flp.shtml>), NRCS Conservation Partnership (NRCS), USFWS Rhode Island National Wildlife Refuge Complex Final Comprehensive Conservation Plans, and The Nature Conservancy's regional and statewide priority watersheds (Oliviero and Anderson 2003) and landscapes. The areas identified by these efforts were compared and significant overlap in areas important for conservation was noted.

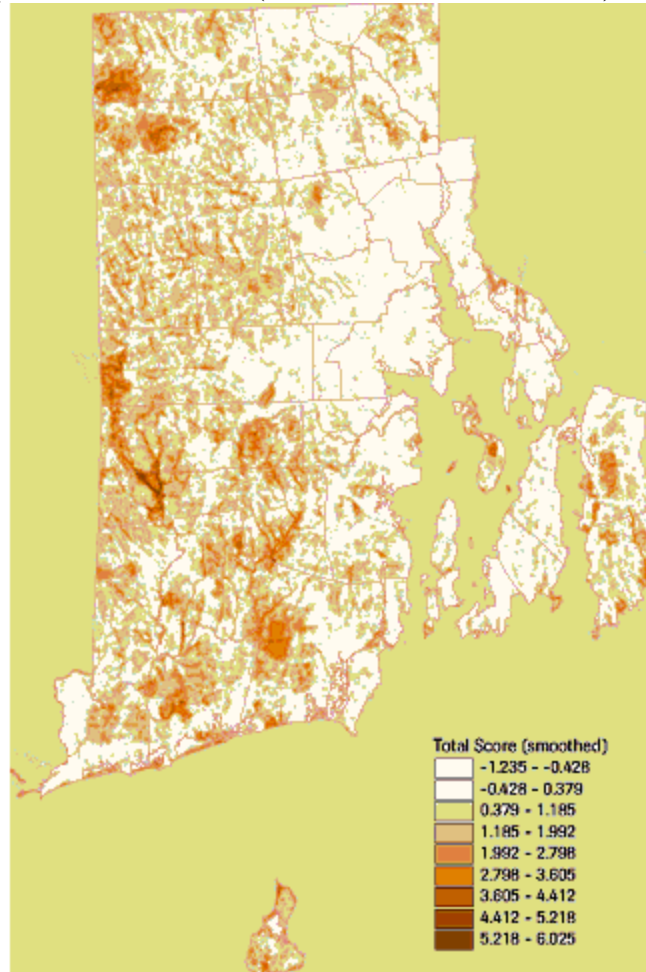
Figure 4.2 CWCS Composite Scoring (Source: CWCS Habitat Team)

This effort took an additional step to further determine those areas most important to GCN species and utilized the mapping partnership established for this effort. The Habitat and Scientific Teams utilized the data and resources of numerous partners to evaluate the best available data and expertise. The Habitat Team compiled the best available spatial coverages and location data for each of the key habitats. Many habitats were not able to be mapped, due to the insufficient level or accuracy of data. The Habitat Team, with significant assistance from URI, TNC and RI DEM GIS experts, conducted an additional analysis by mapping those key wildlife habitats that captured most GCN species. The team began with the key habitats that supported the highest number of GCN species, and assembled data and determined at what level they could be mapped. Only in a few instances could the specific key habitat be mapped (i.e. pitch pine), and usually the more general habitat level (coniferous forest) with data available from RIGIS was mapped. Whenever possible, qualifying parameters were identified that were important features to GCN species or that habitat. For example, not all forest areas were considered key habitat, instead only large patches (500 acres or more) were mapped.

These habitat coverages were then overlaid to produce a composite map to identify conservation hot spots or priority areas. Each key habitat was assigned a score of one, and

each stressor was given a score of negative one. These were summed to produce the total score representing a composite of all spatial layers mapped. Figure 4.2 is the resulting composite map that illustrates the intent and product of this exercise. This map indicates, by varying degrees of shading, those areas deemed important as conservation areas because they support the highest number of GCN species and key habitats in Rhode Island. The smoothed score map (Figure 4.3) provides additional clarity and highlights those areas scoring highest in the state. It should be noted that any shaded area on this map has significant value to Rhode Island's GCN wildlife as represented by even one key habitat.

Figure 4.3 CWCS Composite Score Smoothed (Source: CWCS Habitat Team)



It is intended that this composite map be a guide to help focus RI DEM and partners' land protection and conservation efforts. These GIS coverages and composite summary map represent only coarse level priority areas. As part of this effort, the Habitat Team also identified significant future mapping needs that have been incorporated as conservation needs in this plan. More detailed data and spatial coverage are needed for all these key habitats to provide for assessment and monitoring of habitat status and condition. This information then needs to be disseminated and made available to local, state, and federal level conservation partners.

It is the intent and purpose of this strategy to lay the foundation for the dynamic process of developing accurate and current information on Rhode Island's GCN wildlife species and key habitats. Dissemination of this information will then provide for the important step of incorporating this information into land use decisions and efforts across the state.

Implementation of this important task, as well as the many other priority actions identified in this CWCS will require the coordinated efforts of many conservation partners working together to incorporate the needs of these GCN species and key habitats into their programs and plans across the state throughout the next decade.

Chapter 5: Monitoring and Adaptive Management

Monitoring Rhode Island's GCN species, their habitats, and the effectiveness of the conservation actions identified in the previous chapters is an important and necessary tool for RI DEM DFW and its partners (Element 5). It will allow them to determine the effectiveness of the conservation actions and to reduce and eliminate threats facing the state's fish and wildlife resources. Monitoring is also necessary to track the success of conservation actions, ensuring the most efficient use of limited staffing and funds. As conditions change (e.g., land use patterns, climate change, global or national population trends, new data and information), adaptive management and implementation of the conservation actions identified in Chapter 4 will allow RI DEM DFW to respond appropriately. Adaptive management has received ample attention in the conservation community as an effective method for long-term conservation (e.g., Johnson and Case 2000, TNC 2000, Brown et al. 2001, Groves et al. 2002, Pew 2003, USFWS 2004, and Salafsky et al. 2001, 2002, 2003).

The state of Rhode Island (DEM and its partners) has many monitoring programs in place, such as RI DEM's monitoring of individual species including winter flounder, lobster, largemouth bass, Canada geese, and various waterfowl and upland game (Berounsky 2002; Appendix 5a). Chapter 4 describes species monitoring needs within the Inventory, Research and Monitoring Needs sections of the key habitats, and Table 5.1 and Appendix 5a list the existing monitoring programs and projects conducted by RI DEM and its partners. The recently formed Rhode Island Environmental Monitoring Collaborative (RIEMC) is a partnership of agencies (including RI DEM), organizations and individuals involved in monitoring the state's aquatic environments and was charged with developing and implementing a statewide monitoring program by January 2005 (RIEMC 2005). This partnership collaborative will provide statewide coordination for the development and implementation of – and create an effective monitoring framework and form the foundation for – the additional monitoring needs identified by the CWCS development process.

This CWCS is strategic in nature and presents the conceptual monitoring framework that will be used to assess the status of GCN species and habitats as well as monitor the effectiveness of CWCS conservation actions. Development of an effective monitoring framework was identified as an overarching statewide need in Chapter 4. Implementation of this plan through future RI DEM DFW and partner operational plans will provide details of those conservation actions and their monitoring plans as they are developed. Rhode Island's approach identifies existing monitoring efforts and tools currently used by RI DEM DFW or its partners to assess GCN species, key habitats and related issues, as listed in the plans and programs in Appendix 5. It also recognizes the need for the development of new monitoring tools that better fit this broader, non-traditional systems approach. This thinking reflects the general agreement that the status of diverse natural biological communities is more difficult to quantify and measure than that of single species.

In 2005, a series of meetings and subsequent guidance by IAFWA, Organization of Wildlife Planners (OWP), USFWS, USGS, National Park Service, U.S. Forest Service (USFS), and a variety of federal and state experts and partners developed into a regional and national effort

to assist states in clarifying and filling these multi-scale monitoring gaps. This CWCS identifies the need for the development of a more effective monitoring framework to best assess and evaluate the condition of the community components as well as the success of the actions implemented. This need is captured in the form of identified inventory, research, and monitoring needs in Chapter 4 for both aquatic and terrestrial systems that support GCN species. It reflects the need to develop an effective monitoring framework, including identification of appropriate indicators as well as performance measures for each habitat or component in need of assessment and evaluation.

This chapter describes how conservation actions will be monitored and measured throughout the 10-year implementation of this CWCS. Table 5.3 summarizes the type of evaluation or monitoring action, the planned accomplishment measures, and short and long-term outcomes. Appendix 5 summarizes existing monitoring efforts in Rhode Island acknowledged by this CWCS as overall monitoring mechanisms for these actions and partners. If monitoring is not identified for a GCN species or species group/taxa, Chapter 4 of this CWCS describes monitoring actions for other species which occupy the same habitats; these recommendations are prioritized to benefit the overall habitat, community, or assemblage, including many other GCN species. In cases where not enough information exists to monitor a species or group, or for which monitoring protocols have not yet been developed, this need is documented and followed by a conservation action intended to address that information need. This is true for some taxa groups such as small mammals and invertebrate groups for which standardized protocols need to be developed, and where baseline data do not exist to form the basis of a monitoring protocol. In these cases, these overarching taxa needs are described in Chapter 1 under the appropriate taxa. As the information gaps are filled, any relevant monitoring can be adapted to be more quantitative and specific (Holling 1978). Where new monitoring protocols are needed, Oakley et al. (2003) provides guidelines on how to develop them.

Existing Monitoring of Rhode Island's Wildlife and Habitats

The diversity of existing monitoring programs provides a baseline of the relative condition of the state's fish and wildlife resources but also clarifies data gaps and research needs (Tables 5.1 and 5.2). The URI Coastal Institute, the Narragansett Bay and Estuary Program, and the Partnership for Narragansett Bay held a series of workshops in 2001 to inventory existing monitoring of the state's ecosystems and the use of ecological indicators in those programs (http://www.ci.uri.edu/Projects/mon_ind/default.html) and maintains a resulting database of environmental monitoring programs in the state (Berounsky 2002, available online at <http://www.ci.uri.edu/Projects/RI-Monitoring/Tasks/DB.htm>). The assessment workshops found that:

- o Monitoring is significantly underfunded, especially state-run programs
- o There are significant data gaps in the existing monitoring programs
- o Existing monitoring programs need improved coordination
- o Existing data need to be integrated, analyzed and interpreted as ecological indicators
- o There is heightened federal encouragement to report study results to the public and decision-makers and to increase accountability

Berounsky (2002) describes these findings in detail and outlines management actions to address each. Table 5.2 lists the data gaps that were identified by the workshops.

The Rhode Island General Assembly has also given attention to environmental monitoring, enacting the Comprehensive Watershed and Marine Monitoring Act of 2004 that calls for a comprehensive monitoring program for the state's aquatic habitats, a centralized internet database to disseminate monitoring data, and the establishment of the Rhode Island Environmental Monitoring Collaborative. The RIEMC, hosted by the URI Coastal Institute, contains an inventory of 102 existing monitoring programs (see Table 5.1, Appendix 5, and RIEMC 2005), identifies data gaps and needs, develops indicators to monitor marine habitat health, sets data standards and protocols, and plans to provide marine monitoring data for disaster prevention, preparedness and response in the state's marine waters. The monitoring program also incorporates a mechanism for sharing monitoring data and a communications strategy for public access to that data. As part of the public accessibility of the RIEMC, the Coastal Institute maintains a website (<http://www.ci.uri.edu/Projects/RI-Monitoring/default.html>) and an e-mail listserv to facilitate communication amongst the Collaborative's participants and other interested parties.

Table 5.1 Summary of Existing Monitoring Actions (Source: Berounsky 2002) (Alphabetized by Implementation Lead)

Monitoring Program or Action	Implementation Lead	Level of Monitoring		
		Species	Guild	Habitat
RI Audubon Birdathon	Audubon Society of Rhode Island	X	X	
Diamondback Terrapin Population Study	Barrington Land Conservation Trust	X		
Barrington and Palmer Rivers Monitoring (physical parameters)	Brown University, Dept. of Geosciences			X
Summer on the Water Program (water and faunal sampling Great Salt Pond)	Committee For the Great Salt Pond		X	X
Hazardous waste site clean-up and remediation (Superfund sites)	Dept. of Defense, U.S. Navy			X
Aircraft remote sensing for Chlorophyll-a for Narragansett Bay and coastal waters	EPA-AED			X
Coastal 2000/EMAP (coastal ecosystem health)	EPA		X	X
Blackstone and Woonasquatucket Rivers Watershed Education Project (water quality)	Massachusetts Audubon Society, Smithfield and Tolman High Schools			X
Moshassuck River Monitors (water quality)	Moses Brown and Wheeler Schools			X
Narragansett Bay Program, RI DEM	Narragansett Bay	X	X	X

Monitoring Program or Action	Implementation Lead	Level of Monitoring		
		Species	Guild	Habitat
survey and monitoring programs, including Volunteer DO Night Survey on Upper Narragansett Bay	Estuary Program, RI DEM			
Bird Source (national monitoring program)	National Audubon Society and Cornell Lab of Ornithology		X	
Providence River Sampling (water quality)	Narragansett Bay Commission (NBC)			X
Regional River Fecal Monitoring (5 rivers)	NBC			X
Seekonk River Monitoring (water quality)	NBC			X
Ten Mile River Sampling (water quality)	NBC			X
Lobster Tagging Program	NMFS, RI Sea Grant, CMER	X		
National Status and Trends Program on Narragansett Bay (water quality, fish health, benthic surveys)	NOAA, RI DEM		X	X
NOAA Restoration Center Programs (oil spill and contaminant release response and restoration)	NOAA, RI DEM	X	X	X
Narragansett Bay Window (water quality and benthic surveys)	NOAA/NMFS, EPA, RI DEM, URI			X
National Estuarine Reserve System: Narragansett Bay, RI (water quality, bio-indicators)	NOAA, RI DEM			X
Norman Bird Sanctuary Monitoring (amphibians, grassland birds, marshland)	Norman Bird Sanctuary		X	X
Pawtuxet River Authority (water quality)	Pawtuxet River Authority			X
Oceanology Program on Little Narragansett and Pawcatuck Estuaries (water quality, benthic surveys)	Pine Point School		X	X
Runnins River Monitoring (water quality)	Pokanoket Watershed Alliance			X
Prudence Island Conservancy Citizens Monitoring Program (water quality, meteorological parameters)	Prudence Island Conservancy, Narragansett Bay NERR			X

Monitoring Program or Action	Implementation Lead	Level of Monitoring		
		Species	Guild	Habitat
Rhode Island Bristol County Observer Network (RIBCON) (meteorological parameters)	RIBCON			X
Raytheon Employees Wildlife Habitat Committee (flora and fauna inventories)	Raytheon, Inc.		X	
BioBlitz Surveys (one-day faunal inventories)	RI Natural History Survey	X		
Blue Water Task Force Beachscape (coastal water quality)	RI Surfrider Foundation			X
Lobster Larval Settlement Index	RI Sea Grant, RI DEM	X		
Narragansett Bay Rapid Assessment Survey for Marine Bioinvasive Species	RI Sea Grant, RI CRMC, RI DEM	X	X	
Adult American Shad and River Herring Monitoring (5 locations)	RI DEM	X		
Air Quality Monitoring (15 locations)	RI DEM			X
Aquatic Furbearer Survey	RI DEM	X	X	
Artificial Substrate Monitoring (benthic surveys)	RI DEM		X	X
Biotoxin Shellfish Poisoning Sampling	RI DEM		X	
Bird Species Breeding Monitoring (colonial waterbirds)	RI DEM	X	X	
Chemical Baseline Monitoring (water quality at 25 locations)	RI DEM			X
Coastal Fishery Resource Assessment Trawl Survey (18 – 28 stations in Narragansett Bay, RI and Block Island Sounds)	RI DEM, USFWS	X	X	X
Fin Fish Monitoring on Coastal Ponds	RI DEM	X	X	
Finfish Trawl Survey, Narragansett Bay	RI DEM DFW	X	X	X
Gill Net Monitoring Program (pelagic gamefish)	RI DEM	X	X	
Juvenile American Shad and River Herring Monitoring (5 locations)	RI DEM	X		
Juvenile Fin Fish Survey (18 locations on Narragansett Bay)	RI DEM	X	X	
Largemouth Bass Monitoring (5 locations)	RI DEM	X		
Lobster Fishery Monitoring	RI DEM	X		

Monitoring Program or Action	Implementation Lead	Level of Monitoring		
		Species	Guild	Habitat
Rapid Bioassessment Protocol Monitoring (45 stream locations for macroinvertebrates)	RI DEM		X	X
RI Pollution Discharge Elimination System Monitoring (water quality for >335 locations)	RI DEM			X
Shellfish Growing Area Monitoring (water quality for 305 locations)	RI DEM		X	X
Shellfish Monitoring Program Shoreline Surveys (bacteria sources for 410 miles)	RI DEM		X	X
Summer Inland Breeding Survey of Canadian Geese	RI DEM	X		
Upland Game Species Monitoring	RI DEM	X		
Waterfowl Survey	RI DEM	X	X	
Seasonal Finfish Trawl Survey	RI DEM, Marine Fisheries (1979-present)	X	X	X
Beach Monitoring Program (water quality)	RI Department of Health			X
Drinking Water Monitoring (water quality)	RI Department of Health			X
Salt Pond Watchers (water quality)	Salt Ponds Coalition			X
Bay Watchers (water quality, marsh health, seal and horseshoe crab surveys)	Save The Bay, RI DEM	X		X
Save The Bay's Monitoring (salt marsh and eelgrass restoration monitoring)	Save The Bay, RI DEM	X		X
Kingston Wildlife Research Station Fall Migratory Bird Monitoring	URI, Audubon Society of RI	X	X	
University Of Rhode Island Watershed Watch (water quality for ~110 locations)	URI Cooperative Extension			X
Long-term beach profile monitoring (4 locations)	URI Dept. of Geosciences, RI Sea Grant			X
Monitoring Network for Narragansett Bay Waters (water quality for 6 locations)	URI Graduate School of Oceanography, NOAA, EPA, RI DEM			X
Benthic Infauna in Narragansett Bay	URI Graduate School of Oceanography		X	X
Quonochontaug and Salt Ponds	URI Graduate School	X	X	X

Monitoring Program or Action	Implementation Lead	Level of Monitoring		
		Species	Guild	Habitat
Research Fellowships (shellfish health, winter flounder, water quality, sediments)	of Oceanography			
Water Column Nutrients (long-term for 1 location)	URI Graduate School of Oceanography			X
Narragansett Bay Phytoplankton Surveys	URI Graduate School of Oceanography		X	
Disposal Area Monitoring System (water quality, faunal surveys at offshore disposal sites)	U.S. Army Corps of Engineers			X
Cooperative Agricultural Pest Survey (CAPS)	USDA/APHIS	X	X	
Pawcatuck Watershed Monitoring (water quality)	Wood Pawcatuck Watershed Association			X

The Rhode Island General Assembly also has enacted legislation that establishes the Rhode Island Bays, Rivers and Watersheds Coordination Team within the Governor's office (<http://www.ci.uri.edu/RIBayTeam/default.html>). This Team includes representatives from RI DEM and one of its tasks is to develop an ecosystem-based plan to protect the bays, rivers and watersheds of the state while allowing for sustainable economic development. One component of this systems-level plan is a monitoring program that evaluates the implementation of the plan to support adaptive management. This plan, due in June 2006, is intended to coordinate all the state agencies and functions that protect and regulate aquatic environments in Rhode Island. The aforementioned Environmental Monitoring Collaborative and a similar Economic Monitoring Collaborative are to implement this plan to manage, preserve and restore the state's aquatic habitats.

Table 5.2 Significant Data Gaps in Existing Monitoring Programs in Rhode Island (Source: Berounsky 2002)

Human health concerns (e.g., mercury in fish tissue, bacterial contamination, swimming beach closures)
Impacts of non-point and small point source pollution
Lack of data from out-of-state portions of watershed and airshed
Watershed wide monitoring
Dredging impacts
Biological data (such as organism counts and conditions)
Biological response to stressors
Geographic locations of monitoring
Air quality and atmospheric deposition
Baseline conditions
Historic conditions
Bacterial and microbiological data
Macroalgae
Macrophytes

Bathymetry data/water flow data/ freshwater fluxes
Ground water
Shoreline modifications/development
Seasonal variations (to understand noise in the data)
Benthic communities
Macroinvertebrates
Biodiversity
Fish tissue contamination
Fish populations
Invasive species
Nitrogen inputs (and related impacts)
Sediment types
Septic system failures
Stormwater inputs
Transplant survivability
Drinking water quality
Turbidity (suspended solids)
Sea level rise
Forest health
Landscape features and fragmentation
Riparian zones
Urban forest

Another recent development in monitoring the state's environment was the identification of a need to coordinate all the water quality monitoring in the state that is conducted by diverse organizations (Table 5.2). The RI DEM, Office of Water Resources, has subsequently drafted a statewide Water Monitoring Strategy for 2005-2010 that addresses state and federal water quality reporting requirements, develops environmental indicators, targets priority data needs, and comprehensively coordinates the monitoring of all the state's waters (RI DEM 2004j). The draft Water Monitoring Strategy calls for the synthesis and integration of the various water quality monitoring programs as well as the standardization of their data quality. A freshwater wetland monitoring and assessment plan has recently been prepared by RI DEM with the assistance of several partners (RI DEM 2005d), and The Partnership for Narragansett Bay has formulated a vision for monitoring and a series of ecological indicators for Narragansett Bay and its watersheds (Kleinschmidt Associates 2003).

This Comprehensive Wildlife Conservation Strategy will utilize the comprehensive monitoring programs and protocols developed and implemented by the Rhode Island Environmental Monitoring Collaborative, the Bays, Rivers and Watersheds Coordination Team, and the Water Monitoring Strategy to accomplish aquatic monitoring for the purposes of the CWCS. The RI DEM DFW will work with these entities to integrate and coordinate similar monitoring protocols for the terrestrial habitats and resources of the state.

Monitoring Strategy

Rhode Island's biodiversity monitoring strategy described here includes the regular evaluation of conservation actions to measure their effectiveness and success at achieving the goals of the CWCS. Individual performance measures are included with the priority Inventory, Research, and Monitoring Needs and Conservation Actions provided for each habitat in Chapter 4. These performance indicators will allow RI DEM DFW to evaluate the effectiveness of each action to meet CWCS objectives. The data generated by and for the performance measures (e.g., acres or stream miles protected, restored, or enhanced) will be used as input into an accomplishment tracking system (Table 5.3), and will also be serving the dual purpose of tracking progress in implementing the CWCS.

CWCS monitoring builds on existing monitoring and survey systems and explains how information will be obtained to determine the effectiveness of conservation actions. Table 5.1 lists many of the existing plans and programs that have been developed by local, state, regional, national, or international partners for monitoring many GCN species or their habitat components in Rhode Island. An update of this inventory was recently completed by the RIEMC (2005), finding a total of 102 separate monitoring initiatives currently operating in the state. In many actions in Chapter 4, existing monitoring actions/plans are supported by this CWCS and will be utilized wherever possible to monitor conservation actions.

Existing monitoring and survey systems were used as the foundation from which to gain partner/stakeholder input to identify and develop new additional systems where appropriate. New monitoring programs or projects are needed to address the data gaps listed in Table 5.2 (Berounsky 2002) and for habitats or species that are not currently monitored but that have been identified by this plan as being in greatest conservation need. For example, new and/or expanded monitoring programs are needed to evaluate impacts to estuarine and marine habitats and species from dredging, invasive species, shoreline development and modifications, turbidity, sea level rise, and non-point and small point pollution. New monitoring programs or projects are also needed to fill gaps in existing monitoring for urban forests, forest health, transplant survivability, and atmospheric deposition in terrestrial habitats.

New habitat and species level monitoring actions are identified in the priority Inventory, Research and Monitoring Needs and Conservation Actions sections for each key habitat in the previous chapter. If monitoring is not identified for a GCN species or species group/taxa, new monitoring actions for other species which occupy the same habitats are described; these recommended actions are prioritized to benefit the overall habitat, community or assemblage, including many other GCN species. In cases where not enough information exists to monitor a species or group, or monitoring protocols have not yet been developed, this need is documented and followed by a conservation action to address that information need. This is true for some of the small mammals and invertebrate groups for which standardized protocols need to be developed, and where baseline data have not even been collected to form the basis of a monitoring protocol.

The priority Inventory, Research, and Monitoring sections under each habitat in the previous chapter recommend the appropriate level of monitoring for that habitat or its species, whether it be at the species, guild, taxa, or habitat/community level. Within each habitat, the most appropriate level of monitoring has been identified and prioritized by the technical and taxa committees to best monitor that "system" at the appropriate level. The most current scientific information and opinion was used and coordinated with partners to maximize effectiveness. Monitoring frameworks or protocols recommended by TNC, the USFS, USGS or EPA will be evaluated for their applicability to Rhode Island's habitats.

Rhode Island's monitoring strategy involves monitoring at a variety of geographic scales -- local, state, regional, national, and international -- to evaluate the status of species or species groups as well as the effectiveness of conservation actions. For example, PARC recommends herpetofaunal monitoring with standardized protocols for the northeast region, similar to USFWS and PIF BCRs and other regional, national and international Bird Plans (i.e. Table 5.3 was adapted from the ACJV Plan). As a result, this monitoring strategy will use the standardized regional protocols for herpetofaunal monitoring in order to place Rhode Island's populations in the appropriate context. Other standardized monitoring protocols, such as those of the Breeding Bird Survey, International Shorebird Survey, North American Bat Conservation Partnership Strategic Plan, and American Fisheries Society, will be utilized wherever appropriate so that Rhode Island's data will be compatible with regional and national conservation efforts.

Rhode Island's monitoring strategy also incorporates several time scales (short-term, interim and long-term) to monitor the implementation and effectiveness of conservation actions and the status and condition of key habitats (as recommended by Schoonmaker and Luscombe 2005). In the short-term, the monitoring strategy is to determine whether conservation actions have been implemented. In the interim, the monitoring strategy seeks to evaluate whether the conservation actions were successful in improving the status and/or condition of GCN species and key habitats – did the conservation actions worked as theorized? Long-term objectives of the monitoring strategy will spatially track the abundance, distribution, condition (both historic and current) of GCN species and key habitats, their conservation status, and will adaptively manage the desired future conditions.

The short-term objective of tracking the implementation of conservation actions will be accomplished by using the performance measures outlined in Chapter 4 for each conservation action. Implementation information will be managed in an accomplishment-tracking database (Table 5.3). The status and trends of individual GCN species will be tracked by adapting the existing RI DEM DFW's GCN dataset to include categories for the status of GCN species, research and survey project results, and inventory and monitoring data. A web-based data entry and/or retrieval system will be developed for RI DEM DFW staff, researchers and partners, allowing scientific data to be readily shared and disseminated. Other RI DEM databases and geospatial data will be updated as inventory, survey, research, and monitoring product information becomes available. These electronic information management mechanisms may be linked with the National Biological Information Infrastructure (NBII) network, or its Northeast Information Node, to facilitate information sharing at the regional and national levels.

The interim objectives of evaluating the success of conservation actions to improve the status and/or condition of all of the key habitats will be accomplished primarily through existing monitoring programs such as the new Water Quality Monitoring Strategy and Rhode Island Environmental Monitoring Collaborative. The EPA's Coastal Assessment provides another source of data for monitoring estuarine and marine systems in particular. A new monitoring program for terrestrial habitats may be modeled after these existing aquatic programs, incorporating existing monitoring projects of partner organizations (e.g., TNC, PIF, USFWS, USGS, USFS) and academic institutions into a statewide program.

The long-term objectives of monitoring the key habitats will be accomplished using existing and new geographic information system (GIS) databases. By updating the existing SNE GAP for terrestrial habitats in Southern New England for those in Rhode Island, and by adding an aquatic GAP, RI DEM DFW will be able to track the status and trends of the state's key habitats. Periodic updates of land use and land cover in the state will allow the abundance and distribution of each habitat to be monitored as conservation actions and SWG projects are implemented. Areas where additional efforts are needed will be identified and adaptively incorporated as the CWCS is updated. Many conservation actions will be incorporated into the GIS tracking system, allowing RI DEM DFW to monitor partnerships and public involvement such as conservation easements, stewardship agreements, volunteer monitoring projects, restoration and enhancement projects, and land acquisitions and donations.

This CWCS will serve as a baseline for the current status of GCN species and key habitats. As information gaps identified in Chapter 4 are filled, the status and condition of species and habitats will be updated through the adaptive management process. RI DEM DFW will, with the Scientific Review Team and key stakeholders /implementation partners, regularly review and reevaluate conservation actions and employ adaptive measures to keep the CWCS a dynamic document on track with the specific, current needs of Rhode Island's GCN species and their key habitats. Annual completion and reporting requirements of research projects will provide any new information for status review by the Technical and Scientific Review Team. Any changes in status of GCN species or key habitats will be input into the DFW database for these reviews. Conservation actions will be tracked by year and result in the database, and will facilitate the SWG grant administration process as well as track species/habitat changes and project accomplishments.

Criteria for Measuring Success

Evaluating the successful implementation of the CWCS conservation actions will take several forms. The CWCS Planning Team has identified distinct success criteria that will allow the RI DEM DFW to continually assess the status of each conservation action. The performance outputs will accomplish the CWCS objectives and have quantifiable accomplishment measures, which are outlined in Table 5.3, as adapted from the Atlantic Coast Joint Venture Strategic Plan (ACJV 2004). Annual accomplishment measures include tracking the acres of key habitat protected or improved through various means (i.e., acquisition, conservation easements, acres restored or enhanced), biological assessments of

GCN species, research to fill data gaps, monitoring programs, information management, funding of conservation projects, and outreach to partners and the public.

Specific criteria to measure the success of the CWCS conservation actions should be measurable to be most effective in evaluating the performance of each action. Success criteria identified by the CWCS Planning Team include the following:

1. A net increase in the acreage of key habitat protected through acquisition, restoration, enhancement and/or creation.
2. A net increase in scientific knowledge of GCN species and key habitats.
3. Successful funding of the highest priority conservation project(s).
4. Successful completion of the highest priority conservation project(s).
5. An increase in partner and public involvement in achieving protection of fish and wildlife resources in Rhode Island.
6. The removal of threats to GCN species and key habitats through avoidance, minimization and mitigation measures.
7. The long-term removal of species on the GCN species list as habitats are protected and threats are mitigated and addressed.

In addition to these measurable criteria, the ability of the conservation actions to address the needs of the fish and wildlife resources of Rhode Island will be monitored with qualitative methods. An improvement in the coordination of similar monitoring projects conducted by disparate sources would be one such qualitative measure. Coordination of all the avian monitoring projects, for example, through a regional resource such as the Atlantic Coast Joint Venture, would enhance the efficiency of each project. This would lead to a qualitative improvement towards successfully implementing the CWCS goals and objectives in regards to avian fauna. Another qualitative measure of monitoring success may be the increased involvement of RI DEM DFW in the Rhode Island Environmental Monitoring Collaborative and other statewide or regional conservation initiatives. By utilizing both quantitative and qualitative success criteria, the RI DEM DFW will be responsive to the diverse nature, scope and scale of the CWCS conservation actions.

Table 5.3 Evaluation Objectives, Performance Outputs and Annual Accomplishment Measures to Assess the Success of the CWCS Conservation Measures (Source: modified from ACJV 2004)

Objective	Overall Performance Output	Annual Accomplishment Measures
Overall	Habitat conserved for GCN species and key habitats	Acres/stream miles protected by fee-simple
		Acres/stream miles protected by easements
		Acres /stream miles restored
		Acres/ stream miles enhanced
		Management capabilities improved
Biological Planning	Biological needs assessment	Biological needs assessment updated
	Threats assessment	Threats assessment updated
	Status, trends, limiting factors	GCN species with status, trends and limiting factors assessed
	Population and habitat objectives	GCN population and key habitat objectives determined/updated

Objective	Overall Performance Output	Annual Accomplishment Measures
		State population and habitat objectives determined/updated
Research	Targeted Research Projects	Priority research projects funded and completed
		Research proposals reviewed/prioritized
	Applied research projects	Annual list updated
		Research proposals written, projects funded
Conservation Design	Conservation planning	Workshops hosted
		Conservation plans written or revised
		Key habitats with GIS data compiled
	Conservation tools	Aquatic GAP developed
		Terrestrial GAP updated
Monitoring and Evaluation	Monitoring programs	Existing monitoring programs utilized/modified to meet CWCS evaluation needs
		Monitoring expanded, new protocols/framework developed
		Coordination with the Collaborative
		New monitoring programs developed
Information Management	Web-based data	Data Web pages developed and/or existing data distribution resources (e.g., RIGIS) adapted
	Accomplishment tracking	Accomplishment tracking data entered and available electronically
	Specific information products	DEM and partner Databases updated and improved
		RIGIS databases/coverages updated
Project Funding	Priority projects	Up-to-date inventory of priority projects maintained
	Federal grants	NAWCA, Farm Bill, NRCS, etc. projects submitted, projects approved, acres conserved
		National Coastal Wetland projects submitted, projects approved, acres conserved
		Neotropical Migratory Bird Conservation projects submitted, projects approved, acres conserved
		National Fish and Wildlife Foundation projects, Anadromous Fish Conservation Act projects, Atlantic Coastal Cooperative Fisheries Act projects, Endangered Species Act Section 6 projects, Landowner Incentive Program projects, Sport Fish Restoration projects and/or other federal grant projects submitted, projects approved, acres conserved
	State Wildlife Grants and other state grants	SWG project applications submitted, projects approved, acres conserved
Partners Outreach	Other funding programs	Other programs receiving information/assistance, projects funded, acres conserved
	Outreach plan	Plan completed or updated
	Web site	Web pages created or updated

Objective	Overall Performance Output	Annual Accomplishment Measures
	Newsletter	Quarterly electronic newsletter produced
	Partner meetings and presentations	Meetings with and presentations to NGOs, field units of federal agencies, ecosystem teams and others
Public Outreach	Brochure	Brochure developed/updated
	Informational/ Educational Plan and products	Plan developed and Products produced (e.g., posters, videos, teacher workshops, nature guides, festivals)

Adaptive Management Process

The effectiveness of the conservation actions in meeting the CWCS goals and objectives will be monitored via several reporting and review requirements. First, RI DEM DFW will annually report on the progress to implement and complete the CWCS conservation actions to the RI DEM. Second, the RI DEM DFW will report CWCS accomplishments to the USFWS as per SWG funding requirements. The status of implementing the conservation actions will be reviewed annually by RI DEM DFW staff and the Scientific Review Team of experts will determine when the success criteria are not being met and adaptive management measures are needed. The RI DEM DFW staff and the CWCS Scientific Review Team will then identify appropriate revisions to the conservation actions and implement them as a form of adaptive management. This will be completed as often as necessary, as the effectiveness of the conservation measures will be measured on various time scales depending on their scope and duration, but at a minimum of once per year.

The RI DEM DFW CWCS database will be updated annually through status review of species and habitat condition for those projects that have been completed. New data and information will be documented and tracked through this new system where species are linked to primary habitats, which are linked with threats, and finally to actions recommended. Completion status of these actions and projects will be tracked and updated each year or project end, and the effectiveness of actions will be evaluated so that actions can be modified if determined to be appropriate.

Coordination with Partners

This CWCS recommends and supports the implementation of partners' conservation plans, i.e. USFWS, USFS, PIF Bird Conservation Regions (BCR), Partners in Amphibian and Reptile Conservation (PARC), Bat Conservation International (BCI), TNC's state conservation blueprint and ecoregion plans, etc., that have identified standardized or recommended monitoring actions for regional/national consistency where and whenever possible. Another CWCS performance measure will be evaluating the extent to which the CWCS and its implementation are coordinated with partners. An effective measure of coordination success will be the degree to which partners integrate these GCN species, habitats and conservation actions into their plans and programs. To that end, each partner

will receive the final CWCS with the request that they incorporate its species and habitats into their programs and coordinate with RI DEM DFW to implement appropriate conservation actions. Updates will be provided to these partners with the request to incorporate new information into their programs and plans. Coordination with the RIEMC will include all partners and provide significant direction and guidance for overall monitoring. Regular annual coordination of all the key monitoring partners assures that the opportunity to review, revise and implement the CWCS will continue through the RIEMC over the next decade, as established by the state for this purpose.

The Comprehensive Wildlife Conservation Strategy will be updated and revised to remain consistent with the regional and national monitoring plans of the U.S. Fish and Wildlife Service (e.g., bird management plans, federally-listed species Recovery Plans, National Wildlife Refuge Comprehensive Conservation Plans) and other key partners. The CWCS monitoring measures will also meet the accomplishment reporting requirements of the USFWS and the Department of the Interior, and coordinate with the RIEMC for statewide development, integration, and implementation of an effective monitoring framework through the next decade.

Chapter 6: CWCS Plan Review and Revision

As the monitoring evaluations discussed in Chapter 5 contribute to the adaptive management of this CWCS, the strategy will be periodically reviewed and revised according to the development and implementation timeframes of RI DEM and partners scheduled programs and updates (Element 6). Interim sections will be reviewed and revised throughout the 10-year period with a full revision completed in 10 years.

As data gaps are filled, new ones will be identified. The resulting increases in scientific knowledge on which this CWCS is based will keep the strategy as up-to-date as possible. The plan is predicated upon the changing state of knowledge and is recognized as a dynamic document. Successful implementation of conservation measures and reduction in the threats facing the GCN species and key habitats will allow RI DEM DFW and its partners to be able to make better-informed management decisions and maintain an efficient use of limited funding and staffing resources. The many operational, conservation and management plans already in existence provide opportunities to regularly review and revise the CWCS plan within the current RI DEM administrative framework.

CWCS Review Process

Many of the existing conservation and management plans in Rhode Island are adaptive in nature and have regularly scheduled reviews. The need to revisit conservation plans periodically, updating them to reflect new information, additional programs, and changing conditions is also recognized by several international, national and regional management plans (e.g. USFWS 1999, Barbour et al. 2003, ACJV 2004, Rich et al. 2004). Table 6.1 outlines the review schedules for some of these relevant plans that will be targeted for CWCS information incorporation into their revisions, just as revision of these plans will be incorporated into the CWCS review and revision process.

The CWCS may become a component of the Rhode Island State Guide Plan (RI DA 2002b), which would integrate it with similar state management plans and emphasize its importance as a statewide planning tool. The State Guide Plan does not have a set revision schedule, but is an adaptive plan that is updated as new information becomes available or its component plans are revised.

Within RI DEM, however, individual divisions prepare Work Plans or Strategies every year. The CWCS will be incorporated into the RI DEM DFW's annual work strategy, with the implementation of the CWCS identified as its own objective. The RI DEM DFW's Work Strategy is formatted with each objective reporting on trends, problems and initiatives. This format lends itself to ready incorporation of the CWCS, which also includes detailed information on trends (status and condition), problems (threats) and initiatives (conservation actions). Each objective in the RI DEM DFW Work Strategy is further delineated with environmental indicators, strategies, activities (conservation actions) and performance measure review schedules. As a result, RI DEM DFW has an existing administrative

framework in which to incorporate the CWCS. Highest priority conservation actions may then be included in each annual Work Strategy, allowing for adaptive management, performance review and institutionalization of CWCS implementation.

Table 6.1 Review Schedule for Existing Conservation and Management Plans

Plan	Review Frequency	Agency	Source
ACJV Strategic Plan	At least every 5 years	Atlantic Coast Joint Venture	ACJV (2004)
Lower New England – Northern Piedmont and North Atlantic Coast Ecoregional Conservation Plans	Periodic as information becomes available	The Nature Conservancy	Barbour et al. (2003), Beers and Davison (1999)
State Comprehensive Land Use /Protection Plans	5 years	RI DEM	RI DEM (2005e)
Local Comprehensive Plans	5 years	Municipalities	RI DA (2003)
Management Plan for the Finfish Fishery Sector	Annually	RI DEM DFW, Marine Fisheries	RI DEM (2004l)
North American Landbird Plan	5 years	Continental Council, Partners in Flight	Rich et al. (2004)
North American Waterbird Conservation Plan	At least every 5 years	Waterbird Conservation Council	Kushlan et al. (2002)
North American Waterfowl Management Plan	5 years	North American Waterfowl Management Plan Committee	USFWS (1999a)
RI DEM Work Plans/Strategies	Annually	RI DEM	e.g., RIDEM (2003f)
Rhode Island Energy Plan	“as warranted”	RI Dept. of Administration	RI DA (2002i)
SCORP	Irregular	RI Depts. of Administration and Environmental Management	RI DEM (2003n)
State Guide Plan	Updated as elements are revised/updated	RI Dept. of Administration, Statewide Planning Program	RI DA (2002b)
State of the State's Waters 305(b) Report	2 years	RI DEM, Office of Water Resources	RI DEM (2004p)

Plan	Review Frequency	Agency	Source
Strategic Plan for the Restoration of Anadromous Fish to Rhode Island Coastal Streams	“As restoration efforts commence and research dictates”	RI DEM DFW	Erkan (2002)
Urban and Community Forest Plan	Within 10 years	RI Dept. of Administration, Statewide Planning Program	RI DA (1999a)
U.S. Shorebird Conservation Plan	Every 5 years for 15 years, then as needed	U.S. Shorebird Conservation Plan Council	Brown et al. (2001)
Watershed Action Plans	3 years	Watershed Councils	
Water Monitoring Strategy 2005-2010	3 years	RI DEM, Office of Water Resources	RI DEM (2004j)

CWCS Review Schedule

While the evaluation of conservation actions will be continuous as information becomes available, the CWCS document will be amended as needed and revised every ten years. A five-year review and evaluation schedule is the most common timeframe for existing management plans in Rhode Island, and Federal Assistance AFA paperwork is also consistent with those plans (Table 6.1). A 10-year revision will incorporate all annual, biannual and five-year review and evaluation information and updates so that the ten year revision will not be a total rewriting, but instead an incremental and iterative review and revision process incorporating new information on a regular basis. Annual federal assistance reports will provide new information from SWG projects which will be entered into the new database and RIGIS/DEM GIS spatial data coverages in order to capture and update the annual accomplishments, changes in GCN species and key habitat status, and the effectiveness of actions. RI DEM DFW staff and technical committees will assess the status of GCN species and key habitats as new data are entered annually or at the end of these projects. This ten year revision schedule will be long enough to be practical in terms of administrative loads but short enough to be responsive to changing conditions, monitoring and research results, and adaptive management revisions.

In summary, the Rhode Island CWCS evaluation, review and revision schedule will have the following benchmarks:

- o Annual reporting for SWG grant requirements and product delivery
- o Annual input and incorporation of data and GIS to RI DEM and partner databases
- o Annual tracking of species status
- o Annual incorporation into RI DEM programs' plans
- o Every two years: status review of GCN species

- o Every five years: implementation and review of CWCS through multiple partners plans' revisions and incorporations
- o Every five years: AFA project review and reporting
- o Monitoring and evaluation review at multiple time and geospatial scales according to RIEMC
- o Complete revision in 10 years- incorporating the above interim updates / reviews of identified sections.

Chapter 7: Coordination with Partners

The previous two chapters discuss Rhode Island's CWCS monitoring strategy and how RI DEM DFW will adaptively manage the implementation of the CWCS and review the strategy on a regular basis. This chapter describes how RI DEM DFW coordinated with partners in the development of this CWCS and how it will continue to work with and through its partners in the implementation of this wildlife conservation strategy (Element 7). Opportunities to use existing partnerships and create new ones to implement the CWCS are also described in this chapter.

The RI DEM DFW has a long history of working with partners to protect the natural resources of the state. From providing grants and funds to actively collaborating on individual conservation projects, the RI DEM DFW and its partners have accomplished significant conservation measures already, and with the aid of this CWCS will continue to do so. Coordination with partners occurs at the institutional level as well as the individual and team levels. The CWCS development process has incorporated a wide variety of stakeholders representing federal, state, local, tribal, academic and non-profit partners (Table 7.1, Appendices 7a, 7b and 8a), as it acknowledges that accomplishing the actions outlined in this CWCS in the next decade will require significant coordination and collaboration among all of them.

CWCS Organizational Infrastructure

In order to coordinate with its partners, RI DEM DFW first had to establish an effective internal SWG administrative framework (see Table 7.1, Figure 7.1). RI DEM DFW officially began CWCS development in early 2004 when an internal team within RI DEM DFW was established, and, due to a state hiring freeze and lack of resources, contracted a consultant to assist in the development of the CWCS process and document. A general scope of work was developed to guide the effort, identifying key tasks to be accomplished. Specific guidance provided by the IAFWA and its teams was used to develop the approach throughout the planning process. With this guidance in mind, and with the input of a broadening circle of stakeholders and the conservation community, Rhode Island developed its CWCS process approach, providing for general and technical input throughout the process.

A CWCS Planning Team was formed with key RI DEM DFW staff (Table 7.2). This team met with the consultant to compile existing resources and develop the initial timeline and framework for the development of the CWCS. A series of organizational and input solicitation meetings were held to involve first key staff and then all RI DEM DFW staff. The effort to obtain input was then expanded through a series of meetings with other DEM Divisions: Forestry, Wetlands, Planning, State Parks, and NHP. A Technical Team was established to deal with the substantial technical scientific data, issues, and correspondence with experts and stakeholders consisting of key RI DEM DFW staff and the consultant.

All levels of RI DEM DFW staff were engaged through initial internal SWG/CWCS informational presentations with question/answer sessions and meetings. Additional input was sought individually at informal meetings and through follow-up correspondence. RI DEM DFW input was then solicited at the program level, where priority setting and conservation needs were discussed. Meetings with Program staff were held to inform and update internal staff and partners on GCN species, key habitats, threats and conservation actions. Habitat GIS and Scientific Review teams were then established to address the need for external expert input on habitat and ecological communities and issues for the CWCS. Key partners were asked to participate on a team or through consultation throughout the process.

Figure 7.1 CWCS Organizational Flow Chart

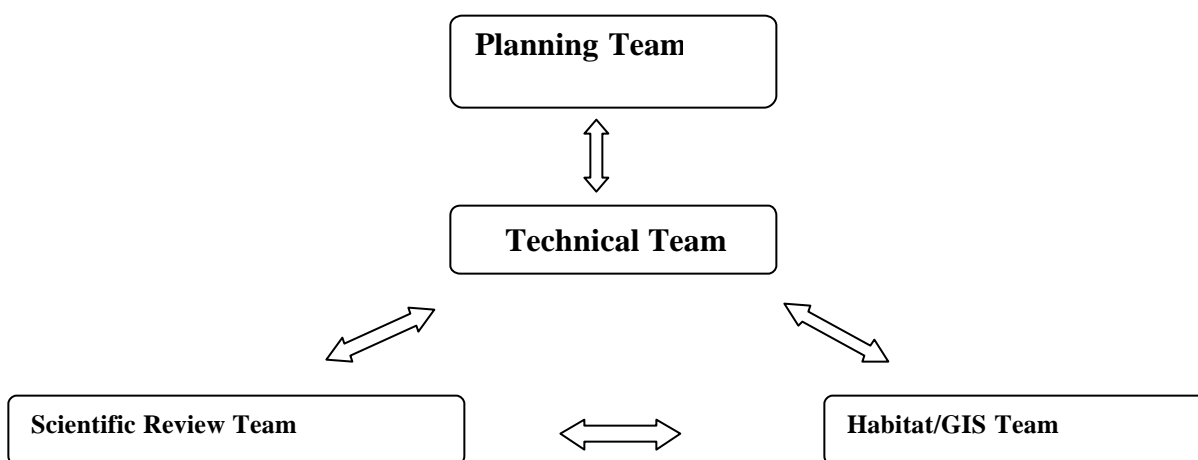


Table 7.1. Rhode Island's CWCS Coordinating Committees/Teams and Structure

Committee/Team	Members	Role	Meeting
CWCS Planning Team- Fisheries and Wildlife Division	Acting Director, Section Chiefs and Asst. Chiefs, consultant	Initiate and develop process and product, oversee and direct process	Every other month meetings, monthly updates
Technical Team	Wildlife Section Asst. Chief and Non-game program coordinator, Marine and Freshwater Fisheries Section Asst. Chief and Non-game program coordinator, consultant	Provide input and feedback on process and species/habitat identification (technical QC) Coordination and progress evaluation (administrative and technical QC)	Monthly during process and priority development, then weekly, or as input required

Committee/Team	Members	Role	Meeting
Scientific Review Team – faunal experts	External and Internal experts (=University, Partner Agency, NGO, and key Stakeholder participation)	Technical input, scientific evaluation and peer review (technical QC)	Monthly or more frequent correspondence, Meetings- Quarterly or as needed
Habitat / GIS Team	External and Internal experts (University, Partner Agency, NGO, and key Stakeholder participation)	Technical input, scientific evaluation and peer review (technical QC)	Initial planning then follow up Quarterly briefings and correspondence

Table 7.2. CWCS Committees/Teams Members and Affiliations.

CWCS Planning Team	
Michael Lapisky	RI DEM, Wildlife
John O'Brien	RI DEM, Fisheries
Mark Gibson	RI DEM, Marine Fisheries
Lori Gibson	RI DEM, Wildlife Management
Najih Lazar	RI DEM, Marine Fisheries
Christine Dudley	RI DEM, Fisheries
Karen Terwilliger	Terwilliger Consulting, Inc.
CWCS Technical Team	
Christopher Raithel	RI DEM DFW
Richard Enser	RI DEM, Natural Heritage Program
Paul Jordan	RI DEM, Div. Planning and Development
Timothy R. Lynch	RI DEM, Marine Fisheries
Joan Touchette	RI DEM, Marine Fisheries
Alan Libby	RI DEM, Fisheries
CWCS Scientific Review	
Peter August	Coastal Institute, URI, GIS, monitoring
Virginia Brown	RINHS, odonates
Charles Brown IV	RI DEM, DFW, mammals
Alan Libby	RI DEM, Freshwater Fisheries, freshwater fish
Richard Enser	RI DEM, Natural Heritage Program, habitats.
Paul Jordan	RI DEM, Div. Planning and Development, GIS
Julie Lundgren	RI TNC conservation scientist.
Timothy R. Lynch	RI DEM, Marine Fisheries, marine fish
Jason Osenkowski	RI DEM, DFW, wildlife
Christopher Raithel	RI DEM, DFW, wildlife
Joan Touchette	RI DEM, Marine Fisheries, marine fish
Lisa Gould	RINHS, inverts
Brian Tefft	RI DEM, Wildlife
Peter Paton	URI, Birds

CWCS Habitat Mapping/GIS Team	
Peter August	Coastal Institute, URI, GIS, monitoring
Paul Jordan	RI DEM, Div. Planning and Development, GIS
Christopher Raithel	RI DEM, DFW, wildlife
Richard Enser	RI DEM, Natural Heritage Program, habitats.
Julie Lundgren	RI TNC, conservation scientist
Kevin Ruddock	RI TNC, GIS
Andrew Lipsky	NRCS
Andrew MacLachlan	USFWS
Frank Golet	URI
YQ Wang	URI, terrestrial remote sensing
Lisa Gould	RINHS
Jason Osenkowski	RI DEM Wildlife
Katherine Sparks	RI Forestry
Deborah Pelton	RI DEM Wetlands

Coordination with Federal, State, Local, and Tribal Partners

Once an internal framework was established, the coordination effort expanded with outreach to major local, state, federal, and tribal partners. RI DEM DFW inventoried and identified its federal, state, local agency and tribal partners, employed the Bleiker Systematic Development of Informed Consent (SDIC) and Citizen Participation by Objective (CPO) and developed a process to inform, involve, and engage partners throughout the development of the CWCS. These methods helped to identify Potentially Affected Interests (PAI) or stakeholders, the objectives of RI DEM DFW CWCS process, and the most effective ways to inform stakeholders. Stakeholders' contribution to the conservation of Rhode Island's wildlife resources was documented through their many programs and plans (Appendices 1a and 5).

Partners were included in each major phase of the CWCS development and participated in the development of the GCN species and key habitat lists. They also provided and exchanged other valuable information and input throughout the document's development. A workshop was held and partners were asked to lead or participate in Taxa and Habitat teams and discussions that produced the GCN species and key habitat lists. Initially contacts were made with each partner, and then were followed by informal meetings and a continuous information exchange. Small, informal focused meetings were held with key local, state, federal and tribal partners around the state to encourage more detailed and more meaningful input during each step (per Bleiker CPO). Initial introductory meetings were held to inform them of the project and solicit input on the CWCS process and recommendations for GCN species and key habitats.

Informal planning and follow up meetings and correspondence occurred on a quarterly basis throughout 2004-05. Key partners exchanged technical information, coordinated activities, and provided updates to keep everyone informed and involved, then participated in additional

meetings with other partners and tribes in order to present a coordinated approach to wildlife diversity conservation in Rhode Island. Examples include meetings with URI, RIGIS, TNC, RINHS, USFWS, and NRCS to closely coordinate conservation, planning, mapping and monitoring efforts. Coordination with neighboring states (i.e., Massachusetts, Connecticut, New York) was also conducted, particularly in regards to addressing shared marine resources and similar habitats. CPO objectives were aimed at sharing and integrating program information so that the CWCS could be used by partners to help implement their programs, and vice versa.

A key objective agreed upon by these partners was to coordinate with and integrate the results of this CWCS into their plans developed over the next 10 years. This step was taken to insure that there would be maximum CWCS coordination, implementation and buy-in by partners for the next decade.

State and federal partners, including USFWS Ecological Services, Private Lands Program and NWR staff, NRCS, Forestry, Planning, and Wetland Programs were also asked to incorporate the GCN species and key habitat conservation targets identified in the CWCS into their programs and plans. Similarly, other key federal partners including Narragansett Bay NERES and EPA were all consulted early in the CWCS process and asked how to best incorporate CWCS targets into their programs and plans, and how the CWCS could best incorporate their programs and plans. Especially relevant and promising was the synergy and opportunities revealed between CWCS targets and the NRCS Farm Bill and the RIEMC programs as they impact GCN species and key habitats. Key partner land protection efforts were also researched and land ownership documented (Table 7.3).

Table 7.3. Existing Land Conservation by RI DEM and its Partners through Land Acquisition, Conservation Easements and Other Agreements

Agency or Organization	Lands Protected (acres)
RI DEM, Division of Fish and Wildlife	46,000 +
RI DEM, Division of Forest Environment	40,000 +
RI DEM, Division of Parks and Recreation	15,000
Municipalities	13,000 +
Audubon Society of RI	9,000 +
NOAA (Narragansett Bay NERR)	4,800
The Nature Conservancy	4,150 +
RI DEM, Division of Agriculture	4,000
USFWS	2,100

The CWCS Development Team coordinated the strategy with key federal partners, each of whom were solicited for input via written and electronic correspondence, invited to meetings and workshops, and requested to review draft versions of the strategy via the RI DEM DFW CWCS website. These agencies included the U.S. Fish and Wildlife Service (Ecological Services, National Wildlife Refuges, Private Lands Program, Coastal Program, Fisheries, and Federal Aid), Natural Resources Conservation Service, Environmental Protection Agency, U.S. Department of Agriculture, U.S. Forest Service, U.S. Army Corps of Engineers, U.S.

Geological Survey, National Oceanic and Atmospheric Administration, National Park Service, and Department of Defense.

The comments and recommendations of these federal partners were considered and incorporated by RI DEM DFW as appropriate during the strategy's preparation. Similarly, RI DEM DFW coordinated the CWCS development with key state, local and tribal partners, as driven by the Bleiker SDIC/CPO process (Bleiker and Bleiker 2000), with all relevant state agency and local partners. Follow-up exchange of information and updates established a new level of coordination between these agencies and partners. Each partner was informed of the CWCS targets, process, and schedule and was asked to incorporate the CWCS information into their appropriate programs and plans.

Coordination with the federally recognized tribal partners consisted of correspondence and meetings that provided information and literature on the SWG state and tribal programs and funding. Coordination also included presentation of relevant state and federal programs that might assist the Tribes in wildlife conservation both short and long term as mutually beneficial to GCN species and habitats. Coordination with the USFWS provided for USFWS staff to assist in this effort and resulted in a complementary partnership approach to available programs at both the state and federal levels. Rhode Island has one federally-recognized Narragansett Indian Tribe; the Pokanoket/Wampanoag Federation has applied for federal status. These tribes were given the opportunity to review and comment on the draft CWCS. As partnership opportunities with state-recognized tribes arise during the implementation stage, RI DEM DFW will coordinate with these tribes on joint conservation projects.

Coordination with these partners throughout the implementation and revisions of this CWCS will occur on a regular basis at numerous levels. DFW and DEM staff will be informing and updating stakeholders at regularly scheduled meetings for partners and stakeholder. GCN species and key habitat information will be presented and these partners will be asked to incorporate them into their plans and programs as they are revised. In that way, there will be an ongoing dialogue and information feedback loop in which partners' plans reflect the CWCS targets and the CWCS incorporates partners' revisions and updated plans and information. This provides an effective mechanism for partner and stakeholder input into CWCS review and implementation as well as participation at the staff, program and organization level.

Collaboration with State Partners

The RI DEM DFW regularly coordinates with state partners (both in Rhode Island and adjacent states) in natural resource conservation and these existing partnerships were utilized to develop this CWCS. These state agency and institutional partners will be involved annually in order to implement many of the CWCS conservation actions. New partnerships will be formed as a result of this process and will be critical to implement new actions that were identified by RI DEM DFW and its partners. The existing partnerships represent institutional opportunities to involve numerous stakeholders in the implementation of the CWCS, addressing the needs of GCN species and key habitats throughout the state. The RI

DEM and its partners, for instance, already own and/or manage over 138,000 acres of land within the state – lands which are already protecting key habitats and available for adaptive management practices to enhance habitat values (Table 7.3, Appendix 7c). Opportunities for future coordination include the annual coordination and other joint partnership meetings that are regularly scheduled throughout the year. Updates to CWCS target species, habitat and actions can be discussed so that partners can incorporate updates into their plans and programs and annual budget for coordinated implementation.

RIGIS

The Rhode Island Geographic Information System (RIGIS) is a consortium of private and government organizations that manages a collective database of GIS information, including biological and other natural resource data (<http://www.edc.uri.edu/rigis/>). RIGIS monitors and coordinates the use of GIS technology in Rhode Island, provides the technical data to the public, and assists partner organizations to use the data. The consortium produced the Rhode Island Critical Resources Atlas, for instance, which assessed the state's natural resources such as rare species habitat, wetlands, water quality, and land use patterns (URI 2004a). RIGIS is based at the University of Rhode Island's Environmental Data Center.

Statewide Planning Program, Department of Administration

The Rhode Island Department of Administration's Statewide Planning Program has developed many management plans for the state and supports several State Councils that oversee state policy and management of several of the threats and key habitats identified in this CWCS. The Statewide Planning Program has formulated an Urban and Community Forest Plan to guide the management and abundance of forest resources in developed settings (RI DA 1999a; <http://www.planning.ri.gov/forestplan/default.htm>); a Forest Resources Management Plan that discusses the conservation of the state's forests (RI DA 2002e; <http://www.planning.ri.gov/sgp/sgp.htm>); the Rhode Island Drought Management Plan (<http://www.planning.ri.gov/sgp/sgp.htm>) and a Water Supply Policies for Rhode Island plan that provides procedures for ensuring the equitable distribution of water resources in the state under different situations (RI DA 2002a and RI DA 1997 respectively); and the Scituate Reservoir Watershed Management Plan, the Cultural Heritage and Land Management Plan for the Blackstone River Valley National Heritage Corridor, and the Comprehensive Conservation and Management Plan for Narragansett Bay, each of which addresses the needs of those particular natural resources (RI DA 2002c, 2002d, and 2002g respectively; <http://www.planning.ri.gov/sgp/sgp.htm>). Other management plans prepared by the Statewide Planning Program assess specific threats or issues such as nonpoint source pollution (RI DA 2002h) and energy (RI DA 2002i). Finally, the program partners with RI DEM DFW in the development and updating of the State Comprehensive Outdoor Recreation Plan (SCORP), which summarizes outdoor recreational assets, needs and management in the state (RI DEM 2003n). Each of these conservation and management plans provides an opportunity for integration with this CWCS, highlighting mutual needs and

conservation actions. These are all anticipated opportunities for coordination and incorporation of CWCS information and targets over the next decade.

The Statewide Planning Office also supports state partner organizations such as the Growth Planning Council, Greenways Council and the Rivers Council. Collaboration with these Councils already exists and can be expanded to implement conservation actions pertaining to their areas of expertise. The Growth Planning Council addresses land use trends, urban sprawl and sustainable development in the state, and has prioritized areas for economic development versus conservation (e.g., RI DA 2001a, 2001b). The Statewide Planning Program periodically monitors land use trends in Rhode Island, issuing technical reports and analyses as well as predicting trends and policy needs (RI DA 1999b, 2000, 2004b). Changes in land use and the increase in development of natural areas is one of the statewide threats identified in the CWCS analysis, and the RI DEM DFW can utilize its existing partnership with the Growth Planning Council to address this threat through continued or more directed monitoring, planning development zones to avoid key habitats and GCN species, and implementing specific conservation actions that address the development and urban sprawl threat.

The Greenways Council endeavors to acquire greenspace, bike paths, and trails in the state and has developed a management plan, entitled “A Greener Path ... Greenspace and Greenways for Rhode Island’s Future,” to prioritize the state’s greenspace needs and projects (RI DA 1994; <http://www.planning.ri.gov/greenways/title.htm>). A Greenways Map, as well as a series of maps showing various themes, including water resources, biodiversity and wildlife, agricultural resources, and forestry resources, can be found online at <http://www.planning.ri.gov/greenways/title.htm>. Many of these greenways and bike paths are planned to take advantage of the natural resources of the state, such as the Blackstone River corridor. The acquisition of these pathways, for which the Department of Administration frequently partners with the Department of Transportation, is often in key habitat areas (e.g., riparian buffers). The RI DEM DFW can coordinate the planning and development of these greenspace and pathway projects with the Statewide Planning Program to protect and restore key habitats and GCN species identified in this CWCS.

The Rivers Council is responsible for designating and supporting individual Watershed Councils and the management of the state’s rivers and streams (<http://www.planning.ri.gov/rivers/default.htm>). The Rivers Council has developed a Rivers Policy and Classification Plan that classifies the state’s watersheds, assesses their health, and identifies threats (RI DA 2004a; <http://www.planning.ri.gov/rivers/plan.htm>). Some of these priorities have been identified as threats to key habitats and GCN species in this CWCS analysis, and the RI DEM DFW’s existing partnership with the Rivers Council affords an opportunity to implement conservation actions that address these priorities rapidly. The Watershed Councils are existing partners as well, and collaboration on specific riparian and aquatic conservation projects will continue to implement several CWCS conservation actions.

Coastal Resources Management Council

The Coastal Resources Management Council (CRMC) was established in 1971 as a separate state agency to be the regulatory authority along the Rhode Island coast (<http://www.crmc.state.ri.us/>). The RI CRMC governs development projects in all state waters (up to 3 miles offshore) and for 200 feet inland from any coastal features such as beaches, dunes, coastal wetlands, bluffs, cliffs, rocky shores, and manmade shorelines. In addition to its regulatory authority, the Council develops coastal management plans and policies, oversees other state agencies and local governments that deal with coastal zone management issues, and sponsors coastal zone research on emerging issues. The RI DEM frequently partners with the CRMC on coastal zone projects such as salt marsh or eelgrass restoration projects and water quality issues in Narragansett Bay. Protection of coastal and marine GCN species and key habitats will continue to be integrated into RI DEM's partnership with the CRMC.

Department of Transportation

The Rhode Island Department of Transportation (RI DOT) is responsible for the construction and maintenance of the state's roadways (<http://www.dot.ri.gov/>). RI DOT operates a Scenic Roadways program, various bicycle pathways, and the state ferry system. RI DEM and RI DOT partnered together on the creation of the Blackstone River Bikeway State Park (17.1 miles) and the East Bay Bike State Park (14.5 miles), both of which afforded RI DEM the opportunity to protect riparian corridor habitats. RI DOT also coordinates with RI DEM on the construction of new roadways and other transportation projects, allowing the opportunity to protect GCN species and key habitats on a site-by-site basis and mitigate the threats of habitat loss and fragmentation.

Collaboration with Local Partners

Rhode Island's municipalities are often partners with RI DEM in the conservation of the state's natural resources. Managing almost 2,000 parks and beaches totaling over 13,000 acres (RI DEM 2003n), municipalities are an important stakeholder in the implementation of this CWCS. These municipalities frequently partner with local organizations to conserve natural resources and have protected over 30,000 acres of open space throughout the state (RI DEM 2003n). The Comprehensive Community Plans that each municipality is required to develop and maintain (on a five-year update schedule) guide local land use planning and provide an opportunity to implement CWCS conservation actions on a local level. RI DEM has existing partnerships with several municipal organizations and governments, some of which are highlighted below. This will provide an effective mechanism for coordination throughout the CWCS revision and implementation efforts over the next decade.

The Providence Plan

The city of Providence is the largest urban area in Rhode Island and represents a significant opportunity for RI DEM to implement habitat restoration projects in a developed setting. The Providence Plan (<http://www.provplan.org/#>) is a nonprofit partnership amongst city and state agencies, the academic community, private entities, and the residents of Providence to address poverty and urban decline through economic and community development and renewal projects. The Woonasquatucket River Greenway Project also seeks to promote environmental education and awareness of river conservation and ecology within the city. The municipal organization has partnered with RI DEM, EPA, NPS, U.S. Department of Transportation and others to implement the riparian restoration project, using it as a pilot watershed project.

Scituate Conservation Commission

The Scituate Conservation Commission, one of several municipal Conservation Commissions in Rhode Island, protects watershed resources, preserves local natural scenic areas, and promotes and develops local natural resources (http://www.scituateri.org/scit_conservation_page.htm). Focusing on the natural resources located within the Town of Scituate, the Commission supports research projects and environmental education programs, and partners with other municipal and state organizations on conservation projects. The Commission often collaborates with the Scituate Land Trust, for instance, in local land preservation efforts. The RI DEM DFW can coordinate with the Scituate Conservation Commission and its local partners to implement CWCS conservation actions for key habitats within the Town of Scituate, encouraging the local organizations to consider CWCS priorities in their local conservation projects.

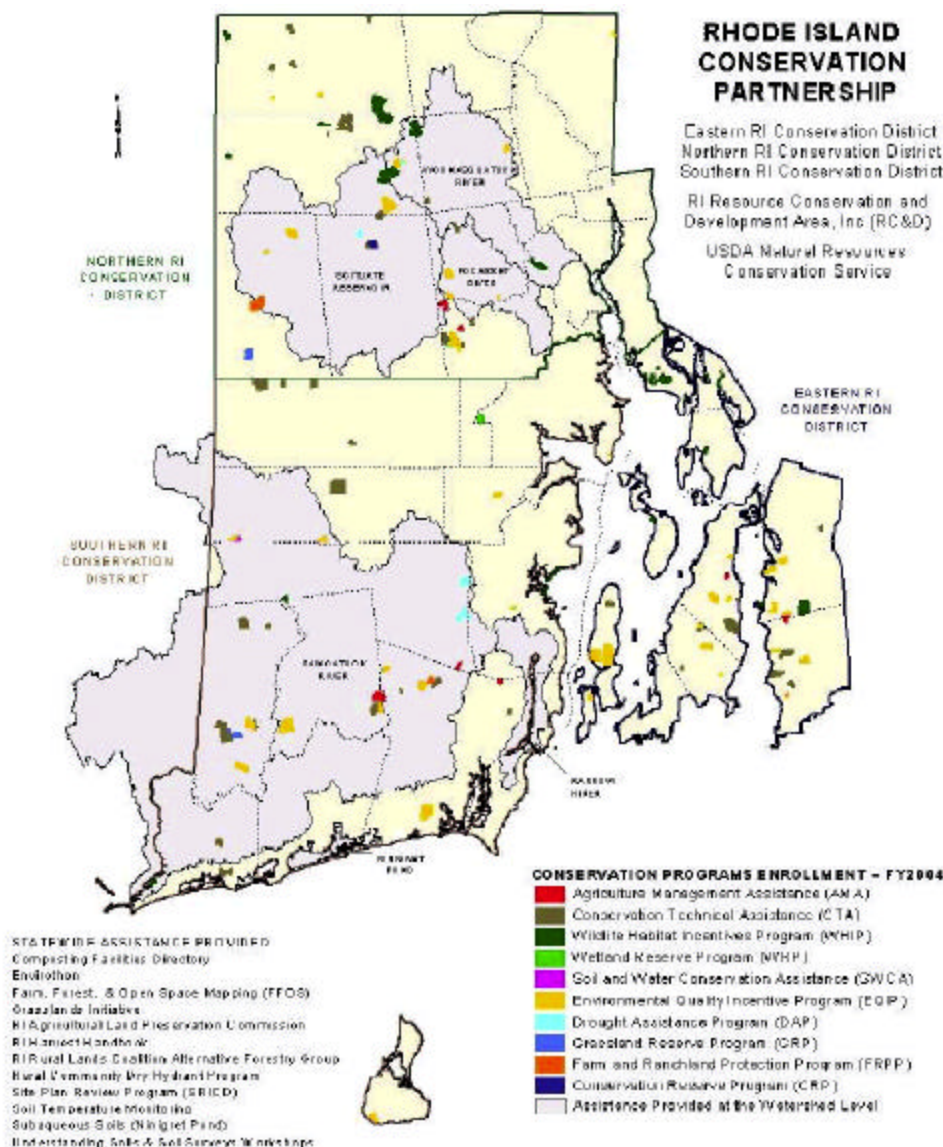
The Rhode Island Association of Conservation Commissions (RIACC) has an existing relationship to facilitate collaboration between the RI DEM, EPA and local Conservation Commissions (<http://www.environmentcouncilri.org/riacc.html>). This relationship provides an additional opportunity for RI DEM to partner with local Conservation Commissions to implement this CWCS.

South Kingstown Comprehensive Community Plan

Every municipality in Rhode Island must develop a Comprehensive Community Plan, which maps out local land use, open space, natural resource and other community priorities (RI DA 2002g, 2003). Local Comprehensive Community Plans must be consistent with the State Guide Plan, which includes all of the state conservation and management plans previously discussed. The plans are required to be updated every five years. The South Kingstown Comprehensive Community Plan, for example, calls for close coordination with the RI DEM and the CRMC to ensure that regulatory permits are consistent with the town's land use goals and policies (Edwards and Kelcey 2004; http://www.southkingstownri.com/code/planning/pmisc_040604_134243.pdf). This is a key

opportunity for incorporation of GCN species and habitat conservation needs at the local level and has been recognized as a high priority action for this CWCS.

Figure 7.2 Rhode Island Conservation Partnership (Source: USDA Natural Resource Conservation Service 2004)



Rhode Island Marine Fisheries Council

The Rhode Island Marine Fisheries Council (RIMFC) is an advisory council that holds monthly meetings to advise the RI DEM Division of Fish and Wildlife on the management of the state's marine and estuarine fish and shellfish resources. The Council has advisory panels devoted to shellfish, the fishery industry, and individually managed species as needed. The RIMFC aids in the protection of the state's fishery resources through the issuance of aquaculture leases, development of annual fishery management plans, and coordination with

the New England Fishery Management Council and Atlantic States Marine Fisheries Commission (see below for more information on the NEFMC and ASMFC). In addition, the Council addresses emerging threats or problems such as gear conflict, the density of fish pots in nearshore areas, dockside sales, and compliance with floating fish trap regulations.

Another example of conservation at the local or district level is the Resource Conservation and Development Program (RC&D) in Rhode Island. The following map (Figure 7.2) shows the RC&D areas and conservation program enrollment in the diversity of conservation incentive funding programs in Rhode Island. This conservation partnership represents the participation of numerous federal, state, local, and private entities to deliver natural resource conservation locally.

Collaboration with Federal Partners during the CWCS Development and Opportunities for Implementation through Key Federal Partners

U.S. Fish and Wildlife Service

The U.S. Fish and Wildlife Service (USFWS) maintains several fish and wildlife conservation efforts in Rhode Island. The National Wildlife Refuge System has established a complex of National Wildlife Refuges (NWR), protecting valuable fish and wildlife habitat. The Rhode Island NWR Complex includes the Block Island NWR, the John H. Chafee NWR at Pettaquamscutt Cove, Ninigret NWR, Sachuest Point NWR, and the Trustum Pond NWR. These refuges have conserved over 2,100 acres of coastal habitat in the state (RI DEM 2003n). Each refuge has developed a Comprehensive Conservation Plan that summarizes the fish and wildlife resources and habitats contained within it, assesses the refuge's resource and management needs, and outlines a conservation plan for meeting those needs (USFWS 2002a-e). Several GCN species are found on the USFWS Refuges, representing a prime opportunity to incorporate GCN Species and habitat information into their CCPs and management plans in order to further implement the CWCS through this important federal partner. Regularly scheduled annual coordination meetings are anticipated to provide opportunities for information exchange and updates on CWCS targets and implementation progress. Continued cooperative work on piping plover, colonial waterbirds and rare beetles are examples of such opportunities over the next decade.

In addition to preserving land for the conservation of valuable fish and wildlife resources within Rhode Island, the USFWS has provided several million dollars in grants for conservation projects in the state in recent years. The Private Lands Program works with the NRCS on the implementation of various Farm Bill programs on privately-owned lands and represents a continued opportunity for RI DEM DFW to implement the CWCS on non-public lands (see NRCS summary below). The management of federally-listed species within Rhode Island is coordinated by the New England Ecological Services Field Office in Concord, New Hampshire. The Southern New England-New York Bight Coastal Ecosystems Program in Charlestown, Rhode Island, collaborates with states and partners adjacent to Narragansett Bay on habitat restoration projects, land conservation, and the identification of priority coastal habitats and threats to coastal and marine habitats

(<http://www.fws.gov/r5snep/nep1.htm>). The USFWS's Fisheries Program works to protect fish and wildlife habitats in Rhode Island, focusing on the restoration of migratory fish to the Pawcatuck River basin. The USFWS also maintains a Law Enforcement Special Agent in Narragansett to enforce existing federal fish and wildlife conservation laws and occasionally assist state law enforcement efforts. The RI DEM DFW regularly collaborates with each of these USFWS offices and the refuges, and the grant programs represent a funding mechanism for implementing this CWCS.

Coordination meetings with each of these programs will occur throughout the next decade on important conservation issues (recovery planning, CCP revisions, landowner assistance, refuge planning, migratory bird planning) and provide opportunities to implement CWCS target GCN species and key habitat conservation actions, and exchange and update information on these important targets. Revisions of each CCP and other program plans will allow USFWS to incorporate CWCS targets and become an active implementation partner for many of the identified conservation actions as well as the update and revision of the SWCS.

U.S. Geological Survey

The U.S. Geological Survey (USGS) has several on-going natural resource programs and projects within Rhode Island and its marine waters that contribute to the conservation of fish and wildlife resources. The Water Resources Division (WRD) of the USGS has on-going projects to study water quality and quantity in Rhode Island, particularly groundwater resources in the Pawcatuck River basin and on Block Island (<http://ri.water.usgs.gov/>). Through the National Water Quality Assessment Program, the USGS has performed extensive water quality studies of the Blackstone River basin. The Biological Resources Division (BRD) of the USGS also has scientific programs to aid in the understanding and conservation of fish and wildlife resources within Rhode Island, with staff located in a cooperative studies unit at URI (<http://biology.usgs.gov/state.partners/activities/ri-act.html>). RI DEM DFW coordinates with USGS scientists to monitor, research, and protect the state's fish and wildlife resources, and this ongoing partnership will allow for efficient implementation of several of the research and monitoring needs identified in this CWCS.

A Gap Analysis Program (GAP) project was conducted in the mid 1990's for southern New England. The GAP project resulted in further work and refinement in Massachusetts and the BIOMAP project there. The Rhode Island portion of GAP was completed and vertebrate models are now available for this area. Predicted faunal distributions based on the Southern New England GAP have been integrated into the CWCS to assess the abundance and potential distribution of GCN species and key habitats.

U.S. Department of Agriculture

Natural Resources Conservation Service (NRCS)

The Natural Resources Conservation Service (NRCS) offers several programs for private landowners, states, communities, tribes and nonprofit organizations to conserve and protect fish and wildlife resources (<http://www.nrcs.usda.gov>, Table 7.4). These programs typically are administered with the assistance of the USFWS and in Rhode Island, the RI DEM DFW. The grant programs offer a means for the state to collaborate with private landowners to achieve fish and wildlife conservation goals in a cooperative manner. The NRCS develops State Wildlife Habitat Incentives Program (WHIP) plans to prioritize habitat needs and areas within each state. Funding from the WHIP and Wetlands Reserve Program (WRP) have restored hundreds of acres of these priority habitats, and provide an ongoing partnership for implementing CWCS conservation actions related to these key habitats and the GCN species they support. This is a key partnership opportunity for implementing conservation for GCN and key habitats, as NRCS incorporates the information from this CWCS into their plan revisions and programs. Regularly scheduled coordination meetings are anticipated to continue annually and provide opportunities for information exchange and updates on CWCS targets and implementation progress.

The NRCS partnered with RI DEM, EPA and URI in 2003 to develop a wetland restoration plan for the Woonasquatucket River watershed; the partnership subsequently began implementing this plan by restoring the Riverside Mills site in Olneyville. And the new Map Coast Partnership between NRCS, RI DEM, CRM, NBEP, URI, the Coastal Institute, RINHS, and many others has undertaken a project to develop a subaqueous soils classification system that will facilitate the mapping of aquatic coastal ecosystems (<http://www.ci.uri.edu/Projects/MapCoast/default.html>).

U.S. Forest Service

The U.S. Forest Service (USFS) offers technical and financial assistance to states, operates national programs on invasive species, forest and rangeland management (including fire) and biological diversity, and tracks the status, distribution and health of forestland throughout the country (<http://www.fs.fed.us/>). While there are no national forests in Rhode Island, the RI DEM partners with the USFS to inventory and monitor the state's forest resources, the trends of which are discussed in Chapters 2,3, and 4 (e.g., Butler and Wharton 2002, Widmann 2002). The USFS was a partner with RI DEM and the Rural Lands Coalition in the South County Greenspace Project. This existing partnership provides a foundation to implement CWCS survey, monitoring and analysis conservation actions related to key forest habitats.

Table 7.4. Natural resource conservation programs available through the federal U.S. Department of Agriculture to Rhode Island and their allocations for FY2005 (when available) or the most recent year with available figures

Agency	Program	Description	Financial Assistance	Technical Assistance	FY05 Allocation
Farm Service Agency (FSA), U.S. Dept. of Agriculture (USDA)	Conservation Reserve Program (CRP)	Voluntary program for farmers and ranchers to assist in compliance with environmental laws and regulations, establish vegetative cover on highly erodible cropland, improve water quality, establish wildlife habitat, and enhance wetlands and forests.	Yes	Yes	\$ 2,000 (FY2004)
Natural Resources Conservation Service (NRCS), USDA	Agricultural Management Assistance (AMA)	Voluntary program that provides cost-share assistance to farms for watershed management or irrigation structures, tree planting for windbreaks or water quality improvement, soil erosion control measures, integrated pest management or conversion to organic farming.	Yes		\$ 133,587
	Conservation Partnership Initiative (CPI)	Voluntary program that provides grants to states, communities, tribes, and NGOs for planning conservation projects in terrestrial and aquatic habitat, coastal resources, livestock nutrient management, and/or minor/specialty crop pest management.	Yes	Yes	National grant fund
	Conservation Security Program (CSP)	Voluntary conservation program that rewards farmers and ranchers in high priority watersheds (including the Scituate Reservoir and Pocasset watersheds) that maintain and enhance the highest standards of environmental stewardship on their lands.	Yes	Yes	

RHODE ISLAND'S COMPREHENSIVE WILDLIFE CONSERVATION STRATEGY

Agency	Program	Description	Financial Assistance	Technical Assistance	FY05 Allocation
	Environmental Quality Incentive Program (EQIP)	Voluntary program that provides cost sharing for agricultural improvements that will help meet water quality and other environmental objectives.	Yes	Yes	\$ 5,461,693
	Farm and Ranch Lands Protection Program (FRPP)	Voluntary program that provides matching funds to state, tribal or local governments, and non-governmental organizations to purchase development rights to maintain existing farms and/or ranches.	Yes		\$ 3,258,459
	Farmland Protection Program	Voluntary program that provides matching funds to states, communities, tribes and nonprofit organizations for the purchase of conservation easements to protect productive farmland.	Yes		\$ 1,328,600 (FY2002)
	Grassland Reserve Program (GRP)	Voluntary program that allows landowners to protect, enhance or restore grasslands, pastures, shrublands, and ranges on their properties.	Yes	Yes	\$ 1,747,881
	Resource Conservation and Development (RCandD) Program	Localized program that assists state, tribal and local governments and NGOs in rural areas in conservation planning and management, sustainable development and quality of life improvements.	Yes	Yes	
	Soil and Water Conservation Assistance (SWCA)	Voluntary program to provide cost-share incentives to farms and ranches for soil and water conservation measures, related natural resource conservation, and compliance with environmental laws and regulations.	Yes		\$ 38,600 (FY2001)

RHODE ISLAND'S COMPREHENSIVE WILDLIFE CONSERVATION STRATEGY

Agency	Program	Description	Financial Assistance	Technical Assistance	FY05 Allocation
	Watershed Protection and Flood Prevention Program	Voluntary program that assists landowners and local organizations to develop and implement watershed plans, conduct river basin studies, flood hazard analyses, floodplain management practices, and water and land conservation measures.	Yes	Yes	\$ 0 (\$ 0 in FY2004)
	Watershed Surveys and Planning	Voluntary program that assists states, communities, tribes and others to survey and plan watershed protection, sediment and erosion control, water quality, flood prevention, fish and wildlife enhancement, wetland restoration and creation, and other water needs projects.	Yes	Yes	\$ 0 (\$ 535,500 in FY2004)
	Wetlands Reserve Program (WRP)	Voluntary conservation program that protects, enhances and restores wetlands and their wildlife resources on private lands.	Yes	Yes	\$ 546,800
	Wildlife Habitat Incentives Program (WHIP)	Voluntary program that assists landowners to create high quality aquatic, riparian, wetland and upland habitat areas that support wildlife populations of local, state, national or tribal significance.	Yes	Yes	\$ 1,120,558
U.S. Forest Service, USDA	Forest Inventory and Analysis Program	Tracks the status, distribution and health of forestland throughout the country.		Yes	
	National Resources Inventory (NRI) Program	Monitors the status and trends of non-federal land use throughout the country.		Yes	

RHODE ISLAND'S COMPREHENSIVE WILDLIFE CONSERVATION STRATEGY

Agency	Program	Description	Financial Assistance	Technical Assistance	FY05 Allocation
	Stewardship Incentives Program (SIP)	Voluntary program that encourages private forest landowners to maintain productive and healthy forests.	Yes	Yes	
	State and Private Forestry Programs	Assists private landowners, businesses, states, tribes and communities to sustain and manage forestlands, control invasive species, restore urban trees and greenspace, and manage the impacts of wildland fires on communities and the environment.	Yes	Yes	

Environmental Protection Agency (EPA)

The Environmental Protection Agency (EPA) is the federal agency responsible for enforcing the Clean Air Act, Clean Water Act, and other environmental regulations that protect Rhode Island's fish and wildlife resources. The agency has a specific presence in Rhode Island through its partnerships with the Rivers Council, URI, RI DEM and others on several conservation projects and scientific studies. It developed the Rhode Island Resource Protection Project (RIRPP), which is part of a New England-wide effort to identify the region's most ecologically healthy areas and created a Resource Protection Area map (<http://www.edc.uri.edu/rirpp/>). Maps resulting from this joint federal/state effort are displayed in Chapters 2 and 3 to depict relative distribution of general habitat resources in the state. The EPA partnered with the Partnership for Narragansett Bay Warwick, the Pawtuxet River Authority to develop a wetland bioassessment project, and Tiverton and Little Compton to develop a Conservation Plan that prioritizes wetland and other natural resource conservation areas (Murphy and Ely 2002).

National Oceanic and Atmospheric Administration (NOAA)

The National Oceanic and Atmospheric Administration (NOAA) administers several natural resource programs that effect Rhode Island's fish and wildlife resources (<http://www.noaa.gov>). NOAA is the key federal agency charged with protecting the nation's marine resources, including federally-listed marine species such as sea turtles (when they are in the water; the USFWS has jurisdiction over nesting sea turtles) and shortnose sturgeon. Federal fishery management plans (FMPs) and the implementation of Essential Fish Habitat (EFH) regulations are also NOAA functions. As a result of these interests, NOAA maintains a research and regulatory presence in the state's marine waters.

The Rhode Island Sea Grant Program falls under NOAA as well (<http://seagrant.gso.uri.edu/>). NOAA's Office of Ocean and Coastal Resource Management oversees state coastal zone management agencies (the Coastal Resources Management Council), authorizing and funding their management programs (<http://coastalmanagement.noaa.gov/>). In addition, NOAA's Office of Response and Restoration produces oil spill ecological risk maps and responds to the clean-up and restoration of damaged ecosystems following oil and fuel spills (<http://response.restoration.noaa.gov>). NOAA is the leading federal agency promoting the research and restoration of submerged aquatic vegetation (SAV) and has collaborated with (and funded) eelgrass restoration projects in Narragansett Bay. (<http://www.csc.noaa.gov/benthic/mapping/analyzing/narragan.htm>). NOAA also manages a network of National Estuarine Research Reserves (NERR), including the Narragansett Bay National Estuarine Research Reserve (<http://www.nerrs.noaa.gov/NarragansettBay/welcome.html>). The Narragansett Bay NERR was established in 1980 and expanded in 1993. It currently owns and manages 2,300 acres on Prudence, Patience and Hope Islands plus an additional 2,500 acres of open water habitat (to a water depth of 18 ft) in Narragansett Bay.

New England Fishery Management Council

As mentioned in Chapter 1, the New England Fishery Management Council (<http://www.nefmc.org>) is a regional council that manages the fishery stocks of numerous marine and estuarine species, several of which have been identified as GCN species for Rhode Island (e.g., Atlantic salmon, monkfish, skates). Rhode Island is a member of the NEFMC, and RI DEM regularly collaborates with the Council on the protection and management of these species as well as marine habitats (Appendix 7a). The Council also works with NMFS and others in the protection of key habitats through the designation of Habitat Areas of Particular Concern and Marine Protected Areas, the management of Essential Fish Habitat, and collaborative fisheries management research through NMFS's Cooperative Research Partners Program.

Atlantic States Marine Fisheries Commission

Rhode Island is a member of the Atlantic States Marine Fisheries Commission, which assists in the management of mobile fishery species within state waters through regional and national coordination (<http://www.asmfc.org>). As listed in Chapter 1, the ASMFC has formulated interstate fishery management plans for several GCN species, including American eel, Atlantic sturgeon, Atlantic menhaden, lobster, horseshoe crab, weakfish, and winter flounder. The Commission's Research and Statistics Program coordinates stock assessments, tagging, habitat mapping, economic and social science studies and many other research efforts related to fisheries resources and management. Thus the ASMFC is a vital partner and mechanism for protecting Rhode Island's fishery resources. Regularly scheduled coordination meetings are anticipated to continue annually and provide opportunities for information exchange and updates on CWCS targets and implementation progress.

National Park Service

The National Park Service (NPS) maintains the Roger Williams National Memorial in Providence and the Touro Synagogue National Historic Site in Newport. The NPS is the lead federal partner in the Blackstone River Valley National Heritage Corridor, which was created in 1986 and encompasses areas within both Massachusetts and Rhode Island (<http://www.nps.gov/blac/home.htm>). At almost 400,000 acres, the Blackstone River National Heritage Corridor is "New England's largest national park" (Gibbs et al. 1995). The NPS is collaborating with the RI DEM and others to develop a Cultural Heritage and Land Management Plan for the Blackstone River corridor. This plan includes a natural resources inventory and assessment, with which the CWCS can be integrated. The existing partnership between the NPS and the RI DEM provides an excellent opportunity to implement CWCS conservation actions in the Blackstone River corridor.

Department of Defense

The U.S. Department of Defense operates several military facilities within Rhode Island. Newport is known as the “birthplace of the Navy” and is the location of the Naval War College and a naval port (Gibbs et al. 1995). Many of the coastal islands in Narragansett Bay historically were military installations, including Sachuest Point NWR, Prudence Island, Gould Island, and Dutch Island. Southern Prudence Island was utilized as a naval installation and storage depot during World War II, and Gould Island supported a naval torpedo station during World War II (Gibbs et al. 1995). While small military facilities remain on the northern tip of Gould Island, most of the island is now owned by the RI DEM DFW. RI DEM DFW has coordinated with the Department of Defense on the transfer of many historic military facilities and lands to state ownership, managing them primarily for conservation today. The two agencies have also worked together on the restoration of other military lands, remediating contaminated sites and abandoned munitions.

U.S. Army Corps of Engineers

The U.S. Army Corps of Engineers (USACE) is the federal agency that oversees the protection of wetlands and waters of the U.S. through the Section 404 of the Clean Water Act permit program and the Section 10 of the Rivers and Harbors Act permit program. These permit programs protect the wetlands and waters of Rhode Island by avoiding, minimizing and mitigating impacts to these important habitats. The New England District of the USACE is located in Concord, Massachusetts (<http://www.nae.usace.army.mil>). RI DEM closely coordinates with the USACE on its regulatory functions to protect the state's wetlands and waters, and the GCN species and key habitats identified in this CWCS can be integrated into those regulatory permit reviews. USACE also designs, constructs and maintains water resources development projects like dredging, dredge disposal, and shoreline stabilization. The Water Management Section owns and maintains numerous dams, reservoirs and floodways, but none of these are located in Rhode Island. The technical and financial assistance programs of the USACE, including their Aquatic Ecosystem Restoration Program, will provide an additional mechanism to implement CWCS conservation actions. Regularly scheduled coordination meetings are anticipated to continue on specific projects and environmental review annually to provide opportunities for information exchange and updates on CWCS targets and implementation progress.

Collaboration with Tribal Partners

Rhode Island has one federally-recognized Native American tribe and one that is not presently recognized by the federal Bureau of Indian Affairs. These tribes were the original conservators of fish and wildlife resources in the state that became Rhode Island, and continue to protect and revere the region's fish and wildlife resources. Both tribes

were contacted and provided the opportunity to participate as partners in the development of this CWCS plan.

Narragansett Indian Tribe

The Narragansett Indian Tribe received federal recognition in 1983 and owns a reservation in the Pawcatuck River watershed that has 800 feet of river frontage on the Pawcatuck. The Tribal Natural Resources Department is responsible for the protection and management of natural resources on tribal land. Major natural resource and environmental issues include water quality, non-point source pollution, illegal dumping, air quality, indoor air quality, and safe drinking water.

Tribal activities and programs in Forestry Management, Road Maintenance, Road Construction, Water Resources, Wildlife, Parks and Recreation, and Transportation Planning are funded through the Bureau of Indian Affairs (BIA). Activities and Programs on Safe Drinking Water, Water Quality, Environmental Enforcement, Environmental Education, Radon, Air Quality, Wetlands Protection, and Geographical Informational Systems Mapping are funded through the Environmental Protection Agency (EPA). More information on the Narragansett Indian Tribe can be found at www.narragansett-tribe.org. The CWCS Development Team coordinated this strategy with the Narragansett Indian Tribe (Natural Resources staff and Tribal Council Administration staff) through written and electronic correspondence, meetings, and a request to review draft versions of the strategy via the RI DEM DFW CWCS website. The comments and recommendations of the tribe were considered and incorporated by RI DEM DFW as appropriate during the strategy's preparation.

Pokanoket/Wampanoag Federation

The Pokanoket Tribe is currently in the process of seeking federal recognition. Protection through education and preservation of the earth is integral to the Pokanoket Tribe. Their website will solicit organizations and individual volunteers to become involved with their ongoing environmental stewardship. More information can be found at www.pokanoket.org. The Pokanoket Tribe has completed land conservation projects with the Barrington Land Conservation Trust and has three tribal members that serve on the Weypoysset Preserve Trust Board in Bristol. The CWCS Development Team coordinated this strategy with the Pokanoket Tribe through written and electronic correspondence, phone conversations and a request to review draft versions of the strategy via the RI DEM DFW CWCS website.

Rhode Island Indian Council

The CWCS Development Team contacted the Rhode Island Indian Council to inform them of SWG opportunities and discuss potential collaborative efforts, as well as to

obtain information on their fish and wildlife stewardship programs. The Council was asked to review draft versions of the strategy via the RI DEM DFW CWCS website. The comments and recommendations of the tribe were considered and incorporated by RI DEM DFW as appropriate during the strategy's preparation.

Collaboration with Academic Partners

University of Rhode Island

The University of Rhode Island (URI) is a frequent and important partner with the Rhode Island conservation community, collaborating with the RI DEM and others to research, monitor, and implement a variety of conservation projects throughout the state. The URI Department of Natural Resources Science has partnered with RI DEM DFW to develop a database and GIS coverage of amphibians in Rhode Island, using 20 years of RI DEM DFW field records (RI DEM 2002g). The URI Environmental Data Center serves as a statewide repository and clearinghouse for physical and biological data (<http://www.edc.uri.edu/edc/>). The University's Department of Natural Resources and Environmental Management operates a Watershed Watch program and other water quality monitoring and analysis programs (<http://www.edc.uri.edu/>). URI (especially the Coastal Institute) was a key partner in the mapping of key habitats; it is anticipated that they will continue to assist and participate in CWCS review, revision and implementation.

URI also houses several interdisciplinary programs and partnerships, including the Coastal Institute, a Cooperative Ecosystems Study Unit for the North Atlantic Coast, a Field Technical Support Center for the NPS, a Cooperative Studies Unit with the USGS, a Cooperative Extension Service with the USDA, and a Coastal Resources Center that has a cooperative agreement with the U.S. Agency for International Development. The Coastal Institute is a regular partner with the RI DEM on a variety of programs and projects, from the monitoring assessments discussed in Chapter 5 to an assessment of the marine fisheries commercial licensing program (<http://www.ci.uri.edu/>). The Institute has collaborated with RI DEM and others through the Map Coast Partnership (<http://www.ci.uri.edu/Projects/MapCoast/default.html>), the Partnership for Narragansett Bay (<http://www.ci.uri.edu/Projects/PNB/default.html>), and in the development of this CWCS. The mission of the Coastal Institute is to facilitate solutions to environmental problems in coastal ecosystems, including their marine and contributing freshwater components. As a result, the Institute is a vital partner with RI DEM DFW in accomplishing the goals of the CWCS.

The Cooperative Ecosystems Study Unit (CESU) program is a collaborative research partnership amongst 13 federal agencies, 130 academic institutions, and 35 non-governmental organizations. The North Atlantic Coast CESU is one of 16 regional programs and is housed at URI (<http://www.ci.uri.edu/naccesu/>). The goal of the program is to provide quality science-based information for resource managers such as RI

DEM in the coastal zone. The NPS Field Technical Support Center at URI provides GIS support for all national parks in the Northeast United States (<http://www.edc.uri.edu/ftsc/>). Both the North Atlantic Coast CESU and the NPS Field Technical Support Center provide technical and scientific resources with which the RI DEM DFW can address the research and monitoring needs identified in the CWCS.

The Rhode Island Cooperative Extension Service is housed at URI as well. The Cooperative Extension Service has programs on aquaculture, fish and domesticated animal health, and water quality (<http://www.uri.edu/ce/index1.html>). The URI-based Coastal Resources Center aims to provide coastal zone management assistance to local, state, federal and international governments (<http://www.crc.uri.edu/>). URI was a key partner in the development of this CWCS and will remain an important partner in its implementation in many aspects.

Brown University

Brown University is an important academic partner with the Rhode Island conservation community, collaborating with the RI DEM and others to research, monitor, and implement a variety of conservation projects throughout the state (<http://www.brown.edu>). Researchers at the university have partnered with RI DEM and others in the Narragansett Bay Window monitoring program, which conducts monthly surveys of the bay through trawls and fixed arrays of water quality and productivity instruments (<http://www.narrbay.org>). The university also monitors the Barrington and Palmer Rivers and the status of salt marshes in Narragansett Bay (Table 5.1, Appendix 5). The Department of Ecology and Evolutionary Biology has partnered with the Marine Biological Laboratory at the Woods Hole Oceanographic Institution in Massachusetts to offer research programs in climate change, ecosystems studies, environmental change and other topics relevant to Rhode Island's fish and wildlife resources, their habitats, and threats facing both. Brown also houses the Environmental Change Initiative, an interdisciplinary program created to research and address environmental problems such as changes in land use / land cover. The Department of Geological Sciences also collaborates with the Marine Biological Laboratory, Environmental Change Initiative, Woods Hole Oceanographic Institution and others to research the region's physical and ecological environment.

Roger Williams University

Another academic partner, Roger Williams University, also partners with the Rhode Island conservation community (<http://www.rwu.edu>). Roger Williams University is a partner with RI DEM and others in the Narragansett Bay Window monitoring program that conducts monthly surveys of the bay through trawls and fixed arrays of water quality and productivity instruments (<http://www.narrbay.org>). University researchers have also historically partnered with RI DEM in its Rapid Bioassessment Protocol Monitoring program of stream water quality and macroinvertebrates (Table 5.1, Appendix 5).

Faculty in the Department of Biology and Marine Biology research marine mammals, zooplankton, marine bioinvasions, biodiversity of seaweeds, early life stages of marine and estuarine fishes, food web dynamics, aquaculture, anthropogenic impacts on aquatic ecosystems, animal behavior and nutrition, invertebrate ecology and physiology, and other topics that can provide valuable assistance in addressing the inventory, research and monitoring needs identified for Rhode Island's GCN species and habitats.

Collaboration with Non-governmental Organization (NGO) Partners

The RI DEM DFW also collaborates with several non-governmental organizations (NGO) to conserve and protect fish and wildlife resources and their habitats. These stakeholders are vital to successfully implementing this CWCS, and their contributions to this CWCS and natural resource conservation in Rhode Island are discussed in Chapter 8. Existing programs with some of these NGOs provide an important opportunity to implement the CWCS with non-governmental partners. The Nature Conservancy, Audubon Society of Rhode Island, and Rhode Island Natural History Survey, however, were key partners in the development of the CWCS and are highlighted here for their roles. Regularly scheduled coordination meetings are anticipated annually, and will provide opportunities for information exchange and updates on CWCS targets and implementation progress. Participation in these organizations' annual meetings and providing presentation and posters on CWCS updates are examples of coordination opportunities throughout the next decade.

The Nature Conservancy

The Rhode Island Chapter of The Nature Conservancy (TNC) has assisted greatly in the preparation of this CWCS, particularly through mapping and in the selection of and narrative descriptions about key habitat and conservation area priorities. RI DEM frequently collaborates with TNC on conservation planning, programs and issues at many levels (site and species-specific, local, watershed, statewide, etc.). Moreover, TNC has twelve land preserves in the state: Lime Rock Preserve in Providence County, Fogland Marsh Preserve and Quicksand Pond/Goosewing Beach Preserve in East Bay, and Beaver River Preserve, Canonchet Brook Preserve, Ell Pond Preserve, Francis C. Carter Memorial Preserve, Grass Pond Preserve, Headwaters of the Wood River, Matunuck Hills Preserve, Pasquiset Pond Preserve, and Queen's River Preserve in South County. Individual conservation plans for these preserves provide an opportunity to incorporate GCN species and relevant key habitats of the CWCS with TNC's management of their lands, and the existing partnership between RI DEM DFW and TNC creates an opportunity to implement conservation actions on TNC lands. Rhode Island TNC's conservation blueprint was consulted while identifying priority areas for conservation and developing the CWCS maps. TNC also has four landscape projects: Block Island, Pawcatuck Borderlands Landscape, Sakonnet Landscape, and South County Landscape, for which stresses, sources of stress, and prioritized conservation actions have been identified as well as partnership opportunities to implement these actions. Key habitats,

and conservation actions for them, located within these TNC landscape project areas are perfect opportunities for collaboration on mutual conservation priorities. RI Chapter staff participated in the CWCS workshops and will continue to be included in future meetings, workshops and other efforts to review and assess GCN species status and implementation of CWCS actions. TNC was a key partner in the mapping of key habitats and is anticipated to continue to assist and participate in CWCS review, revision and implementation. Regularly scheduled coordination meetings are anticipated annually, and provide opportunities for information exchange and updates on CWCS targets and implementation progress.

Audubon Society of Rhode Island

The Audubon Society of Rhode Island (ASRI) maintains over 9,500 acres of natural habitat in 15 refuges found all over the state of Rhode Island and nearby Massachusetts. The Audubon Society of Rhode Island is engaged in many venues of environmental policy, including water policy, wildlife conservation, and habitat preservation. As such, this independent NGO (not affiliated with the National Audubon Society) participated in multiple CWCS meetings and provided data and expert bird information throughout the development process. The ASRI is also a member of the Environmental Council of Rhode Island (ECRI) and works in collaboration with many other partners including RI DEM DFW. The conservation efforts (e.g., designating Important Bird Areas in Rhode Island) and refuges of the ASRI provide a continuing opportunity for RI DEM DFW to collaboratively implement conservation actions and conserve GCN species and key habitats. RI Chapter staff participated in the CWCS workshops and will continue to be included in future meetings, workshops and other efforts to review and assess GCN species status and implementation of CWCS actions.

Rhode Island Natural History Survey

The Rhode Island Natural History Survey (RINHS) is a large coordinated network of over 200 groups and individuals that serves as the umbrella organization for ecological information in the state (<http://www.uri.edu/ce/rinhs/index.htm>). The RINHS sponsors annual meetings to share and disseminate the latest ecological data and research in Rhode Island, publishes a variety of scientific and environmental education publications (e.g., the Biota of Rhode Island series), and hosts an annual BioBlitz to survey the fauna at a particular location. The Rhode Island Natural Heritage Program database, originally developed by RI DEM and TNC, currently is administered and maintained by the RINHS. Furthermore, the RINHS is producing a Rhode Island Odonate Atlas. RINHS staff was instrumental in the preparation of this CWCS by providing scientific data from their database as well as their taxonomic expertise. Continued collaboration with the RINHS provides a ready mechanism to implement inventory, research and monitoring actions, public outreach and environmental education efforts. RINHS staff participated in the CWCS workshops and will continue to be included in future meetings, workshops and other efforts to review and assess GCN species status and implementation of CWCS

actions. Regularly scheduled coordination meetings are anticipated to continue and provide opportunities for information exchange and updates on CWCS targets and implementation progress.

The National Wildlife Federation, The Wildlife Society, American Fisheries Society

These national groups have been very supportive of the CWCS program and process at the national and regional levels since the TWW and CARA legislation was conceived. National and regional staff has been involved and updated and has provided significant information, coordination, and support at the state level through input and communication with the consultant and the RI DEM DFW staff.

Land Trusts

The Northeast region has the highest number of land trust organizations in the country. These non-profit organizations have protected 2.9 million acres of land across the region (Land Trust Alliance 2004). Rhode Island has more than 41 local and regional land trusts that have protected a total of 22,530 acres of land in the state through ownership, easement or other means of conservation (Land Trust Alliance 2004). The Rhode Island Chapter of The Nature Conservancy created the Rhode Island Land Trust Council in 1999 to provide technical assistance to these land trusts, allowing them to coordinate and collaborate on their activities; the Council has since become an independent organization. The Rhode Island Land Trust Council, Rhode Island Rivers Council and the Rhode Island Association of Conservation Commissions have also partnered together to sponsor an annual Land and Water Conservation Summit, which includes a variety of workshops to facilitate and strengthen conservation partnerships, as well as to educate land trusts on threats and needs to Rhode Island's natural resources, funding opportunities and advocacy methods. The land trusts of Rhode Island represent an important partner in the protection of GCN species and key habitats and offer the opportunity for increased RI DEM outreach to incorporate CWCS needs and goals into local land protection efforts. During the development of the CWCS, the national Land Trust conference was held in RI and a special session and presentation was made to these important partners. CWCS species and habitat targets will be provided to these groups to assist their selection of land prioritization and protection efforts as they are improved and updated throughout the implementation of this strategy.

Chapter 8: Public and Stakeholder Participation

Chapter 7 discussed the involvement of RI DEM DFW's partners in Rhode Island's wildlife conservation and in the development and implementation of this CWCS (Element 7). The public and multiple stakeholders were also involved, and this chapter focuses on their participation from CWCS development through implementation (Element 8). Throughout the development of the CWCS in 2004 and 2005, the CWCS Planning Committee and the consultant worked to involve the public at multiple levels and at each stage of the process. These same efforts, developed during these initial two years to coordinate and communicate with these publics, will be used throughout the implementation period. Increased public awareness will certainly result in more public involvement and participation, which will lead to improved coordination opportunities and mechanisms to be incorporated into the next revision. Regularly scheduled public events and meetings are anticipated to continue annually and provide coordination and outreach opportunities for information exchange and updates on CWCS targets and implementation progress throughout the next decade.

Appendix 8a provides a list of the stakeholders involved throughout the planning process, and Appendix 8b describes the Public Input Plan developed to guide outreach to these publics. Outreach techniques included formal and informal meetings, workshops, newsletters, mailings and other correspondence. Agendas for stakeholder workshops held during the CWCS development process are included in Appendix 8c to demonstrate input solicitation during key phases of CWCS development (identifying GCN species, key habitats, threats, actions and needs) and the RI DEM website was established to receive public input throughout the process

<http://www.dem.ri.gov/programs/bnatres/fishwild/swgindex.htm>

In 2004, information on public and private conservation stakeholder programs was researched and compiled. This resulted in an inventory of existing local, state, and regional/national programs and stakeholders compiled from meetings, correspondence, and research from literature and the Internet. This inventory was then used as the foundation for public outreach strategy development.

In February 2004, RI DEM DFW developed a stakeholder and public input plan (see Appendix 8b) and as discussed in Chapter 7, has involved partners and stakeholders through meetings and correspondence, and the public through website, articles, newsletters and public presentations. The Bleiker Citizen Participation by Objective (CPO) process was employed to identify and target the Potentially Affected Interests (PAIs), the specific messages and objectives to be communicated, and the most effective techniques to reach these targeted publics (Bleiker and Bleiker 2000). Worksheets were completed using this method, and the results identified seven highly recommended techniques to employ for the CWCS development and implementation phases (See Appendix 8b). As described in Chapter 7, a series of introductory and follow up briefing meetings was held to solicit input and feedback from key partners and stakeholders. Additional input was solicited as invitations were sent to more than 200 stakeholder PAIs

(Appendix 8a) inviting them to workshops to involve them in the development of GCN species and key habitat lists (see Appendix 8c for workshop agendas). Unfortunately, the response rate was low. Communication with other states and programs indicated a similar experience. Stakeholder comments were incorporated with updated lists posted again on the website. In order to reach additional stakeholders, the CWCS project developed and utilized a website that posted information on SWG and the CWCS process and pieces of the CWCS as it became available, for review and comment. Draft GCN species and key habitat lists and draft versions of the plan were posted to the RI DEM DFW website for public review and they were made available to stakeholders early on for technical review and input.

For the purposes of this CWCS effort, the "public" was categorized into three tiers of PAIs. These included partners (federal, state, local, tribal, public and private partners as well as internal partners within RI DEM) interested individuals and groups, and the general public. Each of these three tiers is described below, along with its level of coordination and involvement.

Tier 1: Partners/collaborators with significant role and/or program

- All federal, state, local, tribal public and private partners
- Leaders, staff and programs that contribute significant data or scientific knowledge base to be incorporated directly into CWCS
- Leaders, staff and programs that collaborate on development, review/revision, implementation, monitoring and assessment or re-evaluation of the CWCS

Partners/Collaborators include:

RI DEM Internal Partners: DFW Freshwater Fisheries, Marine Fisheries, Wildlife, Planning and Development, Natural Heritage Program, Forestry, Wetlands, etc.

RI DEM External Partners: RIGIS, RI DA, CRMC, RI DOT, municipalities, USFWS, USGS, USDA, NRCS, USFS, EPA, NOAA, NPS, DOD, USACE, Tribal Nations, URI, Brown University, TNC, Audubon Society of RI, RINHS, Land Trusts, TWS, AFS, NWF, DOW

Coordination and involvement during development, review and revision, and implementation:

- One on one informal introduction and planning meetings
- Follow-up small informal briefings and coordination meetings
- Invitation to stakeholder workshop series - first to identify GCN species and key habitats, second to identify threats and actions and to prioritize actions
- Invitations to serve on teams and/or to develop CWCS including draft write-ups, maps, lists of species and habitats, monitoring framework, etc.
- Request for plans / programs to cite and incorporate in CWCS and revisions, and request for partners to incorporate CWCS material in theirs
- Brochure and update materials sent and request for inclusion in organization newsletter

- Request to review and comment on website updates of plan materials
- Development and presentation of poster to present at annual conference and meetings

Tier 1 individuals and groups were contacted for input throughout the CWCS development process (see Chapter 7 for more details). Regular correspondence and sharing of technical information was critical to assist in the development of the CWCS. Input and feedback from collaborative partners was solicited through personal, informal meetings with organization representatives and staff. Per the input plan and CPO techniques, input was solicited at each stage of the project. Partner expertise on teams at working meetings and additional follow-up provided “peer review” and refinement during each of the processes of identifying GCN species and key habitats, determining the most critical problems and threats to species and their habitats, and prioritizing effective conservation actions. Use of various programs' existing target species/habitats and recommended conservation strategies was important in focusing existing RI DEM DFW programs and projects to benefit from and complement potential collaborative efforts.

Tier 2: Interested groups and individuals with limited role/program

- Many PAI stakeholders (both public and private) with little or no technical data, such as small private preserves, watershed groups, advocacy groups, agencies and institutions with limited interest and influence on wildlife or land use
- Staff/members with limited or no data or scientific knowledge base that is directly applicable to the CWCS Strategy, but have a potential role in outreach or general input into the development and future implementation of the Strategy
- PAIs with the potential to assist in the development and implementation of the CWCS

Coordination and involvement during development, review and revision, and implementation:

- Invitation to stakeholder workshop series - first to identify GCN species and key habitats, second to identify threats and actions and to prioritize actions
- Request for plans / programs to cite and incorporate in CWCS and revisions, and request for PAIs to incorporate CWCS material in theirs (information swap)
- Brochure and update materials sent and request for inclusion in organization newsletter
- Request to review and comment on website updates
- Presentations at meetings

See list of Stakeholders in Appendix 8a

Tier 3: General, uninvolved or unaware Public

- Citizens not directly involved in a Tier 1 or 2 group project

- Able to benefit from the development and implementation of the CWCS as related to economic, recreational and quality of life benefits from effective statewide wildlife conservation

Coordination and involvement during development, review and revision, and implementation:

- Brochure and update materials sent and request for inclusion in organization newsletter
- Request to review and comment on website/ updates
- Presentations at scheduled public, community, and organization meetings

Tier 2 and 3 publics (individuals and groups) were informed about the CWCS process and goals. They were kept informed of ongoing progress through information posted on the web, RI DEM letters and updates, and by utilizing their scheduled meetings and newsletters to provide presentations and updates through their existing internal communication mechanisms. Input was then solicited from Tier 2 individuals and groups both during and after RI DEM DFW staff had sufficiently developed the document to a “Draft” product stage, ready for external public review on the website, and they were notified of each update.

Bleiker's CPO process employed during the development of the CWCS also planned for the continuation of this input and involvement through revision of this CWCS. One important objective identified through the Bleiker CPO was to maintain stakeholder and public involvement through the implementation stage. The various levels of involvement that were solicited from all these groups during strategy development were designed by objective to continue input and feedback from these informed stakeholders and publics during implementation and revision of the Strategy. The CWCS and CPO processes were designed to include continued input from stakeholders both short and long-term and to keep these publics informed of SWG projects and results through annual reports, magazine articles, meetings, organization newsletters and web site progress reports. Through these methods of continued coordination and updates, the CWCS process was designed to keep stakeholders and the public informed and involved throughout the implementation stage.

The general public (Tier 3) and PAIs will be kept informed and educated about the CWCS, its projects and results through a variety of existing public outreach mechanisms. RI DEM, through multiple partnerships such as the recently established RIEMC, will coordinate on monitoring and review through the existing scheduled program and plan updates. These programs' existing communication mechanisms will provide further outreach to a wider audience to inform more publics about CWCS information and priorities.

In addition to public website progress reports and educational materials, magazine articles, newsletters, and newspaper articles, public outreach can utilize environmental and education centers. The many existing events, programs and resources within the partners of the Rhode Island conservation network, such as URI, Audubon Rhode Island,

and other federal, state, and local partners' educational facilities, can be used to host and include public outreach events on the CWCS, GCN species and habitats, and how RI DEM and its partners are implementing conservation actions to improve Rhode Island's fish and wildlife resources and their habitats.

Existing PAI facilities and programs, both private and public, can serve as valuable tools to disseminate conservation education and public outreach materials into classrooms throughout the state throughout the implementation phase. Universities, laboratories, and other conservation centers, undergraduate and graduate programs can integrate CWCS priorities and activities into ongoing and new research and education efforts at the collegiate level. Utilizing existing partnerships to educate the public also involves these partner PAIs. Education and dissemination of information on GCN species and their key habitats were identified as important statewide, overarching needs in Chapter 4.

Specific techniques to be used during CWCS implementation and review are similar to those identified as most effective during the CWCS development stages. PAIs will be informed and involved through active committee and working meetings, website updates and interaction, and by making use of existing stakeholder organization meetings and newsletters. Examples include annual conferences and coordination meetings such as the URI Coastal Institute, RINHS, and other stakeholder events and gatherings. Informal meetings with key partners and Tier 1 and 2 stakeholders will be an ongoing part of the annual program updates and evaluation. Solicitation of input and technical information from expert taxa committees as peer review and evaluation will occur on a biennial basis to provide updates to the RI DEM DFW GCN species dataset and GCN status review. Their expert advice will be consulted regularly during the process of SWG proposal solicitation and selection review. Finally, Tier 1 and 2 stakeholders will be intimately involved in the 10-year revision of this document, as they will continue to play a major role in identifying GCN species and key habitats, as well as updating and identifying new threats and actions for the next decade of CWCS implementation. Stakeholders and the public will be kept informed of any updates, and participatory events can be used to solicit additional information. This includes magazine and newsletter articles, and exhibits and presentations at public events (i.e. fairs, festivals, public meetings, etc.) for increased exposure. The public input plan outlines the methods and intervals of outreach and communication to keep both stakeholders and the public involved and informed throughout the implementation phase, and will help them to prepare for the revision in the next ten years.

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Acronyms and Abbreviations

ACJV	Atlantic Coast Joint Venture
AFA	Application for Federal Assistance
AFS	American Fisheries Society
AMA	Agricultural Management Assistance
APHIS	Animal and Plant Health Inspection Service
ASA	Applied Science Associates, Inc.
ASMFC	Atlantic States Marine Fisheries Commission
ASRI	Audubon Society of Rhode Island
BBS	Breeding Bird Survey
BCC	Birds of Conservation Concern
BCI	Bat Conservation International
BCR	Bird Conservation Regions
BDI	Biological Distinctiveness Index
BIA	Bureau of Indian Affairs
BioMap	Massachusetts Biodiversity Assessment Project
BMPs	Best Management Practices
BRD	Biological Resources Division, U.S. Geological Survey
CAPS	Cooperative Agricultural Pest Survey
CBC	Christmas Bird Count
CCP	Comprehensive Conservation Plan
CESU	Cooperative Ecosystems Studies Unit
cm	Centimeter(s)
CMER	Cooperative Marine Education and Research Program, University of Massachusetts and National Oceanic and Atmospheric Administration
COW	Cowardin et al. (1979) [<i>Classification of Wetlands and Deepwater Habitats of the United States</i>]
CPI	Conservation Partnership Initiative
CPO	Citizen Participation by Objective
CRMC	Coastal Resources Management Council
CRP	Conservation Reserve Program
CSO	Combined Sewer Overflow
CSP	Conservation Security Program
CWCS	Comprehensive Wildlife Conservation Strategy
DEM	Department of Environmental Management
DFW	Division of Fish and Wildlife
DO	Dissolved oxygen
DoD	Department of Defense
ECRI	Environmental Council of Rhode Island
EFH	Essential Fish Habitat
EMAP	Environmental Monitoring and Assessment Program, Environmental Protection Agency
EPA	Environmental Protection Agency

EPA-AED	Environmental Protection Agency, Atlantic Ecology Division
EPT	Ephemeroptera, Plecoptera, and Trichoptera
EQIP	Environmental Quality Incentive Program
FGDC	Federal Geographic Data Committee
FMP	Fishery Management Plans
FRPP	Farm and Ranch Lands Protection Program
FSA	Farm Service Agency
ft	Feet
FY	Fiscal Year
GAP	Gap Analysis Program
GCN	Greatest Conservation Need
GIS	Geographic Information System
GRP	Grassland Reserve Program
HBI	Hilsenhoff Biotic Index
HUC	Hydrologic Unit Code
IAFWA	International Association of Fish and Wildlife Agencies
IBA	Important Bird Area
ID	Identify
IUCN	International Union for the Conservation of Nature
IWI	Index of Watershed Indicators
kg	Kilogram(s)
km	Kilometer(s)
kt	Karen Terwilliger
lbs	Pound(s)
m	Meter(s)
MA	Massachusetts
MAFMC	Mid-Atlantic Fishery Management Council
MANEM	Mid-Atlantic/New England Maritime Regional Working Group for Waterbirds
mi	Mile(s)
MPA	Marine Protected Area
NABCI	North American Bird Conservation Initiative
NAFWA	Northeast Association of Fish and Wildlife Administrators
NALCP	North American Landbird Conservation Plan
NASA	National Aeronautics and Space Agency
NAWCP	North American Waterbird Conservation Plan
NBC	Narragansett Bay Commission
NBEP	Narragansett Bay Estuary Program
NBII	National Biological Information Infrastructure
NEES & WDTC	Northeast Endangered Species and Wildlife Diversity Technical Committee
NEFMC	New England Fishery Management Council
NERR	National Estuarine Research Reserve
NGO	Non-governmental organization
NHP	Natural Heritage Program

NLCD	National Land Cover Data
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOS	National Ocean Service
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NRI	Natural Resources Inventory
NVCS	National Vegetation Classification Standard
NWI	National Wetlands Inventory
NWR	National Wildlife Refuge
NY	New York
ORV	Off road vehicle
OWP	Organization of Wildlife Planners
OWR	Office of Water Resources
PAI	Potentially Affected Interests
PARC	Partners for Amphibian and Reptile Conservation
PC	Planning Committee
PIF	Partners in Flight
PNB	Partnership for Narragansett Bay
ppt	Parts per thousand
QC	Quality control
RC&D	Resource Conservation and Development
RI	Rhode Island
RI DA	Rhode Island Department of Administration
RI DEM	Rhode Island Department of Environmental Management
RI DEM DFW	Rhode Island Department of Environmental Management Division of Fish and Wildlife
RI DEM NHP	Rhode Island Department of Environmental Management, Natural Heritage Program
RI DOH	Rhode Island Department of Health
RI DOT	Rhode Island Department of Transportation
RI EDC	Rhode Island Economic Development Corporation
RI EMA	Rhode Island Emergency Management Agency
RIACC	Rhode Island Association of Conservation Commissions
RIBCON	Rhode Island Bristol County Observer Network
RIDAG	Rhode Island Department of Environmental Management, Division of Agriculture
RIEMC	Rhode Island Environmental Monitoring Collaborative
RIGIS	Rhode Island Geographic Information System
RIMFC	Rhode Island Marine Fisheries Council
RINHS	Rhode Island Natural History Survey
RIRPP	Rhode Island Resource Protection Project
RIWP	Rhode Island Watershed Partnership
RPA	Resource Protection Area
RS	Remote Sensing

SAFMC	South Atlantic Fishery Management Council
SAV	Submerged Aquatic Vegetation
SCORP	State Comprehensive Outdoor Recreation Plan
SDIC	Systematic Development of Informed Consent
SFR	Sport Fish Restoration Program
SIP	Stewardship Incentives Program
SNE GAP	Southern New England Gap Analysis Program
sp	Species
ssp	Species (plural)
SWCA	Soil and Water Conservation Assistance
SWG	State Wildlife Grant
TCI	Terwilliger Consulting, Inc.
TMDL	Total Maximum Daily Load
TNC	The Nature Conservancy
TT	Technical team
TWW	Teaming With Wildlife
URI	University of Rhode Island
URI EDC	University of Rhode Island's Environmental Data Center
US DOI	U.S. Department of the Interior
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USFWS-NAAT	U.S. Fish and Wildlife Service, National Advisory Acceptance Team
USGS	U.S. Geological Survey
WCRP	Wildlife Conservation and Restoration Program
WDTC	Wildlife Diversity Technical Committee
WHIP	Wildlife Habitat Incentives Program
WMA	Wildlife Management Area
WPWA	Wood-Pawcatuck Watershed Association
WRD	Water Resources Division, U.S. Geological Survey
WRP	Wetlands Reserve Program