



Rhode Island Wildlife Action Plan

Chapter 4

Actions to Conserve Rhode Island's Species of Greatest Conservation Need and Key Habitats

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Introduction

This WAP Conservation Planning Process began with the identification of conservation targets. Chapter 1 described Rhode Island’s fish and wildlife species in most need of conservation. Chapter 2 described how Rhode Island identifies key fish and wildlife habitats in the state. The WAP process then identified the key problems and threats facing these conservation targets (SGCN and their key habitats) as presented in Chapter 3. This chapter focuses on the priority conservation actions that address these threats to Rhode Island’s SGCN and their associated habitats. This directly addresses Element 4 and is an important part of the overall mission of RI DEM DFW.

Identifying prioritized conservation actions will lay the foundation for the dynamic process of developing accurate and current information on Rhode Island’s SGCN and key habitats. Use and dissemination of this information will enable the important step of incorporating it into land use decisions and key conservation efforts across the state. Implementation of the actions will require the efforts of many conservation partners working together to incorporate the needs of SGCN and key habitats into their programs and plans throughout the next decade.

Regional Context and Priority Actions Identified by Northeast Wildlife Action Plans

After the completion of the 2005 CWCSs, a survey was conducted as part of the AWFA National Synthesis to identify the key actions listed by each state in their SWAPs (AFWA unpublished and 2011). A list of these key recurring actions in the 13 northeastern states is presented in Table 4.1.

Table 4-1. Key Actions Identified by Northeastern States Wildlife Action Plans.

Key Actions Identified by Northeastern State Wildlife Action Plans (in descending order of listing recurrences)
Land/Water Protection: Resource & Habitat Protection
Planning/Best Management Practices (BMPs): Planning
Data Gaps/Research: Monitoring
Land/Water Protection: Site/Area Protection
Education & Awareness: Awareness & Communications
External Capacity Building: Alliance & Partnership Development
Data Gaps/Research: Property Assessment and Prioritization
Data Gaps/Research: Research
Land/Water Management: Habitat & Natural Process Restoration
Data Gaps/Research: Threats Assessment
Land/Water Management: Site/Area Management
Data Gaps/Research: Data Collection and Management
Law & Policy: Legislation
Education & Awareness: Training
Law & Policy: Compliance & Enforcement
External Capacity Building: Conservation Funding

Key Actions Identified by Northeastern State Wildlife Action Plans (in descending order of listing recurrences)
Law & Policy: Policies & Regulations
Land/Water Management: Invasive/Problematic Species Control
Livelihood, Economic & Other Incentives: Conservation Payments
Law & Policy: Private Sector Standards
Species Management: Species Management
Planning/BMPs: BMPs
Other: Non-IUCN Action: Other
Data Gaps/Research: Inventory
Data Gaps/Research: Exploratory Survey
Data Gaps/Research: Evaluation
Data Gaps/Research: Species assessment
Species Management: Species Recovery
Livelihood, Economic & Other Incentives: Conservation-related Livelihood
Livelihood, Economic & Other Incentives: Eco-friendly Alternatives
Livelihood, Economic & Other Incentives: Market-driven Incentives
Livelihood, Economic & Other Incentives: Non-Monetary (cultural, etc.) Values
Education & Awareness: Formal Education

Priority Conservation Actions in Rhode Island

Background of Fish and Wildlife Conservation in Rhode Island

The evolution of fish and wildlife conservation efforts throughout the early to mid-1900s in the U.S. is well documented. Key federal legislation [including Federal Aid in Sport Fish Restoration Act of 1950, now referred to as the Dingell-Johnson and Sport Fish Restoration Act (16 U.S.C. 777, et seq. as amended) and the Federal Aid in Wildlife Restoration Act (16 U.S.C. 669-669i; 50 Stat. 917) of September 2, 1937, as amended)] has funded significant state efforts focused primarily on game species since their enactment. The 1970s brought additional attention to rarer species through the ESA (16 U.S.C. 1531-1544, 87 Stat. 884), as amended and other broader environmental legislation. In Rhode Island starting in the late 1960s, The Nature Conservancy focused their land acquisition effort on the protection of biodiversity and developed the NHP methodology to assist that mission. That program became a partnership with the RI DEM and the RINHS which remains today.

In the 1970's The Nature Conservancy's slogan was "*the last of the least and the best of the rest*". The first part of this paradigm meant that the rarest species were considered the most vulnerable and the highest priorities for conservation. Acquiring parcels of land with clusters of rare species was extremely successful and many significant areas were protected in the ensuing years. In Rhode Island, projects such as Limerock Preserve (Lincoln), the Lewis Farm (Block Island) and the Matunuck Hills (South Kingstown) were targeted explicitly for the protection of biodiversity. Most NHPs were eventually incorporated into state environmental agencies and many states also developed environmental review

functions to regulate the habitats of rare species. The exportation of NHP methodology into the realm of environmental review carried with it the same assumptions – that the rarest needed help the soonest.

Concurrently, state environmental agencies (i.e., RI DEM) established endangered and threatened (E/T) species programs that were similar to and strongly influenced by NHPs. State E/T programs dealt primarily with federally listed or candidate species and secondarily with state-level priorities, which were usually vertebrates and other familiar species groups. The original focus on E/T birds and mammals occurred, at least in Rhode Island, because those were eligible for federal aid funding through Section 6 of the ESA and the Federal Aid to Wildlife Restoration (a.k.a. Pittman-Robinson) Act. As state agencies developed dedicated funding from non-federal aid sources, their programs expanded to include less traditional species, including reptiles, amphibians, and some invertebrate groups. However, this step in the progression of state wildlife agencies is still in process in Rhode Island, and has resulted in a “*last of the least*” (fine-filter) approach to most of the state wildlife conservation efforts over the past several decades.

Animal populations are, quite literally, “moving targets”. Many are secretive and have large spatial requirements. Populations can therefore be difficult to delineate and the status of the most mobile of Rhode Island’s animal populations can be linked to processes that occur at continental or even hemispheric scales. Assessing animal species richness is also daunting. Rhode Island has about 900 vertebrate species, but there are estimated to be tens of thousands of invertebrate animals and many other life forms in taxonomic groups that are so obscure that check lists or inventories do not exist. The second half of The Nature Conservancy model (“*the best of the rest*”) was designed to grapple with this problem. Protection of exemplary vegetation communities or other features (i.e., habitats) represented a coarse-filter approach; unusual plant communities were thought to support other unusual biota, even if not specifically identified. The Nature Conservancy’s two-pronged paradigm was a way to cover all the bases – the fine scale inventory of rare species could focus action on areas with good information, while coarse filters could draw attention to those areas without detailed surveys.

With development of the SWG Program in 2000, state fish and wildlife agencies had the opportunity to address this problem anew as they were required to develop SWAPs. SGCN now include rarities as well as species that are presently common but vulnerable, with the stated goal of *keeping common species common*. This inclusion stretches the conservation capacity of state agencies even further. What began with sport-fish and game transitioned into other popular and funded wildlife, and then incorporated additional species with less charisma (e.g., amphibians). What does this mean for state agencies and conservation? Even if expertise existed (either on staff or external contract), there are many species, many conservation issues, and not much time for action. SWAPs anticipate and begin to address this need. By requiring state agencies to create a compendium of key wildlife and their habitats, describe the threats to those species, and develop appropriate conservation actions to protect them, the SWAP guidance facilitates wildlife agencies to adopt a coarse-filter approach. This highlights the need for complementary strategies to incorporate the last 40 years of fine-filter efforts with the broader, landscape level, coarse-filter approach. The actions described in this chapter have been developed and prioritized by RI DEM with more than a hundred of its partners and stakeholders, to provide a more comprehensive conservation approach and build upon the foundation of the 2005 plan.

Current RI WAP Conservation Action Priorities

How Conservation Actions were Identified 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 WAP revision was to review the 2005 plan along with the most current efforts and priority conservation actions and adapt them as appropriate to address Rhode Island's specific SGCN and their key habitats. This not only improves the probability of plans being implemented but also improves their overall effectiveness by recognizing the relevant work of partners as integrated 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 (see Appendix 1). This assessment was conducted to identify those conservation actions that would best address the threats and problems identified in Chapter 3 and protect the SGCN and key habitats discussed in Chapters 1 and 2 respectively.

Once the 2005 and updated actions were compiled, they were reviewed by the RI WAP Technical Team which consisted of more than 40 experts and 7 taxonomic committees. Actions were organized using a standard classification system (IUCN/TRACS) as a foundational reference to develop a matrix of actions that addressed each threat identified for Rhode Island's target species and habitats. Actions were developed for the highest priority threats identified. This served as the first order of prioritization. Each action developed was also assigned a rank of 1 to 3 (1= Low, 2= Moderate, and 3=High). The NE Lexicon action criteria (drafted at the time RI WAP actions were ranked) were considered when the expert taxonomic and habitat teams were ranking threats and actions. They applied the lexicon criteria to represent the degree of urgency and likelihood of success in the priority rank for each SGCN and habitat actions. These scores were summed for relative priority scores for each action (Figure 4-1 and 4-2).

Over 100 existing conservation programs and plans were identified through a literature search and were used as a foundation from which to develop the list of threats in this chapter, the WAP, its Profiles and the companion document. Key citations are listed at the end of this chapter on threats to SGCN and their habitats, and additional threats were compiled from current local, state and regional, national and international conservation plans listed in Appendix 1a. Appendix 3 represents threat classification system used by the many partners to identify and rank threats for the RI WAP.

All actions in all tiers were compiled and summed by IUCN/TRACS Action categories to determine which categories were most frequently used to address the key threats listed in chapter 3. This was completed for all SGCN and for all habitats. Most frequently prescribed actions for individual taxa or groups of species are presented in taxa-wide actions later in this chapter. The overall results showed that land and water protection and land and water management actions were most commonly prescribed for both SGCN and key habitats. Education and outreach were also commonly prescribed as important actions to address threats at all tiers. Law and policy actions were also recommended as actions to address both habitats and species. Data collection and planning emerged as recurring needs to address the lack of information and planning. Different, more specific needs and actions emerge as one advances through the tiers. Where information was insufficient to identify conservation actions, the process focused on identifying research, inventory, and monitoring needs to obtain the missing information. Actions were refined by the Technical Team and Scientific Review Team through a series of workshops and 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.

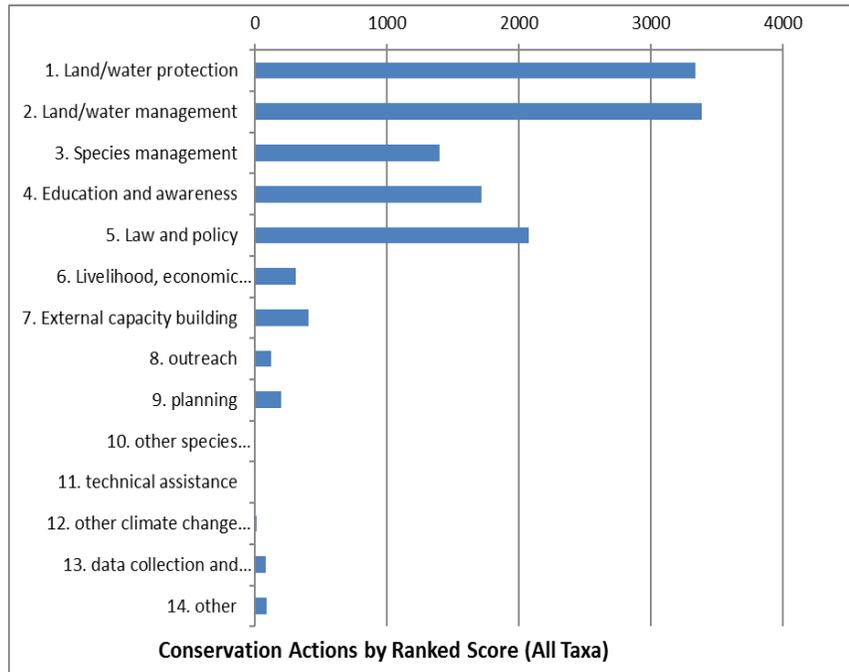


Figure 4-1. Overall rank of all actions compiled at all Tiers

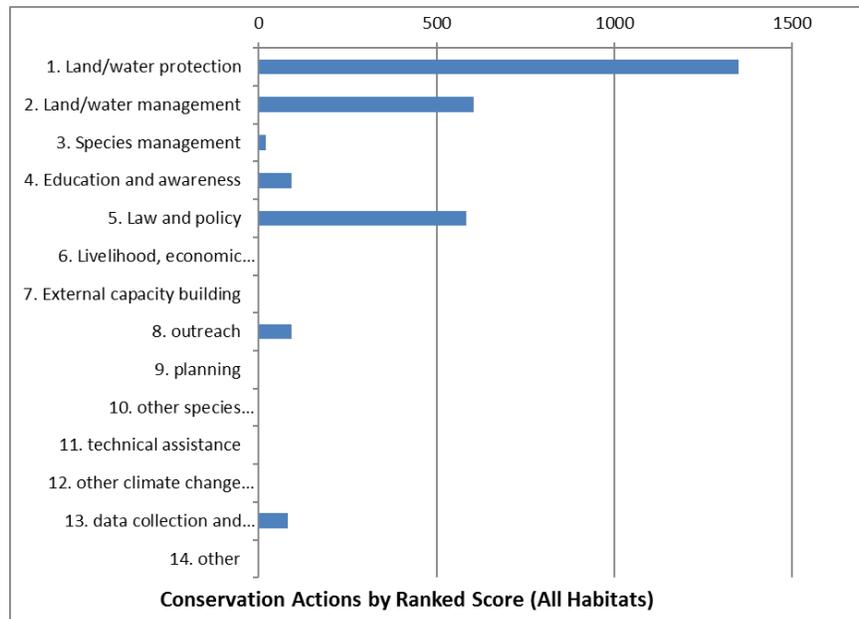


Figure 4-2. Most Frequently Prescribed Conservation Actions for all Key Habitats

Stakeholder and public input was further solicited through workshops that focused on threats and action review and prioritization. Press releases and specific follow up invitations were sent to partners, stakeholders, and participants from the previous SGCN and habitat workshops and meetings during 2013 and 2014. A core group of individuals (almost 50) responded, providing valuable input and feedback. The

list of threats, conservation actions, inventory, research, and monitoring needs were posted on the web for 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 four (4) tiers: 1) statewide, overarching, 2) taxa or species suite-focused, 3) habitat- focused threats and actions, and 4) species-focused.

Conservation threats and their accompanying actions for Tier 1 are those that can be implemented throughout Rhode Island (refer to Table 4-2) and have potential to affect all species and habitats. Projects such as program coordination, land acquisition, education, or mitigation of contaminants or disease 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. Actions that address regional needs, especially RCN priorities, are considered high priority and included in this tier. Other examples include coordinated regional data collection and management.

Tier 2 includes those actions that have a high potential to affect groups of species. In other words, the threats and actions are applicable to multiple (usually taxonomically related) species. In many cases, data needs, research projects, and the creation of digital GIS coverage are appropriate for a suite of species. 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 can extend across species and habitat boundaries. RSGCN and regional RCN priority species are included here.

Table 4-2. Tier Ranking System

Tier	Scale	SGCN /Habitats
1	Statewide	All
2	Geographic	Select groups- Taxa
3	Local/patch	Habitat-specific
4	Species/group	Species/species group specific

Prioritizing the coarse-scale, statewide actions do not diminish the need to consider conservation at the species and habitat level. This level provides finer differentiation of actions as well as focal areas which help target and direct the statewide and taxa level (Tier 1 and 2) actions on the landscape. This WAP revision relies heavily on key habitat identification as a form of “coarse filter” approach to address the needs of groups of SGCN.

Tier 3 provides additional differentiation. Where meaningful, species (especially invertebrates and birds) were grouped by habitats and focal species were identified to help further target conservation action development (i.e., pitch pine moths or forest birds). Such groupings shared the same habitat, threats, and actions and were merged to avoid redundancy and to highlight the interrelationships and similarities. This process was also employed with aquatic taxa, especially marine, where focal species were identified to represent guilds or groups of species with similar needs (i.e., anadromous, demersal, etc.). Species groupings and 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., use 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 or other functional grouping (see species profiles).

Also in Tier 3, individual habitat or community lists were generated where additional specific actions were deemed necessary for that community (see habitat profiles- Appendix 1). 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.

Tier 4 actions are even more specific to those levels mentioned previously. This category contains actions that are necessary for one or at most a small cluster of wildlife species. Examples of Tier 4 actions might include nest-box programs for nesting birds or a focused survey and educational program for Chimney Swifts. Tier 4 threats and actions can be found in the Species Profiles.

ALL ACTIONS PRESENTED IN THIS DOCUMENT ARE CONSIDERED PRIORITY

ACTIONS. Those actions that have a greater conservation effect across taxa and habitats were considered high 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 (Highest= 3, Moderate= 2, Low =1). 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 WAP is designed to respond to those needs. It should be recognized that all these actions are priority actions needed for the conservation of SGCN 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. This informs a priority need and action to address emerging issues (such as disease, invasive species, etc.) as they arise over the course of the next decade.

2015 WAP Priority Conservation Actions

After the first CWCS was created in 2005, RI DEM suffered personnel losses that severely compromised the plan's implementation. Reorganization and reallocation of existing staff mitigated this situation somewhat, but the state agency responsible for fish and wildlife conservation remains understaffed with little change expected for the foreseeable future. Nevertheless, it is illustrative to look back at the last ten years and see that several of the highest priority actions identified in the 2005 plan were accomplished or are ongoing. These key accomplishments are described in each Action category below along with the action priorities that remain to be implemented over the next decade through this 2015 WAP revision.

The following sections present conservation actions and inventory, research and monitoring needs to reflect the tiered organization and standard classification systems 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 first the broadest, overarching, statewide actions (Tier 1) and then the taxa focused (Tier 2). The more specific species and habitat focused actions are presented in the species and habitat profiles. A compiled list of all actions is presented in Appendix 4 with their rank and TRACS performance measure. *It is important to*

recognize that, in order to avoid redundancy, this RI WAP 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, (e.g. to all forest types) will only appear once in the general habitat category and are implied throughout each specific forested key habitat.

The following Action categories are presented in standardized IUCN classification system as recommended in the AFWA Best Practices with a crosswalk to TRACS (Appendix 4) as developed in coordination with the NE Lexicon for Threats and Actions (Crisfield and NEFWDTC 2013). The action categories are presented by threat in rank order of priority in the sections below. Table 4-3 presents the action categories as most frequently used to address threats to SGCN. Each action was assigned a rank and specific performance measure as well as a more general measure from the TRACS system using the IUCN /TRACS crosswalk.

Table 4-3. Action Categories Frequently Used to Address Threats to SGCN

Actions per Group in Grand Sum (Ranked) Order	
IUCN Threat Code	Sum
1. Land/water protection	1,350
2. Land/water management	605
5. Law and policy	583
8. Outreach	93
4. Education and awareness	91
13. Data collection and analysis	82
3. Species management	20
9. Planning	1
6. Livelihood, economic and other incentives	0
7. External capacity building	0
10. Other species management	0
11. Technical assistance	0
12. Other climate change actions	0
14. Other	0

Actions to Address Habitat Loss, Fragmentation, and Degradation of Key Habitat Land and Water Protection and Management

Land acquisition was identified as a critical component of wildlife conservation to counterbalance the threat of habitat loss due to terrestrial development and biological decay from inadequately-sized preserve areas. In the 2005 CWCS, actions were identified to *facilitate acquisition or easement of key parcels and coordinate acquisitions with other state and regional programs and develop focal area and focal species approaches in Rhode Island.* The focal area approach outlined in the 2005 plan was not formally adopted, but elements of it were routinely presented in the state’s Land Acquisition (LAc) meetings.

One of the first major accomplishments of the WAP was a large contribution in funding for the acquisition of the Shepard (Glen Avon Farms) and Cioe properties in West Greenwich, now known jointly as the Tillinghast Pond Management Area. This project contained several physical and political components that made it one of the most significant land acquisition projects in recent Rhode Island history. Politically, the three-pronged partnership that developed (with the town of West Greenwich and The Nature Conservancy) allowed SWG funds to be effectively leveraged. The parcel was relatively large (2200 acres) but also was adjacent to existing preserved areas and therefore resulted in a continuous swath of protected land throughout western West Greenwich and Coventry. This part of Rhode Island remains fairly rural (it is the largest forested area between Boston and Washington D.C.) and includes additional acreage in the State of Connecticut. Even though species inventory was fragmentary, the property was suspected to contain viable populations of several SGCN. The property is large enough for wildlife populations to not be impacted from road and edge effects, and the management strategy that subsequently developed routed public access in a way that maintained an undisturbed core of habitat. A management plan was also developed to maintain a balance between public recreation, wildlife values, and natural resource use like tree harvesting and agriculture.

The loss and degradation of habitats from development were identified as major threats to Rhode Island's fish and wildlife (see Chapter 3). Results of the Geospatial Condition Analyses (Anderson et al. 2013) shed additional light on the extent of these threats in the Northeast. In general, high density development of natural habitats can change local hydrology, increase recreation pressure, introduce invasive species either by design or by accident, and bring significant disturbance to the area. Urbanization and forest fragmentation are inextricably linked to the effects of climate change, because the dispersal of forest plants and animals are disrupted by development and roads.

It is not surprising that the action “Land and Water Protection and Site Protection” was listed most often as a significant category of conservation actions. Even though the intent of this plan is to protect wildlife, it is obvious that areas of undeveloped landscapes are desirable for many reasons. All vegetated parcels have some value to wildlife and the WAP recognizes that conservation needs to be conducted at all spatial scales, from broad landscapes to the smallest backyard. Every municipality, land trust, and citizen has some ability to influence the fate of a habitat and something to contribute to the state’s wildlife conservation program.

Many wildlife species are sensitive to human presence and in a small and rapidly urbanizing state these animals are among the most vulnerable, and the most challenging to protect. In Rhode Island, most existing preserves are not large enough to support vulnerable species, due to pressures from public use of the preserves and indirect influences from surrounding land uses. Therefore, a strategy of increasing the size of protected preserves is appropriate. The RI DEM LAC has typically prioritized new acquisition projects by their adjacency to existing open space, or that are inholdings within protected lands. Historically, this focus has been done largely to preserve or expand traditional recreational activities, but the spatial requirements of some of Rhode Island’s SGCN has increased the urgency of preserving large parcels of contiguous habitat. If acquisitions are prioritized with wildlife conservation as a primary goal, then issues such as habitat management, additive mortality of animals, and connectivity can be more strategically addressed.

Protection of aquatic systems is a more challenging endeavor because identification of core areas is not a simple spatial exercise, and because undesirable inputs generated throughout an entire watershed, including contaminants and invasive species, can impact aquatic habitats at great distances from their sources. Freshwater aquatic systems also contain a valuable commodity (water) which may be used for power generation, drinking, and irrigation which puts additional stresses on these systems. Nonetheless, aquatic habitats suffer from similar processes that fragment terrestrial systems, and programs to restore stream connectivity and improve or maintain river and stream flow rates and water quality must be expanded. Fish such as River Herring, American Eel, and Brook Trout are useful indicators of the success of improvements in river connectivity and water quality. Such efforts will also provide ancillary benefit to other threatened SGCN, such as freshwater mussels which depend on fish populations to complete their life-cycles.

One example of an area-sensitive species is the Eastern Hognose Snake (*Heterodon platirhinos*). The population status of this snake in southern New England needs further study, but research has indicated that the home range of this species averages 125 acres (Lagory et al. 2009). As such, the Eastern Hognose is particularly vulnerable to impacts associated with fragmentation of its habitat, especially from roads and suburban developments that can interfere with daily and seasonal movements. The Eastern Hognose has also been the subject of unwarranted persecution due to its appearance and actions that are suggestive of rattlesnakes, and also widespread use of chemicals (herbicides, pesticides, and fertilizers) by homeowners that may reduce populations of toads, the primary food of the Eastern Hognose Snake. Klemens (1993) reports that the Eastern Hognose has been declining in southern New England since 1900, with historical data indicating that it formerly had a more extensive range and locally higher population densities. Therefore, concern about its future status is justified despite its occurrence in protected habitats that may be too small to support viable populations. Preservation of the Eastern Hognose Snake in Rhode Island will depend on protecting large tracts of suitable habitat along with mitigation of mortality through education.



Eastern Hognose Snake

Chris Raithe

Statewide Overarching Threats and Actions – Tier 1

Threat: Habitat loss from development (IUCN 1.0)

Action: Facilitate acquisition or easement of key parcels and coordinate acquisitions with other local, state and regional programs and partners that incorporate RI WAP priorities. Rank: 3

Performance Measures:

- *Number of new acquisitions or conservation easements of key habitat parcels by RI DEM or its partners.*
- *Number of unprotected parcels identified and mapped in focal area.*
- *Percent incorporated into existing digital data bases.*
- *Number of partners involved in acquisition and/or easements in focal areas.*
- *Number of key parcels added to partners plans as priority.*

Because most of Rhode Island’s future needs will rely on the amount of habitat remaining, fee acquisitions and conservation easements that protect land will be among the most important components of this WAP. 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.

Action: Develop and continue partnerships with public and private landowners and identify any other appropriate partners to protect and manage key habitats. Rank: 3

Performance Measures:

- *Number of partnerships developed.*

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 and near the preserve, or to provide connectivity between core areas. Such partners may include private landowners, state and federal regulatory agencies, 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: Identify appropriate partners and provide technical assistance about existing programs or new opportunities. Rank: 3

Performance Measures:

- *Number of new partners contacted and enrolled in conservation programs.*
- *Number of acres of key habitats conserved by partners.*

Action: Continue to support the RI WAP Community Liaison position and Community Companion Guide implementation in order to provide technical assistance about existing RI WAP data, programs or new opportunities. Rank: 3

Performance Measures:

- *Number of municipalities and partners contacted and provided RI WAP information, maps and tools for conservation.*
Number of acres of key habitats conserved by partners.

It is critical to develop outreach strategies and technical assistance programs that outline goals of each project and build relationships to the extent possible. Efforts will be prioritized to target focal areas and critical habitats identified in this WAP and the community liaison can provide technical assistance whenever possible.

There are a number of existing programs (e.g., within NRCS, USFWS, and other agencies) designed to promote opportunities for private landowners and other entities to enhance wildlife conservation and habitat management on their properties. Landowners 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 7a). 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.

In order to effectively conserve all SGCN, some wildlife preserves will need to be continually managed to reduce detrimental impacts associated with poor habitat quality, increased predation, nest parasitism by Brown-headed Cowbirds, contamination from outside sources, invasive species, human disturbance, and a changing climate.

Actions to Address Strategic Planning for Land Protection and Management in Rhode Island

Conservation Opportunity Areas Actions Identified for the 2015 WAP

In an effort to provide further guidance in implementing the multitude of conservation actions identified, an additional exercise was conducted during the development of this 2015 SWAP to attempt to focus actions on the ground. AFWA Best Practices (2012) recommend that SWAPS identify and spatially depict priority areas on the landscape that offer the best opportunities and potential for SGCN conservation, designating them as "Conservation Opportunity Areas" (COAs).

COAs should be considered as priority areas for conserving Rhode Island's SGCN and key habitats. COAs contain and highlight locations with significant existing or potential wildlife and habitat resources and areas where partners can contribute to plan, implement, and evaluate conservation actions.

Although conservation actions taken throughout the state can help fish and wildlife, focusing investments on priority landscapes can increase the likelihood of long-term success over larger areas, improve funding efficiency, and promote cooperative efforts across ownership boundaries. COAs are landscapes where broad fish and wildlife conservation goals can best be met. Working in these landscapes can increase effectiveness of conservation actions at larger scales than can individual projects scattered throughout the state.

Over time, voluntary conservation actions consistent with local priorities and existing plans will be carried out within COAs by a variety of partners (e.g., landowners, land managers, watershed councils,

land trusts, NGOs, municipalities, Soil and Water Conservation Districts, etc.). The impact of these conservation actions on SGCN and key habitats will be monitored. Through this process, additional information will be gained on the habitat characteristics of importance to SGCN.

It should be understood that while COAs have special importance in conserving Rhode Island's SGCN, not all listed species occur within this set of locations, and restricting conservation actions to these areas will not necessarily maintain viable populations or meet the objectives outlined in the 2015 RI WAP. It should also be noted that many restoration opportunities exist outside these COAs that can contribute significantly to conservation in RI, especially in towns or developed areas. However, designating COAs is an important step in defining priority focus areas for implementing conservation actions.

This COA mapping process began by incorporating existing spatial priorities developed from other regional, state and local conservation planning efforts or partners since the goals and fundamental assumptions are compatible with the WAP. Several RCN mapping projects previously mentioned through this document were included (e.g. the NE Terrestrial and Aquatic Habitat Maps, the Geospatial Condition Analysis, Resiliency, Connectivity Map, Permeable Landscapes). Additional local and statewide resources were also incorporated (e.g. RhodeMap, SLAMM, NHP, IBAs, TNC Important Coastal Habitat).

This COA map is intended for general planning purposes only. It should not be used for legal boundary definition, regulatory interpretation, or property conveyance purposes. The resources identified on this map are intended to capture habitats with high conservation value by identifying the largest intact and connected blocks of common habitats, as well as other unique places based on rare, resilient, or productive natural systems. This map provides a general guide for strategic investment in Rhode Island's natural areas and is not intended as a comprehensive inventory of all valuable natural habitats. This facilitates incorporation of the COAs into the Statewide Planning process and local land use Comprehensive Plans. Next steps should include developing customized municipal information, maps and plans at a finer scale through a cooperative local planning process to incorporate these WAP priorities into local land use decisions.

To provide consistency and compatibility of scale, and to create seamless planning products across partnership boundaries within states, the NETHCS and NEAHCS are utilized as recommended in the NE Lexicon (Crisfield and NEFWDTC 2013). These are cross-walked to the RIECC system as described in Chapter 2. Additional features mapped are listed below.

This COA map (Figure 4-10) depicts the focal area approach described earlier in this chapter. It incorporates the key regional connectivity and resiliency data from the Northeast RCN landscape level spatial mapping projects including the Geospatial Condition Analysis (Anderson et al. 2013), Designing Permeable Landscapes (UMASS in progress). It enhances The Nature Conservancy's NE Habitat Map data with state and local data to most accurately map these COAs for RI.

The COAs began with the large unfragmented forests, core areas buffered from development, and added to that other key habitats identified in the RI WAP, such as those with high biodiversity value and high vulnerability.

Methodology and Features Mapped in the COAs

The following features were mapped to create the RI WAP COAs:

Unfragmented Forest Areas (Figure 4-3)

- Core natural areas from Statewide Planning Process.
- Forest and brushland blocks 30 meters from development.
- Two size classes
- 250-500 acres
- >500 acres

Habitats with high habitat value and high vulnerability (Figure 4-4)

- WAP Key Habitats ranked highest for Biodiversity Value and Vulnerability

Other diverse or otherwise important habitats

- Areas with high ELU diversity. ‘better’ and ‘best’ categories (also used in Statewide Planning process and RhodeMap) (Figure 4-5)
- Element occurrence density map from RI DEM (Figure 4-6).

Marine and Estuarine Systems (Figure 4-7)

To highlight the importance of the marine and estuarine environments we show the RI state waters (3 miles from shore)

Important Coastal Habitat (Figure 4-8)

- The Nature Conservancy’s North Atlantic Coast (NAC) Ecoregional Priorities, based on size, condition and confirming species.
- Coastal Salt Ponds
- Salt marsh
- Rocky shore
- Beaches/dunes
- The Nature Conservancy identified important bird stopover sites (coastal shrub in Little Compton, Narragansett, and Block Island)
- Important Bird Areas (IBAs) from the National Audubon Society

Natural Corridors (Figure 4-9)

- Corridors included in the Statewide Planning (RhodeMap) process. These are paths that connect the core natural areas.
- River corridors and other pathways identified by The Nature Conservancy regional connectivity analysis.

Freshwater Restoration Opportunities (Figure 4-11)

- The Nature Conservancy and RI DEM identified the first barrier to fish migration (dams) from the marine environment.

This effort took an additional step to further determine those areas most important to SGCN and utilized the mapping partnership established for this effort. The Habitat and Taxa 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.

Some finer scale habitats were not able to be mapped, due to the insufficient level or accuracy of data. The Habitat Team, with significant assistance from URI, The Nature Conservancy and RI DEM GIS experts, conducted an additional analysis by mapping those key wildlife habitats that captured most SGCN and key habitats identified in the RI WAP with high biodiversity value and vulnerability. The team began with the key habitats that supported the highest number of SGCN, and assembled data and determined at what level they could be mapped. Whenever possible, qualifying parameters were identified that were important features to SGCN or that habitat. For example, not all forest areas were considered key habitat, instead only large patches (500 acres or more) were mapped.

These individual habitat/feature coverages listed above were then used to produce a composite map to identify conservation priority areas. Figure 4-10 is the resulting composite map that illustrates the intent and product of this exercise. It should be noted that any shaded area on this map has significant value to Rhode Island's SGCN as represented by even one key habitat. Areas that are not shaded offer additional conservation opportunities from several other aspects such as restoration.

Significant opportunities for improving water quality in impaired or impeded waters are important, especially in conjunction with river connectivity (Figure 4-12). Other key conservation opportunities exist in every town in open spaces for reconnecting communities with their natural environment. The Community Companion Guide to this WAP highlights many ways communities, even though they are outside of the larger landscape level COAs, offer excellent opportunities for conservation. Opportunities include developing backyard and community wildlife habitats, or developing wildlife friendly zoning, infrastructure, lawns that minimize chemicals and fertilizers and maximize native species, or offer buffers or refugia for migrating species. Conserving and managing for open space in any town is important and offers many benefits to its citizens, from clean air and water, to education and recreational opportunities, as well as benefits to wildlife.

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 COA approach to provide a framework for the dynamic process of developing accurate and current spatial information on Rhode Island's SGCN and key habitats. Dissemination of this information will then provide for the important step of its incorporation into land use decisions and planning efforts across the state. Conserving COAs will require the efforts of many conservation partners working together to incorporate it into their programs and plans.

COA Development and Use

This GIS mapping project undertaken by *Mapping and Planning Services* of Jamestown, RI, for Rhode Island’s Division of Planning, sought to form the foundation of the state’s conservation strategy. The project team, led by RI DEM included a team of resource professionals from the URI, The Nature Conservancy and others, has developed and refined a map of significant natural areas in Rhode Island. The resources identified on this map are intended to capture habitats with high conservation value by identifying the largest intact and connected blocks of common habitats, as well as other unique places based on rare, resilient, or productive natural systems. This map is intended as a general guide for strategic investment in Rhode Island’s natural areas. The components of this map were combined with GCN habitats identified as highly valuable and vulnerable through the WAP process to create a new map of Conservation Opportunity Areas.

The COA process should be considered preliminary and dynamic with much additional work needed to improve and advance this concept and map over the next decade. The regional COA process will be used as guidance for improvement and use, and state and local partners will also continue to be engaged in the continuing development and use of the RI WAP COAs. The development and maintenance of an effective data (digital and spatial) management system will be critical to this effort.

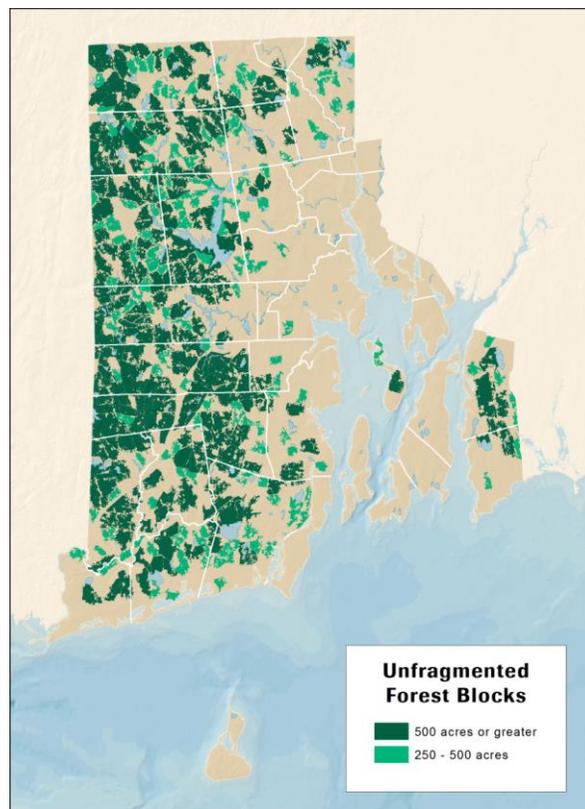


Figure 4-3. Unfragmented Forest Blocks

The heart of the map is the unfragmented forest blocks of 500 acres or greater (Figure 4.3). These blocks capture the best (largest and least fragmented) examples of common forest habitats as well as many rarer imbedded natural systems. Together with unfragmented forest blocks of between 250 and 500 acres, they constitute the ‘core natural areas’ of the state plan. Unfragmented forest blocks of between 250 and 500

acres may be important as connectors between the larger blocks or may be some of the largest and therefore most resilient natural sites in some towns, particularly in the more heavily developed coastal communities. These blocks are defined by their size and developed using the softwood, deciduous, and mixed forest classes from the RIGIS 2011 land use/land cover data that were not within 30 meters of developed land uses (residential, commercial, etc.) or roads.

The core natural areas described by the unfragmented forest sites provide a strong foundation to build a network of functioning and diverse natural systems, but there are many other important habitats that deserve special attention due to a number of factors. Some of these locations have been identified by the RI WAP as habitats with high ecological value and high vulnerability (Figure 4-4). Those sites with data sufficient for mapping are included on the map and include:

- Floodplain Forest
- Hemlock/Hardwood Forest
- Northern Hardwood Forest
- Pitch Pine Woodland/ Barrens
- Mud Flat
- Inland Sand Barrens
- Salt Marsh
- Wet Meadow
- Coastal Streams Freshwater Tidal Marsh
- Rocky Shore
- Sand Flat
- Sea Level Fens
- Brackish Sub-aquatic Beds
- Brackish Marsh
- Atlantic White Cedar Swamp

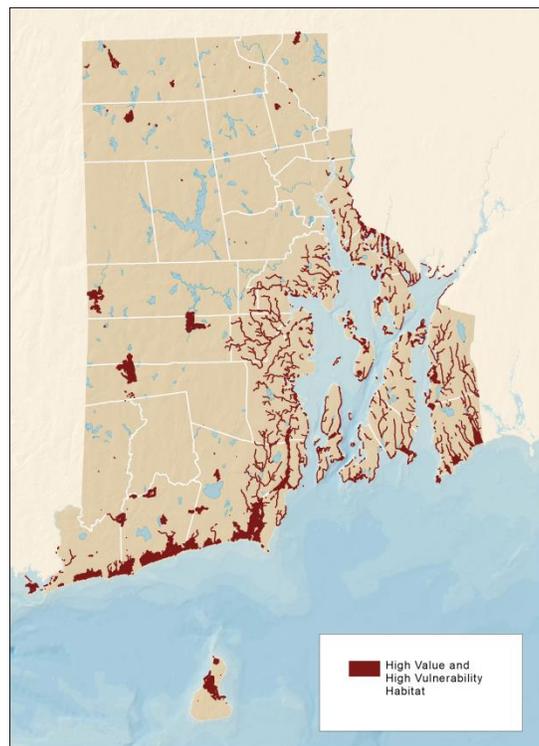


Figure 4-4. Habitats with High Ecological Value and High Vulnerability

Other diverse or otherwise important habitats were mapped as well. These include places with a high ELU diversity: places categorized as ‘better’ or ‘best’ in terms of ELU diversity capture areas with a diverse assemblage of landform, soil drainage class, and soil texture (Figure 4-5). This diverse structure

will remain relatively unchanged by shifting climate and provides an opportunity for diverse assemblages of plant communities and fauna to persist. These sites with diverse ELU types will also likely host a variety of microclimates that will provide opportunities for natural communities to shift and persevere in the face of changing temperature and precipitation patterns.

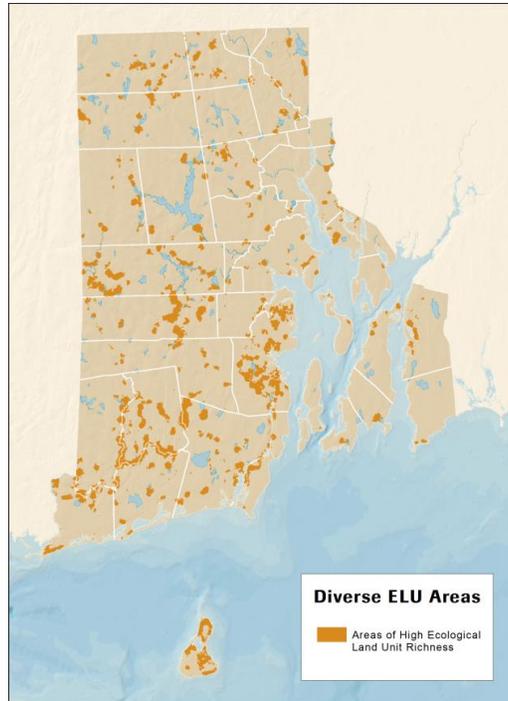


Figure 4-5. Ecological Land Unit Richness

The mapped important habitat areas also include the latest map of Rhode Island’s Natural Heritage Areas, meant to capture the estimated habitat and range of rare species and noteworthy natural communities (Figure 4-6). These places may be the best opportunities for conservation in some communities or they may offer the best locations to maintain natural corridors between the identified natural core areas.

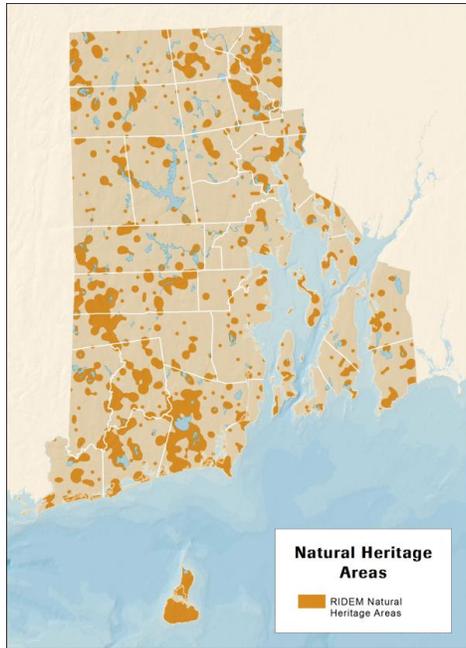


Figure 4-6. Natural Heritage Areas

Rhode Island's marine and estuarine environments have been recognized as globally significant by The Nature Conservancy and others (Figure 4-7). Any plan highlighting the natural resources in need of conservation in Rhode Island should capture these important and productive habitats. To that end, all of the state waters (3 miles from shore) in Rhode Island and Block Island Sounds have been identified as important marine and estuarine systems.

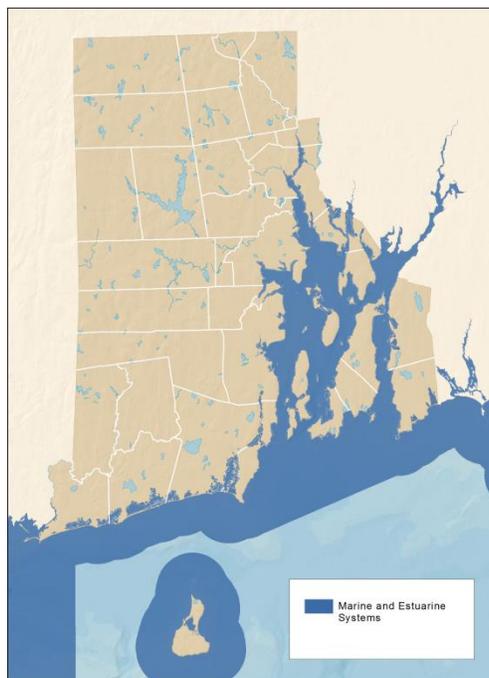


Figure 4-7. Marine and Estuarine Systems

Important coastal habitats have also been mapped to help highlight important natural places on Rhode Island's shore (Figure 4-8). These include: the important bird stopover sites made up of coastal shrubland systems on the north end of Block Island and the western shore of Little Compton; conservation targets identified by The Nature Conservancy's North Atlantic Coast Ecoregional Assessment, including the best regional examples of salt marsh, rocky shore, beaches, dunes, and coastal lagoons (salt ponds); and coastal wetlands identified as IBAs by The Audubon Society.

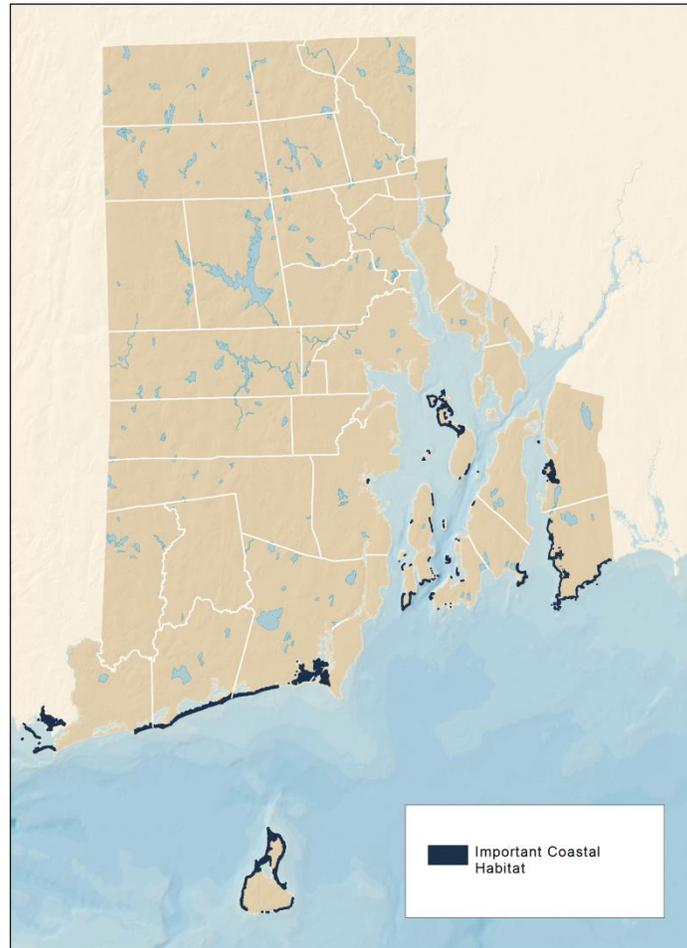


Figure 4-8. Important Coastal Habitat

Connectivity is an important quality of a healthy functioning landscape. Corridors connecting natural core areas and smaller habitats on the landscape allow for the movement of migrating species and the movement of species within their ranges (Figure 4.9). They also allow for the movement of habitat types, populations, and gene flow among populations and locations as species shift in response to climate change. By evaluating the locations of the core natural areas and other important natural systems identified above in relation to one another, a network of major and minor corridors have been mapped. These were informed by The Nature Conservancy's regional connectivity analysis done as part the Northeast Terrestrial Resilience project as well as the use of the natural corridors provided by existing river systems.

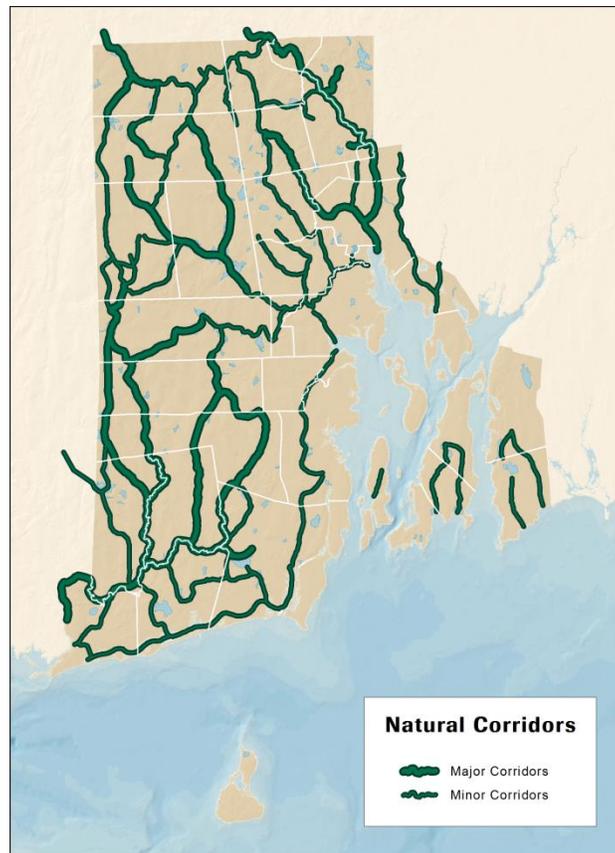


Figure 4-9. Natural Corridors

An important strategy employed by RI DEM, The Nature Conservancy, and other conservation organizations is the prioritization of conservation in areas adjacent to existing conserved areas. This encourages the conservation of larger resilient systems and helps to build on past investments in natural infrastructure. To help identify these important locations and see the conservation priorities in this context, a map showing a simplified version of the COAs and their relation to existing conservation land was created (see Figure 4-10). The simplified legend highlights places with overlapping conservation targets as places with higher habitat value. By differentiating the protected versus not protected places, those areas that both contain COAs and are adjacent to existing conservation land can be identified.

Conservation opportunities are not only land conservation projects. They also include land management strategies and a variety of natural system restoration opportunities. In freshwater river systems maximum habitat availability and function are provided when fish are able to move unimpeded from the headwater streams to the estuaries and ultimately to the marine environments. The many obsolete dams found on Rhode Island's river systems create barriers to fish migration and provide opportunities to enhance river connectivity with their removal. The Nature Conservancy and RI DEM have identified these freshwater restoration opportunities by mapping the first impediments on each reach of river that are encountered when traveling upstream from the ocean (see Figure 4-11). Connected waterways can be expanded toward the headwaters as these barriers are removed.

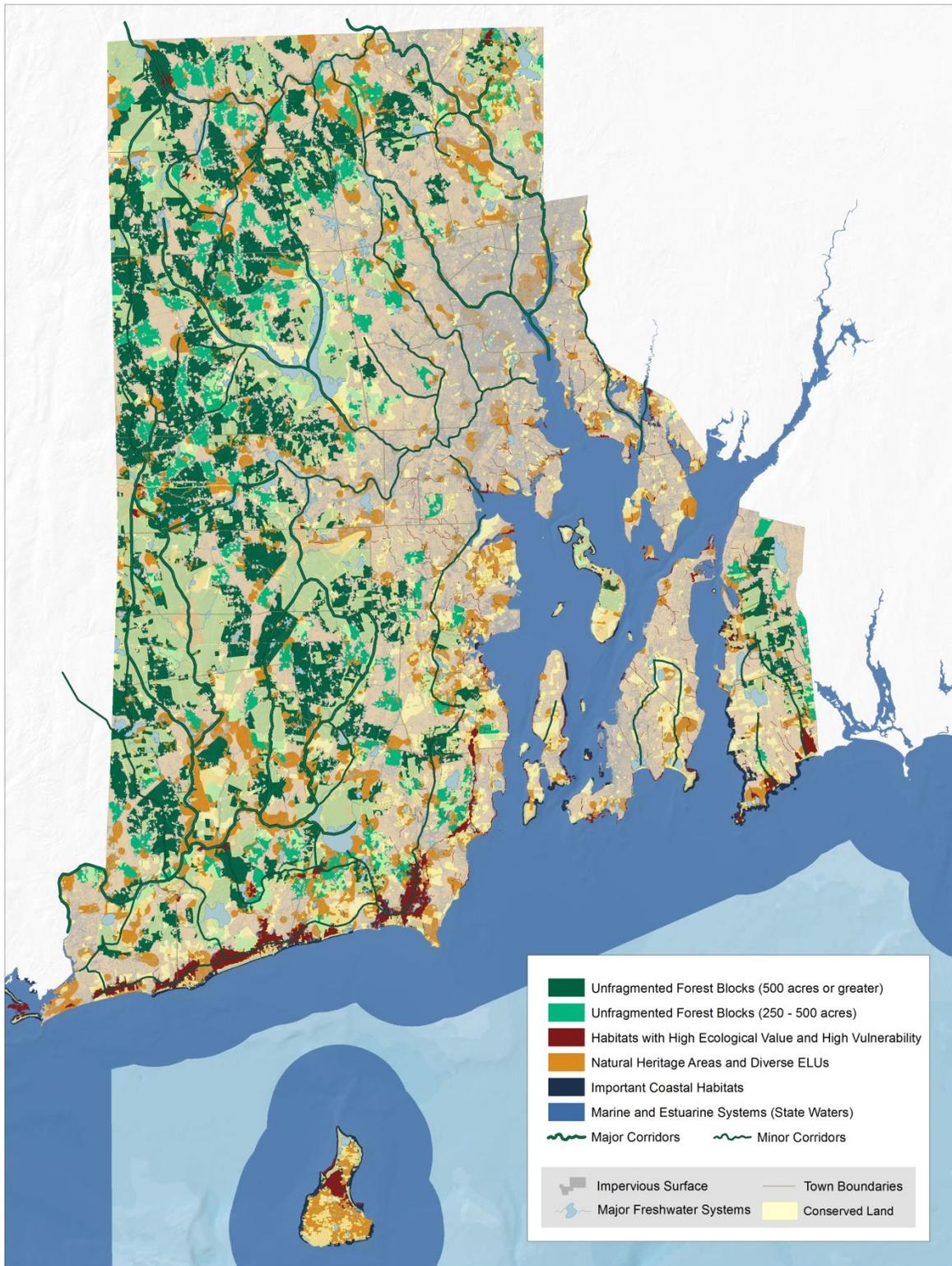


Figure 4-10. Conservation Opportunity Areas



Figure 4-11 Freshwater Restoration Opportunities

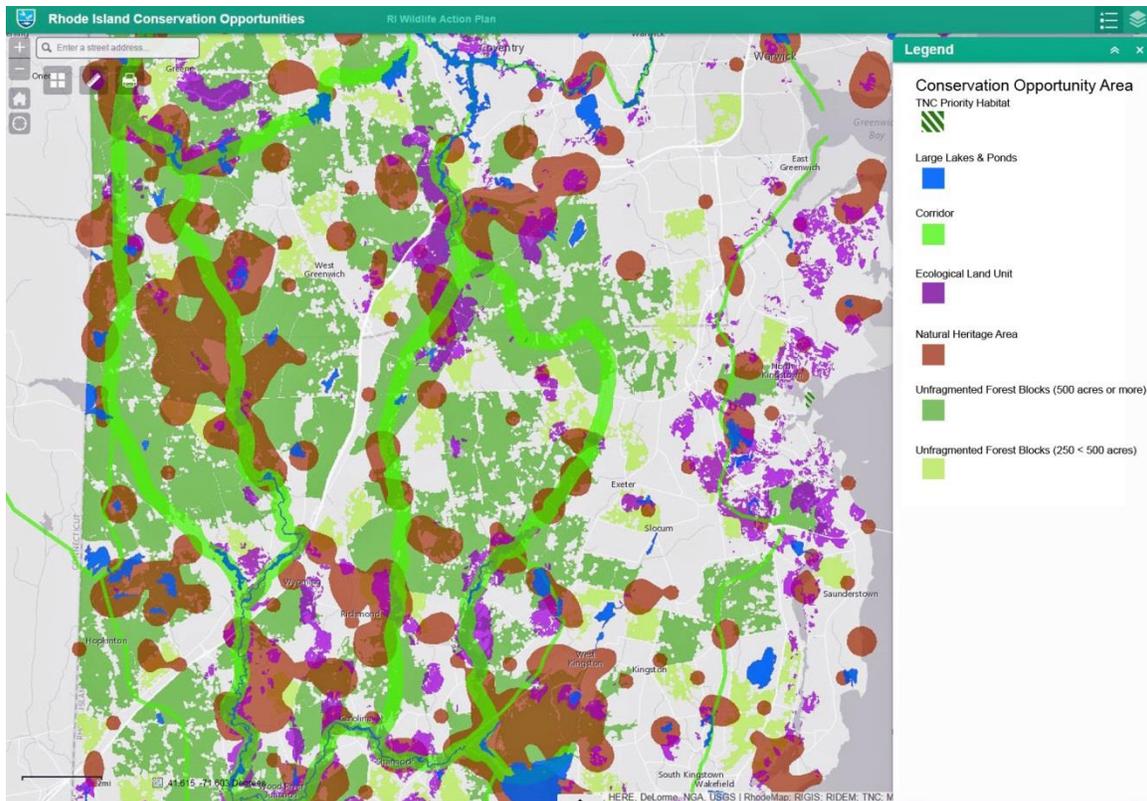


Figure 4-12. RI DEM Interactive Conservation Opportunity Areas Map
<http://ridemgis.maps.arcgis.com/apps/webappviewer/index.html?id=63f3ef956b3e4711ab3f8dd8349f346e>

Threat: Need for Strategic Wildlife and Habitat Planning (NE Lexicon 12.2.1-3)

Actions: Integrate key federal, regional, state, and local plans into the RI WAP. Rank: 3

Performance Measures:

- *Number partners plans that incorporate the RI WAP priorities.*

Appendices 1 and 5 list the many plans and programs that the RI WAP has incorporated and considered. This provides support for common goals and priorities and maximizes coordination between partners. This includes the many E/T species recovery or management plans (e.g., PIF, BCR, NEPARC, etc.) and actions that have already been identified by these programs that do not need to be restated in this plan.

Actions: Encourage other organizations to incorporate the WAP in their plans and revisions, specifically partner plans and local comprehensive plans. Rank: 3

Performance Measures:

- *Number partners plans that incorporate the RI WAP priorities.*

Partners have the opportunity to include and adopt the RI WAP priorities and actions at the federal, regional, state and local scales into their plans. Rhode Map provides the means for towns to incorporate the Green Assets and COA concept into their local comprehensive plans. Federal partners can incorporate

the RI WAP priorities into their plans and revisions. An excellent example is the NRCS incorporation of SWAP priorities into their programs.

Next steps should include providing customized technical assistance information, maps and plans at the municipal scale through a coordinated state/ local planning process to incorporate these WAP priorities into local land use decisions. The RI WAP Community Liaison position will be critical to this effort and will provide towns and local land use decision-makers technical assistance and coordination to apply the WAP principals and updated information to their plans. The Community Companion Guide can be updated to include additional current information and guidance for local planning and land protection efforts.

Actions: Develop focal area and focal species approaches in Rhode Island. Rank: 2

Performance Measures:

- *Percent of landowners contacted within focal areas.*
- *Number of state parks contacted in focal areas; Number of parks implementing recommendations.*

The identification of focal areas is vital to the conservation of many SGCN. And the only assumption needed is that there are a number of sensitive species that need large tracts of habitat to conserve viable populations. The 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 all important areas; 2) All areas are not equally important to wildlife conservation; and, 3) Unless there is a strong component of the WAP process to strategically plan for large *de facto* wildlife reserves and manage them from degradation, then all area-sensitive species will disappear from the Rhode Island landscape. Focal areas should be large and shaped roughly like circles or squares (to maximize roadless 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 RI WAP 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 are less likely to become endangered here.

The focal area approach originally described in the 2005 CWCS is now referred to by AFWA and Federal Aid SWAP guidance as the identification of COAs. This concept identifies areas that are considered priorities for wildlife conservation at the landscape scale. The biological underpinnings of this approach are similar to focal areas, but the COA approach recognizes that wildlife conservation actions cannot occur in areas unless there are resources and support to accomplish them. It will be important to identify the focal areas where it is still feasible to provide the needed protection for sensitive species and then develop the actions to support their conservation.

Effective conservation of SGCN will be accomplished by preserving the largest tracts possible of all key habitats. Some species will not be preserved because we have already lost the opportunity to provide large enough areas (see Figure 4-4). There are no clear answers to how much area and how many individuals were needed to ensure the long-term persistence of a population. Measuring population viability for a species is possible but it is very difficult because one needs to know, at least, the spatial requirements and the demography (population structure) of the species in question. Therefore, population models are

unavailable for the vast majority of species and inventory information, even to the presence-absence level, can be unreliable. All is not lost, however, because vegetation communities and their spatial attributes can help predict areas that can contain viable animal populations.

One important component of the COA approach will be restoration, and restoration projects will be important components of many focal areas. Restoration projects are also politically popular and often fundable. Focal areas need not be officially designated or linked to any regulations or mandate. They could exist for planning purposes only in order to allow effective prioritization of conservation activities, acquisitions, etc. Figure 4-10 depicts the landscape level planning concept that includes both coarse and fine filter conservation by identifying focal/core areas, corridors and sites for conservation and management.

Action: Identify all key habitats, SGCN locations, and focal areas and incorporate into updates of the COA map. Rank: 3

Performance Measures:

- *Number of new sites identified.*
- *Existing data qualified or updated with new information.*
- *Number of new conservation action/research projects identified and completed to address threats.*
- *Number of conservation actions updated to include new habitats.*
- *Updated COA map*

Actions: Identify focal areas or defensible populations and issues specific to all parcels in focal areas. Rank: 3

Performance Measures:

- *Number of focal areas or defensible populations identified.*
- *Percent incorporated into existing digital data bases.*
- *Number of priority issues identified.*
- *Number of new conservation actions/research projects developed to address issues.*

Identification of a viable population for any given species is difficult as adequate survey data and population models are unavailable for the majority of species. However, there are spatial attributes that are useful in identifying focal areas, and metrics such as habitat diversity can also be incorporated into the selection process. First, focal areas must be large. When considering forest habitats for example, research has shown that many forest interior birds require several thousand acres of unfragmented habitat, and planning for focal areas of this size in Rhode Island is a difficult process. The 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 roadless cores as large as possible and should ideally, but not necessarily, have a significant proportion of protected acreage. A model focal area will have a core of protected land surrounded by 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 minimized.

Action: Identify and pursue the protection and conservation of unprotected parcels in focal areas through acquisition and other protection tools and methods. Rank: 3

Performance Measures:

- *Number of new acquisitions of or easements on key parcels in focal areas.*
- *Number of additional acres protected.*
- *Number local conservation plans that incorporate the WAP priority species, habitats and COAs*

One level of action in a focal area approach will be to identify and prioritize the protection of unprotected parcels of land within critical areas.

Next steps should include developing customized municipal information, maps and plans at a finer scale through a cooperative local planning process to incorporate these WAP priorities into local land use decisions. The RI WAP Community Liaison position will be critical to this effort.

Actions to Address Data Collection, Management and Dissemination

The 2005 plan identified the need for additional GIS data to help with the planning process. A key action was to “digitize all state parcel data in digital form and create an overlay of protected lands and water”. Although this work was not directly funded by SWG, there now exist digital data layers of protected lands and this file is routinely updated by RI DEM as parcel status changes. In addition, the RCN grant program has funded the development of terrestrial and freshwater habitat classifications and GIS data layers of Northeast habitat types for use by the states. The federal guidance for the SWAP required plans to describe locations and relative condition of key habitats and community types for priority species and develop plans for monitoring priority habitats and the effectiveness of conservation actions. The 2005 CWCS habitat classification was based on the land-use covers in the RIGIS, which were Anderson level III for land cover-types and Cowardin et al. for wetlands. This classification and the RIGIS spatial data were not adequate to describe terrestrial cover types, which is necessary in many cases to depict wildlife habitats.

For this reason, RI DEM partnered with the RI DOT to obtain statewide coverage of new 6” pixel 4-band ortho-photography. The analysis of ortho-photo imagery data was supplemented with LIDAR canopy and mid-level return data collected by USGS through its Coastal LIDAR initiative. The second phase of this project was to contract for photo interpretation to delineate vegetation types according to the RIECC, a process that is ongoing. Therefore, GIS resources now exist to facilitate planning and habitat modeling at multiple spatial scales and has been used throughout the WAP development process and for the updating of WAP maps.

The 2005 CWCS identified several data collection and sharing needs that involved the transfer and maintenance of hard-copy files into digital formats and a system to manage and update spatial data and SGCN life-history information. A priority action was the effective management and sharing of Natural Heritage and other key wildlife data. Progress has been made on this front but much more work remains. RI DEM, the RINHS, The Nature Conservancy and URI just recently signed an MOU that maps a path forward to update the files and establish a more robust process of data maintenance and dissemination.

The Inland Fishes of Rhode Island (Libby 2013) addresses a key data gap by providing the most current information on the abundance and distribution of fishes in the state. This exemplary book fills an education and data gap by summarizing decades of scientific sampling efforts of RI DEM staff.

Threat: Need for Wildlife and Habitat Data Collection, specifically: Lack of monitoring and landscape-level monitoring strategy to support planning and assessment (NE Lexicon 12.1.1 and 12.1.2)- Inventory, Research, Monitoring Needs

Action: Conduct routine assessment/monitoring of SGCN and key habitats. Rank: 3.

Performance Measures:

- *Number of remote sensing data obtained.*
- *Percent incorporated into existing data bases.*
- *Number of measures developed; percent incorporated into existing data bases.*

The WAP recognizes that assessing and monitoring of wildlife populations and their habitats produce performance measures upon which to evaluate the effectiveness of the process. However, it is not possible to conduct annual inventories for most SGCN. 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. Consequently, there is a need to develop an effective monitoring framework for a wide array of SGCN and their habitats and to assess and monitor the status of these species and habitats in the most effective and efficient way.

The immediate task for the WAP should be to determine metrics that can be measured and which are also important (i.e., have value in predicting the quality of wildlife habitat). A component of the WAP is therefore to investigate whether important monitoring data for a wide variety of species can be obtained efficiently and cost-effectively. An important first step is gathering all of the identified information into a centralized database so there can be consistency and accuracy in the analysis. 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 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 WAP 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 SGCN and key habitats, as well as monitoring their spatial and temporal effectiveness.

Action: Assess threats to SGCN and key habitats. Rank: 3

Performance Measures:

- *Number of new threats identified.*
- *Existing threats qualified or updated with new information.*
- *Number of new conservation action/research projects identified and completed to address threats.*
- *Number of new sites identified.*
- *Number of conservation actions updated to include new habitats.*

The 2005 CWCS indicated that habitat fragmentation and loss were the greatest threats to Rhode Island's biota and that existing conservation areas were not large enough to preserve all area sensitive species. Therefore, the actions above were put in place to *assess threats to species and habitats*. Because the goal of protecting the full complement of biotic diversity can seem overwhelming, selecting certain species or aggregations to use as "umbrellas" to stimulate conservation action, as well as a focal areas approach, were introduced in the 2005 plan. The use of indicator species to focus or evaluate conservation actions has been discussed repeatedly in the literature (e.g., Lovejoy and Oren 1981, Landres et al. 1988, Lambeck 1997). These concepts have been (and remain) somewhat controversial, but the 2015 plan will continue to advocate for their utility. Although these concepts were not put into formal practice after the 2005 plan they have been repeatedly invoked during RI DEM discussions about acquisition and management. The 2015 plan will continue to support the use of these strategies in conservation planning. Models and strategies of this sort are not intended to replace reality; they are intended to replace information gaps.

The threats to plants are similar to those affecting animals, especially in community types that have limited distributions in the state, such as bogs and other small wetlands, pitch pine barrens, and tidal marshes. Fragmentation of forest habitats has only recently emerged as an issue affecting plants because many species thought to be capable of surviving in isolated fragments eventually succumb to these impacts (Flinn and Vellend 2005). Herbaceous understory species represent the majority of plant diversity in forests. In Rhode Island, that diversity is slowly being diminished by the gradual loss of species, a phenomenon that has been well documented by more than 30 years of monitoring through the combined efforts of TNC, RINHP, RINHS, and many individual collaborators and surveyors affiliated with NEPCoP.

Because the future of Rhode Island's wildlife will rely on the amount of habitat remaining, fee acquisition and easements that protect land will continue to be among the most important components of the WAP. Acquisition, in conjunction with effective preserve design and focal area approaches, have the greatest potential to protect the most species for the longest time. No other suite of strategies can mitigate for a lack of habitat, so a suite of land protection strategies is key.

Specific Actions to Address Lack of Information:

- Data collection and analysis-Assemble SGCN life history information into digital form. **Rank: 3**
- Assemble all parcel data for state in digital form. **Rank: 3**
- Determine lethal and non-lethal effects of chemicals. **Rank: 2**
- Determine variables suitable for measuring environmental/patch quality. **Rank: 3**
- Assemble all known SGCN distribution/abundance information into digital form. **Rank: 3**
- Develop appropriate dissemination methods to provide and update data for municipalities and other land use decision-makers. **Rank: 3**
- Develop algorithm to measure fragmentation. **Rank: 3**
- Geo-reference existing taxonomic data sets. **Rank: 2**
- Obtain remote sensing data at periodic intervals. **Rank: 3**
- On-going assessment of threats to SGCN and key habitats. **Rank: 2**

Monitoring

As with this 2015 revision, the 2005 CWCS included performance measures for each action identified. An initial effort of the action determination for this revision involved determining the status of the 2005

actions. The RI WAP teams/experts/staff were asked to list each action as percent completion and whether to carry forward as a priority action. These were then carried forward or deleted as a result of this process, and completion status was recorded as part of the database for tracking past and present actions. Chapter 5 describes the WAP approach to monitoring in more detail.

Threat: Lack of strategic data collection of priority research, inventory and monitoring needs of SGCN and key habitats.

The close proximity of many northeastern states has engendered a long history of cooperative and/or complementary management approaches. Within the Northeast Association of Fish and Wildlife Agencies, a long history exists of a strong technical committee structure. Technical committees are species or habitat-focused groups that exchange ideas and develop common approaches to wildlife issues. Typically, these actions are implemented by individual states using their own funds; however in some cases additional funding has been made available through the Northeast Directors.

The Regional Conservation Needs (RCN) Program formalizes a cooperative approach to address SGCN needs across multiple states. The purpose of the RCN program is to develop, coordinate, and implement conservation actions that are regional/sub-regional in scope, and build upon the many regional initiatives that already exist. The RCN program utilizes a funding mechanism that is equitable to all Northeast states and the District of Columbia, creating a base of funding for regional projects. Since 2007, thirty-seven different projects have been selected. The resulting reports and products can be found at RCNgrants.org.

Action: Develop and implement conservation actions for issues, threats, and opportunities most effectively addressed at a multiple state scale, with the input and involvement of multiple parties involved in the creation and implementation of the State Wildlife Action Plans. Rank 3

Performance Measures:

- *The number of conservation action/research projects selected and completed.*
- *The number of articles, publications, and technical reports developed each year as a result of funded projects.*

Action: Develop process to facilitate research, inventory, and monitoring of priority SGCN and key habitats. Rank: 2

Many critical research and inventory needs were identified in the 2005 CWCS and are identified in the 2015 WAP revision, but these projects will be beyond the resources of the agencies and capacity of existing staff. An effective Request for Proposals (RFP) process should be developed, including scientific/peer review for inventory, research, and monitoring conducted with SWG funds. This will encourage more partner collaboration in the implementation of the WAP and the development of partnerships at the local, state, regional, and national levels. At the regional and state level, an effective, coordinated data collection and management system is needed, especially for RCN priorities and RSGCN species.

Actions: Compile, publish, and disseminate data and results. Rank: 3

Performance Measures:

- *The number of articles, publications and outreach materials developed each year to reach targeted audiences identified.*

The results of surveys, research, and conservation planning conducted by RI DEM DFW and their partners should be published in peer-review journals and other appropriate media, including symposia and annual meetings of professional organizations. 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 WAP.

Specific Actions to address the Lack of Planning:

Resource and habitat protection: Identify key unprotected parcels in focal areas. **Rank: 3**

Planning: Coordinate focal area projects with other state and regional programs. **Rank: 3**

- **Planning:** Develop process to facilitate research priorities. **Rank: 3**
- **Planning:** Identify focal areas or defensible populations for focal species/area approach to conservation. **Rank: 3**
- **Planning:** Identify other critical habitat. **Rank: 2**
- **Planning:** Create process to include conservation expertise in planning stage of all development projects. **Rank: 3**
- **Data collection and analysis:** Adopt standardized data collection and management systems across state boundaries that allow data sharing and analysis. One example is The Avian Knowledge Network (AKN) endorsed by the North American Bird Conservation Initiative (NABCI) as one of the best avian data management practices outlined in NABCI's Data Management Best Practices and Standards for Biodiversity Data Applicable to Bird Monitoring Data. **Rank: 2**
- **Data collection and analysis:** Initiate monitoring of primary resources. **Rank: 3**

Threat: Lack of Resources and Capacity; Resource Management Needs (NE Lexicon 15) specifically, the lack of capacity and advocacy for Comprehensive Wildlife Conservation

Action: Increase the capacity and ability of RI DEM DFW and its partners to implement the WAP.

Rank: 3

Performance Measures:

- *Percent increase in funding for Wildlife Diversity Conservation.*
- *Number of secure funding sources established.*
- *The additional staff and resources to administer, implement, and coordinate the WAP with partners at the local, state, regional and national levels.*

The number of priority needs and actions identified during this process will require significant 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 WAP. Specific actions that will better enable RI DEM DFW to implement this WAP:

- **Increase advocacy for wildlife diversity conservation.**
- **Increase agency resources and capacity for wildlife diversity conservation.**
- **Establish dedicated state funding (match for federal SWG dollars) for work on these SGCN 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 dramatically decreased. 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 WAP target SGCN.

Actions to Address the Need for Education and Outreach

The 2005 plan identified several tasks to address the lack of internal capacity/advocacy and need for additional conservation planning capabilities and coordination. This called for an increase in communication and outreach to potential conservation partners, including private landowners, state and federal regulatory agencies, land trusts, other NGOs and municipalities.

The 2005 CWCS and this revision process identified one of the most important aspects of plan implementation as its delivery mechanism. Rather than develop a plan that sat on a shelf, it was recognized that personal relationships between RI DEM staff and prospective partners would be critical to successful implementation. Although part of this urgency was promoted by the loss of RI DEM staff, it was also obvious that partnerships would be necessary to leverage resources and skills to perform effective wildlife conservation. In 2013, an outreach liaison was hired as a contract position shared by the RINHS and RI DEM. The liaison was tasked with helping to develop the plan and solicit input from key users and land use decision makers, and eventually to bridge the gap between RI DEM and prospective partners and land use decision makers.

The liaison's role is to communicate and integrate the RI WAP into existing programs designed to promote opportunities for municipalities and landowners to enhance wildlife conservation and habitat management in their community. These efforts can be coordinated and new opportunities created by applying existing conservation funding and programs in or near identified focal areas or critical habitats for SGCN identified in the WAP.

The 2005 plan identified several additional areas where education and awareness could help to foster conservation awareness and stewardship to alleviate pressure on wildlife populations. The 2005 CWCS actions called for education/outreach programs, including workshops and other technical support. Although there was little progress on this action until recently, the liaison position was a start. RI DEM DFW has also recently hired a volunteer coordinator to develop more wide-ranging partnerships with the public and an environmental wildlife educator position is also being conceptualized.

Threat: Lack of awareness about the status and needs of SGCN and key habitats.

Actions: Organize education/outreach programs Rank: 3

Performance Measures:

- *Number of workshops.*
- *Number of parties attending workshops or contacted.*

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 SGCN and key habitats.

Specific Actions Identified to Address Lack of Awareness:

- Organize workshops and technical training for staff in GIS, statistics, etc. promote existing programs with private landowners. **Rank: 3**
- Provide technical assistance in conservation planning where required. **Rank: 3**
- Develop new partnerships with private landowners. **Rank: 3**
- Identify appropriate partners for coordinated conservation planning. **Rank: 3**
- Compile and publish research and planning results. **Rank: 3**
- Continue liaison position to outreach to towns and partners. **Rank: 3**
- Outreach to appropriate state parks in focal area. **Rank: 3**
- Initiate contact with private landowners identified within focal areas. **Rank: 3**

Actions to Address Transportation Impacts and Mitigate Road Effects on SGCN and Key Habitats

Whether causing direct mortality or acting as impassable barriers (see Trombulak and Frissell 2000), roads are constraining the extent and mobility of wildlife populations. Worse, road effects extend far from the roadbed. In a review of the effects of roads on wildlife, Forman and Deblinger (2000) concluded that the effects of roads could extend 1000 m into adjacent habitats and stated that, “busy roads and nature reserves should be well separated.” That distance is probably greater for some species (Reh and Seitz 1990). If one wanted to identify an open space area of 1000 acres that was also free of road effects, one could apply a buffer of 1000 m on both sides of all roads that carry traffic. If the road and its surrounding buffer is the area where wildlife habitat has been compromised, then the areas outside of this zone are critical for wildlife persistence. Unfortunately, this exercise would reveal that few roadless areas greater than 1000 acres remain in Rhode Island. That reality heightens the urgency to form and protect such areas. Forman and Deblinger (2000) described the zone of road effects as asymmetric, depending on the effect and the condition and type of adjacent habitat.

Roadways serve as conduits for the introduction of certain contaminants, invasive species, and other secondary effects of human infrastructure. For example, deicing salts from road run-off can affect amphibian larvae and eggs (Karraker 2008). Outdoor lighting attracts and leads to the demise of night-flying moths, and traffic noise can also make wildlife shy away from the road, leading to degraded or unoccupied habitat. Some of these affects cannot be removed without risking public safety, but in some cases minor tweaks can provide partial mitigation. Roads are imposing barriers to species movement, but connections across or underneath roads can be facilitated to connect habitat patches and thereby extend the effective size of a preserve. RI DEM should develop a partnership with RI DOT to integrate the WAP

into the public infrastructure planning process. Models for this sort of collaboration now exist in many states and there are opportunities to reduce the pressure on wildlife populations from modifications to roads. Among them is the replacement of stream culverts with more species-friendly designs or, at the very least, creating a priority list of road-crossing areas that RI DOT could reference if opportunities were to become available. Because roads serve as the conduits for invasive species dispersal, strategic road placing or closing, especially those within state lands managed for wildlife should be considered.

Threat: Transportation impacts on SGCN and key habitats.

Action: Establish partnership and coordination with state and local DOT to integrate the WAP into the public infrastructure planning process. Rank: 3

Performance Measures:

- *Established partnership/coordination to limit habitat fragmentation from road construction.*
- *Number of road /infrastructure plans integrating RI WAP priorities.*
- *Number of mitigation projects established.*

Action: Assess means to mitigate road effects with state and local DOT. Rank: 3

Performance Measures:

- *Number of mitigation projects established.*
- *Number of sites identified and mapped and mapped.*
- *Percent incorporated into existing digital data bases completion of needed research by RI DEM or partners.*
- *Number of research recommendations incorporated into conservation actions.*

Action: Identify areas of significant road effects in focal areas with local DOT Rank: 3

Performance Measures:

- *Number of partners involved in on-going discussions to limit habitat fragmentation from road construction.*
- *Number of road plans impacted.*

Actions to Address Pollution

Contamination from unwanted inputs was recognized an important threat to wildlife populations in the 13 Northeast CWCSs in 2005 and is so again in the RI WAP for 2015. There are so many types and sources of contaminants that only a brief overview is attempted here. In the marine environment, one of the major threats to birds, fish, marine mammals and benthic invertebrates is oil spills. Prevention is obviously much more desirable than reaction, but if accidents occur, it is important to have a rigorous capacity for post-spill assessment and mitigation. Surveys of commercially valuable species or other organisms particularly sensitive to contamination are critical to set a baseline with which to compare post-spill conditions. Lessons from the last spill highlight the importance of incorporating the RI WAP information into the state Response Plan, and that action will be ongoing.

In terrestrial and freshwater environments, contaminants can reach wildlife through a variety of pathways, including roadways, agriculture, and even private homeowners. Developing a better working relationship

with RI DOT is very important to eventually develop strategies to ameliorate the effects of roads, of which contaminants such as road deicing salt is only one issue. Golf courses, because they are large, road-less and primarily vegetated habitats, can also contribute to the integrity of adjacent preserves. For example, some modifications in the spraying regime for golf courses could potentially add to the viability of the Carolina Management Area, and conversations should begin.

Threat: Pollution impacts on SGCN and key habitats.

A recent development to better coordinate pollution abatement efforts has been the development of the Watershed Counts. This is a collaborative initiative of 60 partner organizations working together to evaluate the conditions and trends of the land and waters of the Narragansett Bay Region. The group originated in 2010 as the Narragansett Bay Region Indicator Development Workgroup to synthesize collected information and report regularly to the legislature on watershed conditions, the status of management efforts, and priorities for the future. The workgroup began as a collaborative among [URI's Coastal Institute](#), the [Narragansett Bay Estuary Program](#), and the [RI Environmental Monitoring Collaborative of the Bays, Rivers, & Watersheds Coordination Team](#). Through a series of workshops, additional agencies, NGOs and university research entities contributed to the gathering and analysis of data and trends. Watershed Counts quickly became a large resource with both deep and broad perspectives on Rhode Island's environment.

The work of Watershed Counts has focused on nine general indicators of environmental quality: beach closures, climate change, freshwater quality, freshwater flow, impervious cover, invasive species, marine water quality, open space, and resource economics.

For each indicator the group has defined specific metrics and annually reports on the indicators to the legislature on Earth Day, after which Watershed Counts convenes project partners to review the project, identify accomplishments and areas for improvement, and discuss work for the upcoming year.

Watershed Count reports have detailed several positive changes that resulted from taxpayer investments in improved wastewater treatment to tackle long-standing pollution problems in the upper Bay. With legislative support, the state has made a strong commitment to reduce the loadings of nutrient pollution (specifically nitrogen) into the upper Bay through upgrades to wastewater treatment facilities. In 2011, year of the first Watershed Counts report, eight of the ten targeted facilities had completed upgrades, and the others were moving toward that goal. In 2014, RI DEM estimated a 74% reduction in nitrogen pollutant loads from these facilities when compared to 2005 levels. It was pointed out that these reductions were needed to alleviate hypoxic conditions (i.e., periods when the water lacks sufficient oxygen to support healthy marine ecosystems).

An additional accomplishment has been completion of the Narragansett Bay Commission (NBC) combined sewer overflow tunnel project that went on-line in 2008 as Part I of a multi-part strategy to abate the release of untreated sewage into the Bay. The tunnel is capable of storing 65 million gallons of untreated wastewater and stormwater which has contributed to a 37% reduction in fecal coliform levels and improved conditions in the upper Bay for recreation and allowed more days of open shell-fishing in some sections.

One indicator reported on by Watershed Counts is the number of beach closures occurring in the state each year caused by high concentrations of fecal bacteria, which in the years 2005 to 2009 were highly correlated with rainfall and the consequent release of untreated sewage. Since 2009, because communities in Rhode Island and Massachusetts have taken steps to reduce the flow of bacteria

especially during high rainfall events, there have been fewer beach closures even with higher amounts of seasonal rainfall.

The 2014 Watershed Counts report also noted that while Rhode Island state agencies conduct marine beach monitoring with funds provided by the US EPA, no federal funding is allocated for freshwater beach monitoring. Instead, beach managers, local communities and other non-profit organizations collect samples and provide funding for analyses. Freshwater quality, human health, and the associated plants and animals would benefit from increased attention and funding (Watershed Counts 2014).

In November 2014, Rhode Island voters approved the Clean Water, Open Space, and Healthy Communities bond referendum which will provide \$20 million of additional funding for the State Clean Water Revolving Fund which provides low interest loans for clean water improvements. Potential projects include infrastructure improvements ranging from wastewater treatment upgrades and storm water quality improvements to combined sewer overflow abatement projects.

In addition, in 2014 a new partnership was formed entitled the Southern New England Coastal Watershed Restoration Program (SNECWRP) to protect, enhance, and restore the waters from Westerly, Rhode Island to Pleasant Bay, Massachusetts, including the watersheds of Narragansett Bay. The EPA received \$2 million in funding to address projects in these coastal waters and watersheds, and provided these funds as grants to the NBEP and the Buzzards Bay Estuary Program. Grants were made available to non-profit organizations, educational institutions, municipalities, and other government agencies to fund nutrient management projects in the greater Narragansett Bay watershed in Rhode Island and Massachusetts, and the Buzzards Bay watershed in Massachusetts.

Funding is designed to support projects that reduce nutrient pollution from fertilizers, septic systems, and other sources to both fresh and salt water systems. Nutrient pollution is regarded as one of the most significant water quality issues facing this region and is a major concern identified in the Comprehensive Conservation and Management Plan of the NBEP. While the first year of funding is focused on nutrients the long-term goals of the SNECWRP include protection, enhancement, and restoration of clean water, healthy diverse habitats, and associated populations of fish, shellfish, and other aquatic-dependent organisms in the coastal watersheds of southern New England.

Managing nonpoint sources (NPS) of pollution, those that cannot be tracked to a single pipe or discharge point, such as overland stormwater runoff and failing septic systems, is challenging. Available monitoring data reveal NPS is a widespread problem affecting every watershed in Rhode Island. NPS are suspected of contributing to the impairments in a majority of the surface waters included on the state's impaired waters list, also known as the 303(d) list. To prevent and combat NPS pollution, the RI DEM Nonpoint Source Pollution Management Program (NPS Program) encourages various actions by state and local governments, businesses, watershed groups and individual landowners. The NPS Program uses the watershed approach to focus on managing nonpoint pollution problems. The DEM NPS Program activities are guided by the RI Nonpoint Source Pollution Management Plan (RI DEM/DOA 1995) as well as EPA requirements governing Clean Water Act (CWA) Section 319 funds.

A primary ongoing activity of the RI DEM NPS Program is the distribution and management of grants to local entities which are awarded on a competitive basis. In keeping with the state's focus on low impact development strategies for managing stormwater, the NPS Program has focused on funding projects that treat stormwater via infiltration, prior to entering a storm drainage system, rather than at "end of pipe." This approach mimics the function of natural hydrology as closely as possible while achieving water quality benefits. Examples and details of projects funded by the DEM NPS Program can be found in

annual reports prepared by the program and available online at:
<http://www.dem.ri.gov/programs/benviron/water/quality/nonpoint/>.

To help assess the effects of NPS pollution, the RI DEM NPS Program continues to contribute to the implementation of the statewide RI Water Monitoring Strategy by providing funding that supports volunteer-based monitoring of lakes and biological monitoring in rivers and streams. Both programs are essential to assessing whether the state's freshwaters support healthy aquatic communities. DEM's partnership with the URI Watershed Watch Program, from 1999 to the present, supports seasonal monitoring by volunteers that provided the primary source of data to allow RI DEM assessment of 74% of lake acres as reported in the 2012 Integrated Water Quality Monitoring and Assessment Report. The data are used to help identify water quality impairments. As there are no point discharges of sanitary wastewater authorized for lakes in the state, water quality pollution problems in lakes are largely attributable to nonpoint source pollution sources.

RI DEM's biological monitoring of rivers and streams focuses on sampling for macroinvertebrates. This biological community has proven to be a reliable indicator of water quality and habitat condition that reflects the cumulative effects of various stressors, including nonpoint source pollution. Sampling and taxonomic identification is performed by a contractor (currently ESS Group, Inc.) for RI DEM at selected stations annually. Since 2004, the sampling has been targeted to support the implementation of the rotating basin approach for assessing rivers and streams. About 200 stations have been sampled via this program, providing a statewide dataset that supports a more complete assessment of water quality conditions in rivers and streams. Sixty-five percent of total river miles in RI were reported as assessed for one or more designated use in the 2012 Integrated Report. The data are used to identify biodiversity impairments in rivers and streams. RI DEM has found such impairments to be widely distributed in the state and often associated with nonpoint sources of pollution.

The NPS Program further advanced Rhode Island's approach to developing watershed-based plans during 2012 for the 24 watershed planning areas designated in RI. RI DEM's approach to watershed planning is two tiered. Tier 1 will be a webpage for each of the watershed planning areas presenting a summary of information available about that watershed with links to documents and other websites for more information. RI DEM believes this will be an important tool for engaging the public on a watershed basis. The goal was to activate this webpage by the end of FY2013.

Tier 2 will be to compile a watershed plan, building on the material collected for the webpage and existing documents, particularly the TMDL reports. These watershed plans, which will satisfy the EPA requirements for watershed based plans, will present in a clear, concise format, a comprehensive overview of the watershed that the public and policy makers at all levels can use to identify key watershed characteristics. Most importantly, the plans will identify actions that are necessary to restore and protect water quality. Recognizing the role of municipal government in managing nonpoint sources of pollution, the emphasis will be on identification of appropriate local actions in the areas of improving stormwater management, local land use regulations, and onsite wastewater management, as well as other watershed specific issues.

Action: Support implementation of RI DEM and key partners' pollution abatement programs and plans to avoid and minimize impacts to SGCN and key habitats. Rank: 3

Performance Measures:

- Number and percent of regional, state and local plans goals met to reduce pollution.

Action: Conduct outreach to landowners, especially those in focal areas, regarding chemical management. Rank: 3

Performance Measures:

- *Number of landowners contacted.*
- *Number of public relations materials developed and delivered concerning home 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 and management. Golf courses, because they are large, roadless, 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 RI DOT to minimize and mitigate adverse impact of projects to important freshwater and estuarine/marine habitats.

Action: Determine lethal and non-lethal effects of contaminants. Rank: 3

Performance Measures:

- *Completion of needed research by RI DEM or partners.*
- *Number of research recommendations incorporated into conservation actions.*

One of the issues affecting nearly all SGCN is the effect of contamination (including disease) on wildlife populations. In order to safeguard preserve areas and other significant wildlife populations, the RI WAP should identify and attempt to mitigate all sources of contamination likely to degrade habitat. This process should also be conducted outside of preserve areas. 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.

Specific Actions to Address Pollution:

Technical assistance and coordination with key agencies and partners

- Coordinate water quality protection with appropriate DOT, regional and federal programs - protect existing and priority sites. **Rank: 3**
- Coordinate with mosquito abatement personnel for chemical management. **Rank: 2**

Outreach

- Outreach to appropriate landowners/users/distributors concerning environmental impacts of chemical management. **Rank: 2**

Data collection and analysis

- Assess effects of sedimentation. **Rank: 3**
- Develop strategies to mitigate aquatic degradation. **Rank: 3**
- Evaluate water quality effects on priority species. **Rank: 3**
- Identify chemical sources and compounds of concern. **Rank: 3**

- Increase data bank on species habitat preferences and use in oil or other chemical spill response planning and mapping. **Rank: 3**

Monitoring

- Monitor area for sediment, nutrient, and contamination levels using indicator species or long term instrumentation analysis. **Rank: 3**

Land/water management

- Increase field and landscape buffers to provide cost effective protection against the cumulative effects of many small, but unavoidable, pollutant discharges associated with an active agriculture enterprise and the kinds of catastrophic pollution that can impair wildlife. **Rank: 3**

Habitat and natural process restoration

Manage stormwater runoff to restore and enhance the natural capacity of the land. **Rank: 3**

Law and policy

- 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. **Rank: 3**

Actions to Address Invasive species

Current literature, surveys and predictive models indicate that many invasive species are continuing to spread across the landscape despite efforts to control infestations. New invaders continue to appear (See Chapter 3) and more can be expected given the predictions of increasing temperature and other climate change factors (NWF and MSCC 2013). Note that there is a difference between exotic/introduced species (invasive species) versus species that are shifting to follow optimal climate conditions and invading from other regions. These may be species that have not been historically found in RI Predicting and understanding invasion processes is essential for determining appropriate management actions and policies.

Some notable advancements have been made since the 2005 CWCS. The Rhode Island Aquatic Invasive Species Management Plan (Aquatic Nuisance Task Force 2007) was formulated to address the issue of invasive species in aquatic habitats; however, there is no statewide plan that focuses on the control of terrestrial invasive species. Therefore, prioritizing control projects tends to be conducted by individual agencies and conservation organizations in response to local infestations so that limited funding for performing such projects is directed to those groups that can provide in-kind or monetary matching funds rather than to areas where control is most critically needed. Management of natural areas and other protected sites is often focused on providing trails or creating clearings in forests for wildlife management objectives, both of which can serve as pathways for the spread of invasive plants. A plan could coordinate and focus multiple state efforts.

The Rhode Island Invasive Species Council (RIISC) was formed in 2000, its mission to protect native biodiversity in Rhode Island by gathering and conveying information on the presence, distribution, ecological and economic impacts, and management of invasive species; to promote uses of native species and non-invasive alternatives throughout Rhode Island; and to work cooperatively with researchers, conservation organizations, government agencies, the green industries, and the general public to identify and manage invasive species pro-actively and effectively. The RIISC is an outreach program of the RINHS, the Rhode Island Agricultural Experiment Station, and URI Cooperative Extension. Although the RIISC published a list of Rhode Island invasives in 2001, the organization has not convened a meeting since. This list was originally developed in 2001 and is in need of revision as three species identified in 2001 as potentially invasive have now become established in the state. These

include Mile-a-Minute Vine, Japanese Stiltgrass, and Water Chestnut. Also, at least one species not previously considered for listing has been found, the Japanese Sand Sedge. The list currently has no legal or regulatory authority, but regulations regarding the importation of particular species may be considered as a means of invasive species control. There is a current need for this role over the next decade to coordinate invasive species in the state.

In recent years, RINHS has taken the lead in educating the public about invasive species issues, coordinating control projects, and helping develop measures that can be used to assess the impact of invasive species on natural habitats. RINHS has also published a separate list of invasive species (2013) to serve as an updated reference by listing species in two categories: Invasive species that are present and widespread, and invasives that are considered to be localized and targets of early detection efforts. This list includes all species confirmed as occurring in Rhode Island through 2013 (List is available online at http://rinhs.org/wp-content/uploads/2011/10/Rhode-Island-Invasive-Species_2013_b.pdf).

At the 2007 RI Land and Water Conservation Summit, RINHS presented a workshop entitled "Invasive Preparedness for Land Conservation Organizations" which considered the elements of a good invasives preparedness strategy, invasives monitoring and control activities that groups can initiate to affect the situation on the ground and also help develop organizational capacity. Emphasis was on plants and key elements of an invasives strategy, simple first steps for monitoring and control, and available resources.

In 2011 the RINHS began assisting the [Narragansett Bay Estuary Program](#) and [URI's Coastal Institute](#) with a project called Watershed Counts, a collaborative effort by a large number of groups to quantify environmental condition and change through time in the Narragansett Bay Region. The role of RINHS in this program was to develop a metric for invasive species that incorporates both on-the-ground measurements of invasives extent and impact, and assessments of invasive survey and management efforts.

In April 2011, a preliminary assessment of the invasive species situation was provided at a news conference at the Rhode Island State House. The group continues to report annually on the extent of invasives and their impact in Rhode Island, as well as on surveys and management efforts. Watershed Counts annual reports and other information is available online at <http://www.watershedcounts.org/>.

In addition to the control of invasive species populations through mechanical and chemical means, the URI Biological Control Laboratory (BCL) has been actively engaged in the search for and testing of biological control agents. This research usually begins in the country of origin of the invasive to determine which insect herbivores keep the plant in check, followed by years of quarantine to determine which insects are suitable for release.

One example of this process began in 2006 with the discovery by a URI doctoral student of moth larvae feeding on Swallow-worts in southern Ukraine (Figure 4-7.). The larvae were brought to partners at the Commonwealth Agricultural Bureau International (CABI) in Switzerland for rearing and initial testing. Research on the biology, impact, and host range of these insects was conducted at CABI and in the URI Insect Quarantine Laboratory over the next six years.

After finding that the moth larvae will only attack and survive on swallow-worts, the URI scientists and colleagues in Canada and Switzerland petitioned the U.S. Department of Agriculture in 2012 to allow field

release of this biological agent in North America. The review panel recommended it for USDA approval on September 4, 2013. The USDA has additional steps in its approval process before the agent can be released in the United States, but the Canadian government granted permission for release in September 2013.

The URI BCL has had previous success in identifying and releasing insects for the control of Cypress Spurge, Purple Loosestrife, and Mile-a-minute Vine, and is continuing its efforts to find and test additional biocontrol agents for other invasives. The Standard Operations Manual for the URI BCL quarantine facility is available online at <http://web.uri.edu/biocontrol/files/2014/02/SOP-2014.pdf>.

Threat: Invasive species impacts on SGCN species and key habitats.

Action: Prepare a Statewide Terrestrial Invasive Species Management Plan. Rank: 3

Performance Measures:

- *Development of a plan within 3 years.*
- *Reinvigoration of the RIISC.*

Similar to the Aquatic Species Management Plan, a plan focusing on terrestrial species would help guide the prioritization of control projects, as well as provide guidance in conducting land management activities to help deter the spread of invasive plants. This would include a Response Plan for Eradicating New Infestations.

Action: Update the List of Invasive Species in Rhode Island. Rank: 3

Performance Measures:

- *An updated invasive species list.*

Action: Initiate Training of Individuals to Conduct Surveys and Early Detection of New Infestations. Rank: 3

Performance Measures:

- *Number training workshops, the number of trained personnel.*

The New England Wildflower Society and RINHS have provided such training but there is a need to develop a larger group of trained individuals given the potential for the infestation of new invasives in the near future resulting from climate change

Action: Coordinate and Support Existing Effective Native Species Programs (including Rhody Native) in Rhode Island. Rank: 3

Performance Measures:

- *Number residents aware of Rhody Native and other programs.*
- *Number residents planting natives and not using/removing invasives.*

Threat: Problem native species impacts on SGCN and key habitats.

Action: Update the Deer Management Plan to continually address the impacts of the species on Rhode Island habitats. Rank: 3

Performance Measures:

- *Updated deer management plan that addresses impacts on key habitats*

An additional factor that can promote the spread of invasive species is related to the overabundance of White-tailed Deer. Recent studies, including that of Eschtruth and Battles (2008), are providing evidence that White-tailed Deer herbivory on native plants can accelerate the invasion of exotic plants, especially on sites where tree canopy removal provides the disturbed conditions that also promote invasion.

In 2012, the town of New Shoreham (Block Island) and RI DEM combined to increase the harvest of White-tailed Deer by opening a lottery-based hunt on state-managed land on the southern part of the island, which was followed by a town initiated island resident bounty hunting program for the 2014/15 season.

Actions to Address Invasive Species Exacerbated by Climate Change

Exotic species can become invasive for a number of reasons. Often, land management practices reduce habitat quality and promote habitat fragmentation. Invasive species are often habitat or dietary generalists and good dispersers which can quickly take advantage of newly-created habitats. While climate change has not been the historic driver of invasive species range expansion in the Northeast, changes in global climate trends are beginning to have a measurable impact on the spread of invasive species. Significant deviation from historic climatic norms are reducing the thermal thresholds that limit the ranges of many non-native species, facilitating conditions that increase the competitiveness of non-native species, and providing more dispersal and colonization opportunities with a greater number and severity of disturbance events.

Invasive plant species are thought to be particularly able to capitalize upon rising average extreme-low winter temperatures. Further evidence suggests that seasonal temperature extremes and other climatic factors interact with a host of non-climate stressors (e.g., understory deer browsing, habitat fragmentation, and management practices) to intensify the ecological impacts of non-native species. While temperature and precipitation certainly impact invasive species, many of these species are disturbance driven.

Specific actions to Manage for the Impacts of Invasive Species under Climate Change have been outlined by the NWF and MSCC (2013):

- 1. Manage forests for structure and age-class diversity.** Stands with dynamic structure and diverse age classes provide a greater number of ecological niches, enabling wildlife and plant species colonization opportunities as environmental conditions become less favorable elsewhere. This diversity may increase the resilience of the stand. Diverse stands also reduce potential economic loss resulting from disturbance events and provide future economic opportunities by managing for climate-hardy species.

- 2. Manage understory herbivory to reduce invasive colonization opportunities.** As the extent of low density development grows, so too does the extent of edge habitat and as a result, White-tailed Deer populations. In areas of high population pressure understory deer browsing can have dramatic impacts on regeneration patterns in the lower uniform layer of vegetation. Understory herbivory is the most important non-climate stressor to interact with and exacerbate the impacts of invasive species. The continued removal of species favored by deer can provide opportunities for invasives that are not currently favored but may become more so in a changing climate to establish and spread. Specific management strategies that have been promoted elsewhere include the use of barriers and fencing, and “hiding” species favored for browse amongst species that are less favored.
- 3. Utilize targeted monitoring to detect colonization of new invasive species, and areas of expansion of existing and established invasives.** Monitoring forest community composition is one of the most important things we can do to assess changes in species assemblages under climate change. However, monitoring for invasives under climate change needs to be increasingly focused on: (1) identifying compositional gaps as they occur in order to preemptively avoid invasion opportunities; (2) monitoring established invasives to identify population reductions as a result of management efforts; or expansion despite management efforts; and, (3) monitoring for changes in the functional roles of established invasive populations in order to identify trends toward naturalization. Targeted monitoring will help us detect when compositional “openings” for invasives occur so that they may be filled.
- 4. Manage plantations away from monoculture stands.** Monoculture plantations, while economically desirable, will be more susceptible to invasive plant, pest and pathogen impacts than biologically diverse stands. Monoculture stands are disproportionately vulnerable to the impacts of increasingly unpredictable disturbance events, higher mean winter low temperatures, and a greater likelihood of short-term droughts. Biologically diverse systems are less likely to experience a complete reduction in ecosystem functionality and resulting services as a result of disturbance, and are more resistant to invasion due to a greater number of filled environmental niches.

Actions to Address Disease

A disease can be thought of as a process that compromises the structure or function in a human, animal, or plant and produces symptoms that are not simply a direct result of physical injury. The manifestation of diseases in wildlife populations resembles the effects of pollution, predation, or other chronic symptoms, but is usually differentiated as being caused by a pathogen, usually a microscopic organism such as a virus, bacteria, or fungus. Equally damaging threats to wildlife and their habitats can also be produced by larger organisms such as parasitic wasps, caterpillars or beetles etc., but these are usually not categorized as diseases.

Unfortunately, emerging diseases have become among the most compelling and immediate threats to wildlife populations and their habitats. Diseases are particularly damaging and insidious because they can decimate wildlife even if the physical habitat is otherwise protected. The catastrophic spread of White Nose Syndrome (WNS) in bats is the best recent example of this process, but in fact various diseases or disease-like processes are now known to be affecting representatives of all vertebrate groups as well as many invertebrates. Even where diseases have not directly affected Rhode Island SGCN, they can lead to

the loss of habitat by destroying stands of particularly important tree species. Emerging diseases are in practicality just another category of invasive species. For example, West Nile Virus (WNV) is a mosquito-borne zoonotic arbovirus that originated in the Old World but was spread to the Western Hemisphere and recorded for the first time in New York City in 1999. Since that time it has continued to spread and its effect on local bird populations, although difficult to quantify, have no doubt been significant, with certain species affected more than others.

Several Rhode Island agencies play a role in the monitoring and mitigation of disease and have faced the challenges of increased disease over the last decade. The RI DEM DFW is primarily concerned with the effects of disease on populations of native animals rather than effects to humans. For example, sentinel programs by RI DEM DFW have been in effect to look for the presence of avian flu and chronic wasting disease (CWD) in Rhode Island animals.

The Rhode Island Department of Health (RI DOH) is primarily responsible for the effects of disease on humans, but there is often a nexus between wildlife diseases and humans. Rabies, for example, is an example of this relationship, whereby a disease can be transmitted to humans by contact with wildlife. In that case, the disease is not thought to be limiting wildlife populations *per se* but is an important public health issue. By responding to potential disease transmissions between bats and humans, the RI DOH is supplying valuable information about the distribution and relative abundance of local bat species. In effect, their response protocols constitute a form of bat sampling that could not be conducted otherwise.

The RI DEM Division of Forest Environment maintains sentinel programs that monitor disease and other infestations that affect forested habitats. The spread of disease and other pathologies have radically changed the composition of Rhode Island forests since ancestral times. The near-total losses of tree species such as the American Chestnut and American Elm because of introduced diseases have been well-documented, but the influx of new diseases or disease-like phenomena continues unabated. In recent years the spread of Red Pine Scale has affected conifer plantations across the state and the Hemlock Woolly Adelgid threatens another important conifer- the Eastern Hemlock. Those agents are piercing insects rather than microorganisms, but the disease-like symptoms are similar nonetheless. Many species of SGCN birds nest in mature conifer plantations and so the loss of such stands, even those composed of exotic conifers, is expected to change the composition of Rhode Island's avifauna and could lead to the loss of several nesting species.

The Rhode Island Division of Agriculture, through the State Veterinarian, mosquito abatement and other programs, resides at the crossroad between wildlife, domesticated animals and, by extension, human health because it has the responsibility of permitting the importation of non-native animals. Although the RI DEM DFW's primary responsibility resides with native animals and the RI Division of Agriculture is responsible for domestic animals and pets, in fact the distinction between these functions is often blurred and continuous dialogue between these offices is necessary to coordinate preventative measures and formulate responses. The regulation of animal and plant importation is an important gatekeeper against the introduction and spread of damaging invasive species and disease. Because it is easier to prevent the arrival of a new disease than respond to it retro-actively, it is critical that all regulatory agencies consistently coordinate with respect to emerging disease issues.

In some cases, regulations have been promulgated to stem the disease vector. One recent example of this was the regulation of importing and planting Currants (Ribes) because they could transmit White Pine Blister Rust disease. In another example the state has banned the sale of bullfrogs, not only because they can devastate vulnerable populations of other amphibians, but also because they are carriers of Ranavirus. As with all regulatory functions, continuous vigilance, coordination and enforcement are desirable.

Threat: Disease impacts on SGCN and key habitats.

Action: Develop and update coordinated plans to address the impacts of emerging diseases on Rhode Island SGCN and their key habitats. Rank: 3

Performance Measures:

- *Updated agency plan that addresses impacts on key habitats.*

Specific information on emerging diseases is found in Chapter 3 and in the species and habitat profiles.

Actions to Address Climate Change

Climate change adaptation strategies are receiving more attention as the impacts of climate change on biodiversity and ecosystems have become more evident. Preparing for and addressing these changes are prominent themes in conservation and natural resource policy and practice. Because maintaining existing habitat conditions will not be possible, adaptation is increasingly viewed as a way of managing change and its associated uncertainty. There is also increasing recognition of the need not only to adjust management strategies in light of climate shifts, but to reassess and, as needed, modify underlying conservation goals (Stein et al. 2013). Specific information on the threat of climate change is found in Chapter 3 and in the species and habitat profiles.

Major advances in the development of climate-adaptation principles, strategies, and planning processes have occurred over the past few years, and there is a growing body of literature to draw from to develop state and local climate change adaptation strategies. An overriding recommendation is that in many cases the most efficient and effective approach will require a habitat or ecosystem-based perspective for conservation (AFWA 2009).

The ecological impacts associated with climate change do not exist in isolation, but combine with and are exacerbated by other stresses on our natural systems. For instance, although climate pressures may be causing species ranges to shift, development and roadways have created a matrix of inhospitable habitat that may inhibit such movement. And while invasive species already have a major negative impact on many ecosystems in the Northeast, many invasives will be favored under future climate conditions, making it even more difficult for native species to adjust and survive under new climatic regimes.

There is no doubt that the climate of the Northeast is changing, and that future projected changes will have major influences on ecological systems. As states across the country grapple with how climate change is impacting their natural resources, the need to set management priorities based on a sound

understanding of projected impacts is becoming increasingly apparent. As such, states across the Northeast are developing and implementing adaptive “climate-smart” land use and management strategies (NWF and MACC 2013).

As a coastal state, the focus of climate adaptation strategies in Rhode Island needs to be directed towards both upland and coastal systems and the connections between these landscapes.

Upland Systems

Upland systems will be primarily influenced by increased temperature, variations in precipitation, and other climatic variables. Developing climate-smart strategies for conservation and restoration projects at upland sites will depend upon understanding both current and future potential impacts of climate change on the ecosystems where those projects are located. To best understand these impacts, it is important to have a deeper knowledge of how the systems work in relation to climate and weather. Maintaining high biodiversity and fundamental ecological processes will make the system more resilient to climate change impacts, allowing it to more readily recover from a disturbance with minimal loss of function. Although management needs are local and often site-specific, planning will need to take place within the context of larger-scale planning to address climate change impacts more effectively.

These goals have often been developed to deal with existing management and conservation issues as well as existing and future threats. Developing guidance that takes climate change into account requires an additional layer of threat analysis to include fluctuations in disturbance regimes, changes in the timing of phenological events, temperature increases, precipitation changes, species range shifts, increased frequency of extreme events, and other climate-driven variables. It is the combined effect of these issues that needs to be considered when developing climate-smart projects and actions.

The general suite of management, conservation, and restoration project approaches will likely not change significantly for climate-smart projects. However, some of the assumptions that go into project planning and design may need to change. Assessing vulnerability to climate change (Element 3) will help determine which approaches may be necessary to address climate change impacts and where new approaches may be needed. Climate change vulnerability assessments will also help identify what we know and what is uncertain about a system or species and can help focus future monitoring protocols. Focusing quantitative assessments more broadly on habitat changes and then applying qualitative assessments of potential species responses may be the best approach given existing information.

Upland Forest Climate Smart Guidance

Ownership patterns and land use trends unique to the Northeast pose a set of ongoing conservation challenges associated with habitat fragmentation, habitat degradation, water quality, and air quality. In turn, these issues interact with and are exacerbated by changing climate trends in complex ways to present a suite of augmented and sometimes new conservation challenges.

Temperature increases over a short temporal scale are likely to result in increased vulnerabilities of habitats, changes in species dominance, and a dramatic reshuffling of species and communities. This assumption is reinforced by dynamic ecosystem modeling which projects that by the end of this century 60% of New England will be dominated by oak species, compared to 21% at the beginning of the century. In Rhode Island, where forests are already dominated by oaks, this reshuffling will be less dramatic;

however, forests will be subject to more significant challenges by the increased spread of invasive species, pests, and pathogens.

Threat: Climate Change impacts on SGCN and key habitats.

Action: Synthesize, prioritize, coordinate current and emerging information and strategies identified in the national, regional, statewide, and local climate change plans. Rank: 3

Performance Measures:

- *Updated agency plan that addresses impacts on key habitats.*

Action: Manage for the impacts of invasive species under climate change as outlined by key vulnerability assessments and adaptation strategies (i.e. the NWF and MSCC (2013)). Rank: 3

Performance Measures:

- *Updated agency plan that addresses impacts on key habitats.*

Action: Implement these overarching climate change management strategies for upland systems and adaptively manage as new information emerges. Rank: 3

Performance Measures:

- *Updated agency plan that addresses impacts on key habitats.*

Specific Actions and Concepts to Apply to Conserve Key Habitats in Upland Systems (Rubinoff et al. 2013):

- 1. Protect and maintain refugia.** Protecting areas that have resisted ecological transitions that have occurred elsewhere will be increasingly important under climate change. Of particular importance will be the ability to identify and protect refugia that exist as a result of fundamental geophysical characteristics such as geologic makeup and physical setting. Protecting sites that have historically enabled the long-term retention of diverse plant and animal species can maximize future biodiversity. Refugia can also act as seed sources for specific genetic variants that can be used in the future to establish new forest components. Of particular importance is the fact that these sites may not be currently protected and as a result may require targeted acquisition efforts and/or land-use restriction agreements. Preemptive efforts need to be made to reduce non-climate stressors that may reduce the quality or capacity of these sites to act as refugia. One of the first things that can be done to help any system be more resilient to climate change is to decrease other stressors. In many cases, managers are more familiar with these other stressors, there is more certainty in what is known about the impacts them, and we often have more control over the severity of them (in comparison to climate change).
- 2. Protect and restore large, contiguous habitat blocks.** Large habitat blocks are more resilient to climate impacts, including weather-related disturbance events and plant invasions. Large habitat blocks with minimal land use activity have larger nutrient sinks that enable them to recover from disturbance events more rapidly. Further, many invasive species are disturbance-oriented edge

species that utilize fragmenting features such as roads and power lines to infiltrate new sites. Therefore, reducing non-climate stressors like habitat fragmentation will go a long way towards increasing the resiliency of a landscape to climate change.

- 3. Protect and maintain both managed and unmanaged forest blocks.** Both managed and unmanaged forest blocks may have certain characteristics that increase the resiliency and/or adaptive capacity of the site to climate impacts. Certain targeted forest structure alterations can increase the resiliency of the site to climate-related impacts including reducing the risk and severity of fire, pest and pathogen outbreaks, and wind and ice damage.
- 4. Maintain and protect biological corridors between habitat blocks and habitat refugia.** As weather and climate trends deviate from historic norms, wildlife populations and individual species will have to move to occupy habitats that contain components necessary for survival including food, shelter, biophysical and geological setting, and reproduction opportunities. Biological corridors linking critical habitat blocks are crucial for migrating individuals and for providing dispersal opportunities at the population level. The primary consideration for maintaining habitat connectivity includes reducing landscape fragmentation driven by anthropogenic land-use activities. Incorporating a landscape scale approach to climate adaptation will be required to facilitate long-term success of biologically diverse species assemblages.
- 5. Actively facilitate compositional shifts in small habitat patches or at heavily managed sites.** As species assemblages reshuffle under changing ecological conditions it is important that systems maintain core ecological functionality. In some cases, preemptively filling key ecological niches may be important to maintaining those processes. One strategy includes anticipating wholesale decline of a particular species and actively promoting the replacement of that species with a more climate resilient species. The more climate resilient species may not have been historically dominant in the system, but could be a natural invader that is shifting north. For example, Sugar Maple is expected to decline throughout much of southern New England. One management technique for actively-managed small patch sites that are expected to undergo significant drying would be to replace declining Sugar Maple individuals with Red Maple and Black Cherry. Similarly, planting White Oak and other oak species in areas that are vulnerable to drought such as narrow ridge-lines and south facing slopes would promote the development of forests that are more resilient to increasing variability in the number of short-term droughts. However, as a result of the uncertainty of projected climate impacts and related compositional shifts, preemptive strategies such as these need to be implemented with utmost caution and generally relegated to small patch sizes or heavily managed sites. Larger habitat blocks are inherently more resilient and often have a greater capacity for adaptive transitions.

Specific Actions and Concepts to Apply in Freshwater Aquatic Habitats (Rubinoff et al. 2013):

A. Management

1. Identify ways to maintain cool water temperatures in streams and ponds so that species adapted to cool temperatures are able to survive.
2. Maintain and expand riparian vegetated buffer areas so runoff from impervious surfaces has the opportunity to cool down and have some pollutants removed before entering cold water streams and ponds.
3. Control aquatic invasive species through more active monitoring efforts, aggressive elimination and control activities, boater education and boat inspections in infested areas.

4. Evaluate options for dam removal or construction of fish ladders so that anadromous fish can reach cooler water to spawn, aiding in restoration efforts. Important to consider the increased risk of opening corridors that may allow exotic invasive species to increase movement into new areas, analyze the trade-offs.
5. Identify and protect remaining critical cold water fish habitat areas and seek to reconnect high quality habitats by removing in-stream barriers and re-establishing in-stream flows.
6. Encourage application of geotextiles and bioengineering techniques for erosion control and stream stability, such as placing geotextiles in or next to streams.
7. Control and seek to minimize non-climate stressor impacts including pollution from non-point sources and impervious surface runoff.

B. Protection

1. Identify and protect climate refugia, areas and systems that are more resilient to climate change or which allow habitats such as wetlands to migrate as sea level rises or flood plains are modified.
2. Protect naturally connected waters in order to maintain natural flow patterns.
3. Target land acquisition and conservation restrictions to protection of vulnerable intermittent headwater streams and their buffer areas; acquisition could be supplemented by stream easements in order to preserve riparian zones and ensure adequate shading of cold water streams. Land acquisitions should employ the best knowledge of where optimal environmental conditions or refugia will occur to maximize limited (financial) resources.

Specific Actions Recommended in Rubinoff et al. (2013) for Bogs, Fens, Forested Swamps, and Herbaceous Wetlands:

A. Management

1. Maintain or improve habitat quality and, correspondingly, the resilience of wetland habitats to changing conditions.
2. Promote riparian zone and floodplain management, restoration and preservation by removing restrictions between rivers and floodplains, removing dams, and integrating Brownfields remediation projects with floodplain restoration; riparian buffers and dam removal can also benefit down-stream water bodies. Climate change projections predict an increase in more intense storms resulting in more floods, thus actions focused on flood reduction and floodplain management may be a high priority.

B. Protection

1. It is essential to preserve areas and buffers that are not yet impacted by human development. As impacts of climate change increase species may depend on large undeveloped areas for survival.
2. Identify and protect resilient wetland ecosystems; focus land protection on large areas with high ecological integrity and functionally healthy wetland complexes that have higher resiliency over time.
3. Identify and prioritize protection of migration corridors between wetland areas and between wetlands and associated upland habitats including large resilient parcels connected by migration corridors. Larger parcels of habitat will be more resilient to impacts from climate

change and thus may provide a refuge for plant and animal species when they are pressured by climate-related stressors.

4. Use LiDAR and other data to identify important wetland areas and ensure that a variety of wetland types are represented in land protection planning in order to make habitats more resilient to climate change.
5. Protect inland wetlands for floodwater storage. Continued protection of floodplains and stream buffers is also an important feature of a comprehensive Low Impact Development (LID) strategy to protect the environment and property under current and future conditions.
6. Maintain floodplains as undeveloped areas, especially preventing high-risk development that may experience more flooding with increased storminess.

C. Actions for Climate Change Advocacy and Outreach:

1. Encourage the passage of state regulations (with supporting local level zoning and planning ordinances) and use of other tools to strengthen protection of isolated vegetated wetlands that are most vulnerable to climate change.
2. Promote restoration of floodplains and wetlands for floodwater storage with expansion, where feasible, for larger floods in the future.
3. Promote the increase of vegetated buffers to reduce non-climate stressors such as non-point source pollution and runoff from impervious surfaces.

Coastal Habitats and Sea Level Rise

In October 2014, the Rhode Island CRMC and its partners published online the Sea Level Affecting Marshes Model (SLAMM) Maps for the coastal wetlands of all 21 Rhode Island coastal communities. The purpose of these SLAMM maps is to show how coastal wetlands will likely transition and migrate onto adjacent upland areas under projected sea level rise scenarios of 1, 3 and 5 feet in the coming decades. These maps are available for viewing online at: http://www.crmc.ri.gov/maps/maps_slamm.html.

SLAMM maps are intended to support state and local community planning efforts and to help decision makers prepare for and adapt to future coastal wetland conditions despite the inherent uncertainties associated with future rates of sea level rise. The CRMC has proposed amendments to Section 210.3 of its coastal program to adopt SLAMM maps for coastal wetland restoration and adaptation planning purposes.

To help in providing guidance to communities and conservation groups for the protection of upland marsh migration opportunity areas, in advance of sea level rise, CRMC first identified Critical Coastal Wetlands based on four criteria:

- *National Audubon Society Important Bird Areas (see Chapter 1);*
- *Existing Large Marsh Complexes (>25 acres);*
- *Unique/Rare Natural Communities (Sea Level Fens); and,*
- *Future Large Marsh Complexes (>25 acres) based on projected marsh migration patterns.*

In addition, the CRMC (Chaffee 2014) has developed preliminary adaptation strategies for coping with sea level rise and enhancing opportunities for marsh migration. These include:

Uplands:

- *Changing/moving land use activities that inhibit marsh migration.*
- *Adopting activities that facilitate marsh migration.*
- *Removal of physical barriers.*

In-Marsh:

- *Drainage improvements (runnel/creek excavation).*
- *Elevation enhancement.*
- *Erosion control along marsh edge.*

Traditionally, since salt marsh restoration activities in Rhode Island began in the mid-1990s, these efforts have focused on restoring tidal hydrology, fill removal, and control of invasive species, especially Phragmites. The development of SLAMM maps and recent assessments of Rhode Island salt marshes by Save the Bay and other groups, there is a realization that SLR is now the primary driver of change and degradation and that new methodologies are needed to address SLR in existing marshes (Chaffee 2014).

The newest modeling tools are starting to be able to estimate coastline's dynamic vs static response to SLR. These models go beyond the abilities of SLAMM models, which typically just make predictions under flooding conditions across the landscape (M. Staudinger, pers. Comm. 2015).

Dr. Robert Thieler and colleagues at USGS (Nathaniel Plant and Dean Gesch) and Columbia University (Radley Horton), recently completed their study evaluating sea-level rise impacts in the northeastern U.S. The project developed a new method to distinguish coastal areas in the northeastern U.S. (Virginia-Maine) that will likely experience a predominantly inundation (e.g., flooding) response to sea-level rise (SLR) from those that will likely respond dynamically by moving or changing (e.g., landforms such as barrier islands and marshes). They found that areas likely to inundate include urban regions of intense development and/or coastal engineering, as well as bedrock coasts. Alternatively, areas likely to respond dynamically include beaches, unconsolidated cliffs, barrier islands, and wetlands.

<https://necsc.umass.edu/projects/research-and-decision-support-framework-evaluate-sea-level-rise-impacts-northeastern-us>

One objective is stabilization of tidal marshes to prevent the erosion of habitat that results from storms and tidal surges that are increasing in frequency and intensity. Typically, “hard” armaments, in the form of rock, wooden, or metal bulkheads, have been used to stabilize 30% of Rhode Island’s coastline. There are several disadvantages to hard structures, including the disruption of the natural processes required to keep coastlines healthy, hindering of coastal access, and exacerbation of erosion in neighboring areas.

In the spring of 2014, The Nature Conservancy began experimenting with a “soft” solution by installing biodegradable coconut fiber coir logs and recycled oyster shells along shorelines to both trap sediment and attract a new oyster population to absorb and dissipate the energy of incoming waves. In partnership with the RI DEM and USFWS the state’s first living shoreline was installed across 500 feet of eroding marshland at the John H. Chaffee NWR on the Narrow River in Narragansett, RI. Monitoring of this “living shoreline” will be conducted at the Chaffee NWR to measure its effectiveness in dissipating wave energy, trapping new sediment, and improving natural processes to determine if the solution is ready for wide-scale application (TNC 2014).



Shoreline erosion prevention using coconut fiber coir logs and recycled oyster shells at the John H. Chaffee NWR, Narragansett, RI. Source: TNC 2014

In addition to the installation of a living shoreline at the Chaffee NWR, the USFWS has proposed elevation enhancement, or gaining “elevation capital” on 15 acres of salt marsh to allow the marsh to keep pace with sea level rise in the near term, and help prevent the catastrophic loss of salt marshes from incremental sea level rise. This will be accomplished by repurposing sediments dredged from the adjacent channel through thin layer deposition. Planting of these sites following application of material will enhance stability, recovery, and lessen short term aesthetic impacts of the action.

According to USFWS, this project represents an opportunity to learn from, test and monitor techniques for estuarine improvements, including the use of locally available equipment for dredging, living shoreline installations, salt marsh surface drainage strategies, and methods to improve salt marsh migration into adjacent upland sites. This will provide important information on the successfulness of these actions and their applicability for use in other areas (USFWS 2014). The Narrow River elevation enhancement project is partially facilitated by a Department of Interior post-Hurricane Sandy grants program for marsh restoration and enhancement. The CRMC has also received a grant through the same program to initiate salt marsh elevation enhancement in the Ninigret salt pond in Charlestown, and to do planning for similar projects at Quonochontaug Pond in Charlestown and Winnipaug Pond in Westerly.

Climate Change Adaptation Strategies for Species of Greatest Conservation Need

Developing adaptation strategies for individual species depends on the vulnerability of specific species independent of, or in addition to, the vulnerability of the habitats within which they are found. In general, strategies employed to mitigate impacts to vulnerable habitats would also benefit resident species, although there are a number of characteristics that may increase a particular species’ vulnerability (IUCN 2008). These include:

- Specialized habitat and/or microhabitat requirements

- Narrow environmental tolerances or thresholds that are likely to be exceeded due to climate change at any stage in the life cycle.
- Dependence on specific environmental triggers or cues which are likely to be disrupted by climate change.
- Dependence on interspecific interactions which are likely to be disrupted by climate change.
- Poor ability to disperse to or colonize a new or more suitable range.
- Also, species with long generation times and low fecundity rates and that have low genetic variability (Staudinger, 2013).

The NEAFA white papers identified the following specific factors:

- **Diet.** Climate change can affect species populations by increasing or decreasing the availability of a primary food source or by changing the seasonal timing of the availability of the food source. Dietary generalists, species that eat a wide variety of foods, are generally less vulnerable than species that depend on specific foods.
- **Disease.** Higher temperatures can increase growth rates, strains, distribution of disease carriers, and susceptibility of the host animal to diseases and parasites, especially for aquatic species. Increased temperatures can also decrease the time it takes for a pathogen to complete its life cycle thus increasing its abundance and spread.
- **Habitat.** Climate change will affect plant community composition through changes in temperature, hydrology, and disturbance regimes (storms, fires, insect outbreaks, and diseases). These habitat changes will have direct effects on population sizes that can be supported by suitable habitat (both aquatic and terrestrial). As with diet, species that utilize a broader range of habitat types will be less vulnerable to climate change.
- **Dispersal.** When habitats are degraded and become unsuitable (for any reason), species' abilities to find new habitat depend on their mobility and the connectivity of suitable habitat, as well as the individual species mobility and adaptability to new or changing conditions.
- **Phenology.** In addition to the importance of timing of food availability, some species rely on environmental cues for breeding or migration, development, and other recurring life history events. Monitoring programs will be needed to determine when populations are declining due to changes in timing and management activities (e.g., hunting, stocking, etc.) may be adjusted. Monitoring programs may also need to shift or expand to capture changes in the timing of migrating populations (e.g., fixed monitoring dates during spring may no longer encompass the start or peak of a migration pulse).
- **Competition and inter-dependence.** Because some species are benefited by changes in climate and habitat while others are negatively impacted, changes in the competitive balance between species or the dependent relationships between species are expected. These changes are complex and likely to be surprising, even with strong monitoring efforts. In the future, new/novel climate niches and associated habitats may completely disrupt established competitive and dependent relationships between species.

In particular, the strategy of introducing species to areas outside their historical range to secure their future under climate change is a controversial adaptation action. Referred to as “managed relocation”, “assisted migration” or “assisted colonization,” there has been considerable debate in the literature

concerning the implementation of this methodology (Beardmore and Winder 2011, Rout et al. 2013). One question is whether conducting such introductions are worth the financial costs and ecological risks (i.e., what might be the potential collateral damage to the ecosystem at the introduction site). This is another example of where structured decision making and scenario planning approaches may be used to help managers make complex and controversial decisions and engage stakeholders in the process. Although the small size of Rhode Island limits the efficacy of conducting such projects within the state, it may be prudent to develop policies regarding managed relocations in advance of requests to conduct such projects.

Actions to Address Human Disturbance

Disturbance to wildlife through legitimate and illegitimate public activity is among the most damaging threats to wildlife habitat but arguably the one most easily mitigated. Some open space areas are considered to be “multiple use,” but unfortunately, many forms of outdoor recreation can disturb wildlife and even drive them from suitable habitats (Schlesinger et al. 2008). Moreover, some human activities usually considered benign can be damaging if they occur excessively at certain times or in sensitive areas. Disturbance is less severe at seasons when many animals are either not occupying a habitat (migratory song birds) or are inactive (reptiles). The political reality is that the public may not support land acquisitions and other conservation actions when human access is denied. As well, designated trails often lead to particular “points of interest” (streams, ponds, open ledges) that may also be occupied by sensitive species, leading to conflicts between trail development and species conservation. However, access points such as parking areas and trails can be routed to skirt relatively remote habitat cores.

Human activities may also result in direct physical damage to habitats because of excessive visitation. Some RI SGCN reside in habitat types (e.g., beaches) with soft substrates that can be easily compacted or scarified. For example, driving on beaches was thought to be the primary impact that caused the loss of the Northeastern Beach Tiger Beetle and led to its listing as a federally threatened species. Interior sand flats and barrens also support rare tiger beetles, and even protected sites may be overrun and degraded by illegal ORV use. More aggressive protection of such habitat types is clearly indicated.

Threat: Human disturbance impacts on SGCN and key habitats.

Action: Awareness and communications; Develop and provide educational program/materials to reduce incidental harm or mortality by human disturbance and intrusion. Rank: 3

Performance Measures:

- *Number programs, outreach material developed to target key users to addresses impacts on key habitats*

Action: Compliance and enforcement; Enforce compliance to reduce incidental harm or mortality by human disturbance and intrusion. Rank: 3

Performance Measures:

- *updated agency plan that addresses impacts on key habitats*

Taxa-wide Actions Listed by Threat with their Status, Performance Measure and Priority Rank – Tier 2

Taxa-Focused Conservation Actions

In addition to the above overarching actions that apply to SGCN and key habitats statewide, the following list of conservation actions and research, inventory and monitoring 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 SGCN groups. It is impractical to repeat all those actions here, so they are incorporated by reference in this document and addressed more specifically in step-down taxa plans and annual work plans. 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, RCN program priorities, etc. as relevant to Rhode Island.

Rank: 2

Performance Measures:

- *Number of recovery plan priority actions implemented for E/T species in Rhode Island.*
- *Number of other partners' management plan actions (local, state, regional and national) accomplished in Rhode Island for SGCN.*

Each of the animal taxonomic groups (Mammals, Birds, Reptiles, Amphibians, Fish, Beetles, Lepidoptera, Odonata, Mussels, and Marine Invertebrates) are addressed and include a list of overall threats and conservation actions/ inventory, research, and monitoring needs. Each action is ranked and includes associated performance metrics by which the success of the action can be measured. Since all actions are listed in Appendix 4, performance measures are listed only once in the appendix rather than the chapter.

In general, land and water protection and management, species management, education and awareness, and law and policy were the most frequently prescribed actions for most taxa.

Mammals

Threat: Lack of information

Actions:

Data collection and analysis

- Continue established long-term monitoring protocols. **Rank: 2.5**
- Evaluate existing significant hibernacula. **Rank: 3**
- Initiate monitoring of primary resources. **Rank: 2**
- Research abundance and distribution of species for which status and habitat can be determined, by including additional data collection in present studies. **Rank: 3**



Brian Wulker

Eastern Small-footed Myotis

Threat: Invasive and other problematic species and genes

Actions:

- Research invasive species issues, management and monitoring protocols related to issues involving impact to SGCN mammals. **Rank: 2**

Threat: Transportation and service corridors

Actions:

Technical assistance

- Establish discussions with state and local DOT. **Rank:1**

Planning

- Assess means to mitigate road effects. **Rank: 1**
- Enhance habitat connectivity for priority species with culverts. **Rank: 2**

Threat: Roads and railroads

Actions:

Law and policy

- Conduct road mitigations where required. **Rank: 2**

Planning

- Identify areas of significant road effects in focal areas. **Rank: 2**

Threat: Human intrusions and disturbance

Actions:

Education and awareness

- Develop and provide educational program/materials to reduce incidental mortality and take from humans. **Rank: 2**

Threat: Natural system modifications

Actions:

Habitat and natural process restoration

- Develop fire prescriptions for priority parcels. **Rank: 2**

Birds

Threat: Lack of information

Actions:

Data collection and analysis

- Assess effects of prolonged drawdowns - protect existing sites first and coordinate with Division of water management to identify priority sites. **Rank: 3**
- Assess effects of stream bank disturbance - protect existing sites first and coordinate with Division of water management to identify priority sites. **Rank: 2**
- Assess effects of water releases at dams - protect existing sites first and coordinate with Division



Peter W. C. Paton

American Black Duck

of water management to identify priority sites. **Rank: 3**

- Assess means to mitigate road effects. **Rank: 2**
- Create GIS coverage of field habitats. **Rank: 1**
- Determine appropriate indicator species or parameters to monitor water quality for pelagic species **Rank: 2**
- Evaluate use of migratory stopover/winter habitat. **Rank: 1**
- Evaluate water quality effects on priority species - protect existing sites first and coordinate with Division of water. **Rank: 2**
- Facilitate detection and diagnosis of diseases outbreaks - develop and fund a coordinated program and protocol to deal with disease effectively and proactively. **Rank: 3**
- Identify areas of significant road effects in focal areas - high for all forest interior species-coordinate with DOT. **Rank: 2**
- Identify concentration areas for non-breeding populations - protect existing sites first and coordinate with Division of water management to identify priority sites. **Rank: 2**
- Initiate monitoring of primary resources - coordinate with ongoing waterfowl research in the region and ACJV. **Rank: 2**
- Initiate monitoring of species at non-breeding sites - monitor breeding (high priority) and nonbreeding (low priority) population, work with landowners, restrict public use, and provide law enforcement. **Rank: 2**
- Research abundance and distribution of species for which status and habitat can be determined by including additional data collection in present studies. **Rank: 2**

Law and policy

- Conduct road mitigations where required. **Rank: 2**

Threat: Invasive and other problematic species and genes; Habitat loss and demographic changes from invasive species (vegetation and animal)

Actions:

Data collection and analysis

- Evaluate nutritional value of exotic fruit-bearing plants. **Rank: 1**

Threat: Transportation and service corridors- Habitat fragmentation from road effects

Actions:

Technical assistance

- Establish discussions with state and local DOT. **Rank: 1**

Data collection and analysis

- Identify areas of significant road effects in focal areas. **Rank: 2**

Habitat and natural process restoration

- Conduct road mitigations where required. **Rank: 3**

Planning

- Assess means to mitigate road effects. **Rank: 2**

Threat: Residential and commercial development

Actions:

Land/water management

- Minimize the loss of riparian habitats as much as possible. **Rank: 3**
- Site/area management; Manage important habitats as required. **Rank: 3**

Planning

- Develop strategies to mitigate aquatic degradation. Protect existing sites first and coordinate with Division of water management to identify priority sites. **Rank: 3**
- Encourage the use of “bird-friendly” glass in all new construction that utilizes more than a specified square footage of glass surface. **Rank: 3**

Threat: Natural system modifications; Loss of habitat from plant succession

Actions:

Data collection and analysis

- Identify priority parcels needing seral stage management. **Rank: 3**
- Identify priority parcels to retain as core forest areas with minimal management. **Rank: 3**

Habitat and natural process restoration

- Implement burn management on priority parcels. **Rank: 3**

Threat: Natural system modifications

Actions:

Site/area management

- Manage important habitats as required, reduce disturbance at nesting sites, and protect existing nesting sites. **Rank: 3**

Habitat and natural process restoration

- Implement priority restoration projects. **Rank: 3**

Threat: Lack of planning

Actions:

Habitat and natural process restoration

- Identify suitable restoration projects. **Rank: 2**

Planning

- Identify priority parcels needing seral-stage management, habitat - add nest box management program. **Rank: 2**
- Identify priority parcels to retain as core forest areas with minimal management - maintain forest interior habitat with shrub understory. **Rank:2**

Threat: Residential and commercial development; Lack of management and restoration of degraded habitat

Actions: Habitat and natural process restoration

Identify suitable restoration projects and implement priority restoration projects. **Rank: 2**

Threat: Lack of information from research to address habitat and taxonomic issues

Actions:

Data collection and analysis

- Assess taxonomy/population relationships. **Rank: 2**
- Continue established long-term monitoring protocols. **Rank: 3**

Threat: Lack of information dissemination, outreach, education

Actions:

Invasive/problematic species control

- Develop and provide educational information about invasive species. **Rank: 3**

Outreach

- Develop and provide educational program/materials to reduce incidental mortality and take from humans. **Rank: 3**

Threat: Fire and fire suppression

Actions:

Habitat and natural process restoration

- Coordinate burn management with other state and regional programs - continue to identify priority areas and burn with partners develop a coordinated statewide management coordination to identify how to best manage state lands. **Rank: 2**

Threat: Invasive and other problematic species and genes

Actions:

Habitat and natural process restoration

- Facilitate research to identify and mitigate disease potential - develop and fund a comprehensive disease surveillance program for all taxa. **Rank: 2**

Threat: Invasive and other problematic species and genes

Actions:

Invasive/problematic species control

- Research and implement mechanisms to control predation by feral cats. Options include discouraging artificial feeding of feral cat populations, development of trapping programs to reduce feral cat populations, and potential licensing of domestic cats.

Threat: Pollution

Actions:

Technical assistance

- Coordinate water quality protection with appropriate DOT, regional and federal programs - protect existing sites first and coordinate with Division of water management to identify priority sites. **Rank: 2**
- Coordinate with mosquito abatement personnel for chemical management - protect existing sites first and coordinate with Division of water management to identify priority sites. **Rank: 2**

Herpetofauna

Threat: Invasive non-native/alien species; Habitat loss and demographic changes from invasive species (vegetation and animal)

Actions:

Planning

- Create and implement invasive species monitoring protocol. Develop and implement sampling protocol for aquatic exotics. **Rank: 1**



Alex Figueroa

Timber Rattlesnake-Roads that fragment their habitat put this species at risk

Threat: Transportation and service corridors; Habitat fragmentation from road effects

Actions:

Technical assistance

- Establish discussions with state and local DOT. **Rank: 2**

Data collection and analysis

- Identify areas of significant road effects in focal areas. **Rank: 3**

Habitat and natural process restoration

- Conduct road mitigations where required. **Rank: 3**

Planning

- Assess means to mitigate road effects. **Rank: 3**

Threat: Pollution; Habitat fragmentation and degradation from chemical contaminants and disease

Actions:

Technical assistance

- Coordinate with mosquito abatement personnel for chemical management. **Rank: 2**

Data collection and analysis

- Identify chemical sources and compounds of concern. **Rank: 3**

Alliance and partnership development

- Coordinate chemical management with other state and regional programs. **Rank: 2**

Threat: Biological resource use; Demographic changes from incidental take (human)

Actions:

Education and awareness

- Develop and provide educational program/materials to reduce incidental mortality and take from humans. **Rank: 3**

Alliance and partnership development

- Coordinate incidental take programs with regional or national initiatives. **Rank: 2**

Threat: Lack of Planning; Habitat fragmentation from lack of focal area approach to conservation

Actions:

Outreach

- Outreach to golf courses in focal areas concerning impact of vegetation and chemical use. **Rank: 2**
- Outreach to nurseries in focal areas concerning chemical use. **Rank: 3**

Threat: Lack of information for monitoring and on-going assessment

Actions:

Research, survey, inventory, monitor habitats

- Monitor spatial qualities of habitat. **Rank: 3**

Threat: Residential and commercial development; Habitat loss from impairment of aquatic contiguity

Actions:

Habitat and natural process restoration

- Enhance habitat connectivity for priority species with culverts. **Rank: 2**

Fish



Atlantic Sturgeon-A Regional and Rhode Island SGCN

Threat: Lack of information

Actions:

Data collection and analysis

- Begin surveys in Narragansett Bay for pelagic fish earlier in the year to survey spring fish. **Rank: 3**
- 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. **Rank: 3**
- Create and implement invasive species monitoring protocol. **Rank: 3**
- Determine appropriate indicator species or parameters to monitor water quality for pelagic / anadromous fauna. **Rank: 3**
- Develop and implement sampling protocol for aquatic exotics. **Rank: 3**
- Facilitate research to identify and mitigate disease potential. **Rank: 3**

- Identify and map critical areas in the life history of species, particularly spawning areas. **Rank: 3**
- Identify concentration areas for non-breeding populations. **Rank: 3**
- Increase data bank on species habitat preferences and use in oil spill response planning and mapping. **Rank: 3**
- Initiate monitoring of species at non-breeding sites. **Rank: 3**
- Monitor spatial qualities of habitat. **Rank: 3**
- 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. **Rank: 3**
- Research abundance and distribution of species for which status and habitat can be determined, by including additional data collection in present studies. **Rank: 3**
- Research environmental sensitivity for slight changes in environmental factors that may lead to large impacts to the resource. **Rank: 3**
- Research marine mortality to determine the mortality rate of fish once they return to the estuary. **Rank: 3**
- 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. **Rank: 3**
- Research the bioaccumulation of pollutants in bottom feeders by locating, reducing and monitoring the input of pollutants into the water column. **Rank: 3**
- Research the impacts of pollution through tissue sampling of demersal finfish. **Rank: 3**
- Research whether hypoxia is changing the growth patterns for species of demersal finfish by using laboratory testing. **Rank: 3**
- Survey SGCN at priority sites. **Rank: 3**
- Undertake Multi season, pre- and post- dredging biological surveys to assess impacts to animal and submerged aquatic vegetation communities. **Rank: 3**
- Use gut content analyses to research the causes of high mortality after spawning, determining what is preying on species following spawning or if there are environmental causes. **Rank: 3**
- Identify key locations where short-term closures may have the most impact to restore fish populations and close those areas to fisheries. **Rank: 3**
- Assess which species are the most susceptible to threats and monitor them as indicator species. **Rank: 3**

Threat: Invasive and other problematic species and genes

Actions:

Technical assistance

- Coordinate invasive species management with other state and regional programs. **Rank: 2**

Data collection and analysis

- Identify and characterize fishery habitat functions and service in the area where the invasives have been found. Track changes in the species composition. **Rank: 2**
- Research invasive species management and monitoring protocols. **Rank: 2**

Invasive/problematic species control

- Assess pathways of introduction from water gardens and mail order. **Rank: 2**
- Coordinate aquatic exotic management with stocking agencies and mosquito abatement personnel. **Rank: 2**
- Develop and implement invasive species management program. **Rank: 2**
- Develop and implement program to mitigate effect of aquatic exotics. **Rank: 2**
- Develop predator control program to conduct intervention where appropriate for priority species. **Rank: 2**
- Identify potential damaging aquatic invasives and exotics. **Rank: 2**
- Identify potential damaging exotic plants. **Rank: 2**

- Identify priority areas for invasive plant management. **Rank: 2**

Species management

- Evaluate need for predator control intervention for priority species. **Rank: 2**

Threat: Pollution

Actions:

Technical assistance

- Coordinate chemical management with other state and regional programs. **Rank: 3**
- Coordinate with mosquito abatement personnel for chemical management. **Rank: 3**

Data collection and analysis

- Assess effects of sedimentation. **Rank: 3**
- Identify chemical sources and compounds of concern. **Rank: 3**
- Increase data bank on species habitat preferences and use in oil spill response planning and mapping. **Rank: 3**
- Monitor area for sediment, nutrient, and contamination levels, using indicator species or long term instrumentation analysis. **Rank: 3**

Land/water management

- Increase field and landscape buffers to provide cost effective protection against the cumulative effects of many small, but unavoidable, pollutant discharges associated with an active agriculture enterprise and the kinds of catastrophic pollution that can impact wildlife. **Rank: 3**

Habitat and natural process restoration

- Manage stormwater runoff to duplicate the natural process. **Rank: 2**

Law and policy

- 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. **Rank: 3**

Threat: Transportation and service corridors

Actions:

Technical assistance

- 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. **Rank: 2**
- Establish discussions with state and local DOT. **Rank: 2**

Data collection and analysis

- Assess means to mitigate road effects. **Rank: 2**
- Identify areas of significant road effects in focal areas. **Rank: 2**

Land/water management

- Enhance habitat connectivity for priority species with culverts. **Rank: 2**
- Set up preventative measures to limit transportation both internationally and locally. **Rank: 2**

Site/area management

- Avoid locating roads near wetlands and fish bearing streams. Roads should be sited to avoid sensitive areas such as wetlands, streams, steep slopes. **Rank: 2**

Habitat and natural process restoration

- Conduct road mitigations where required. **Rank: 2**

Threat: Dams and water management/use

Actions:

Data collection and analysis

- Address cumulative impacts of past and current dredging operations on fishery resources by considering them as part of the permitting process. **Rank: 3**
- Assess effects of prolonged drawdowns. **Rank: 3**
- Assess effects of water releases at dams. **Rank: 3**
- Assess effects of water withdrawals. **Rank: 3**

Habitat and natural process restoration

- 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. **Rank: 3**

Law and policy

- The diking and draining of tidal marshlands and estuaries should not be undertaken unless a satisfactory compensatory mitigation plan is in effect and monitored. **Rank: 3**

Threat: Lack of planning

Actions:

Technical assistance

- Coordinate monitoring with other state and regional monitoring programs. **Rank: 2**

Land/water management

- 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. **Rank: 2**

Planning

- Develop a strategic conservation plan for anadromous fish that will provide needed fish passage locations for shad, which can serve as a representative species. **Rank: 2**
- Identify and map critical areas in the life history of species, particularly spawning areas, and determine site fidelity to those areas. **Rank: 2**
- Use an adaptive management plan with ecological indicators to oversee monitoring and ensure mitigation objectives are met. Take corrective action as needed. **Rank: 2**
- Identify priority sites for survey, especially for freshwater fish and invertebrates. **Rank: 2**

Threat: Agriculture and aquaculture

Actions:

Resource and habitat protection

- Improve land use efficiencies for key agricultural inputs including nitrogen phosphorus pesticides and irrigation water. **Rank: 2**

Planning

- Identify priority parcels to retain as core forest areas with minimal management. **Rank: 2**
- The full range of agriculture buffer practices has to be systematically deployed, protected and managed across the agriculture landscape or overall aquatic habitat improvements will be minimal. **Rank: 2**

Threat: Residential and commercial development; Lack of management and restoration of degraded habitat

Actions:

Land/water protection

- Implement priority restoration projects. **Rank: 3**

Species and habitat management planning

- Identify suitable restoration projects. **Rank: 3**

Threat: Natural system modifications

Actions:

Land/water management

- Wherever possible, "soft" approaches (such as beach nourishment, vegetative plantings, and placement of large woody debris) to shoreline modifications should be used. **Rank: 2**

Threat: Biological resource use

Actions:

Law and policy

- Coordinate incidental take programs with regional or national initiatives. **Rank: 3**

Threat: Shipping lanes

Actions:

Compliance and enforcement

- Enforcement of ballast exchange measures well outside the coastal zone. **Rank: 1**

Threat: Roads and railroads

Actions:

Site/area management

- Assess means to mitigate road effects. **Rank: 2**

Threat: Lack of resources, staff, internal capacity

Actions:

Land/water management

- Increase number and training of response teams in the event of an accident. **Rank: 3**

Threat: Climate change and severe weather

Actions:

Other climate change actions

- Assess whether a succession of species may be occurring as a result of temperature changes. **Rank: 2**

Invertebrates- Benthic

Threat: Lack of information

Actions:

Data collection and analysis

- Conduct a literature search to identify key periods of the life history of benthic invertebrates and identify other research needs. **Rank: 3**

- 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. **Rank: 3**



URI

Tube worms in Rhode Island

- Research, survey, inventory, monitor populations; Assess the vulnerability of species during their reproductive cycle. **Rank: 3**
- Research, survey, inventory, monitor populations; Expand species surveys and increase data collection by adding selected target species to existing surveys. **Rank: 3**
- Research, survey, inventory, monitor populations; Research abundance and distribution of species for which status and habitat can be determined, by including additional data collection in present studies. **Rank: 3**
- Research, survey, inventory, monitor habitats; Identify and map critical areas in the life history of species, particularly spawning areas. **Rank: 3**

Threat: Residential and commercial development

Actions:

Research, survey, inventory, monitor populations

- Monitor the status and condition of species before they are impacted by building commercial fisheries. **Rank: 3**

Law and policy

- Minimize the loss of riparian habitats. **Rank: 3**
- The diking and draining of tidal marshlands and estuaries should not be undertaken unless a satisfactory compensatory mitigation plan is in effect and monitored. **Rank: 3**

Threat: Lack of planning

Actions:

Law and policy

- 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. **Rank: 2**

Planning

- Research slight changes in environmental factors that may lead to large impacts to the resource. **Rank: 2**

Threat: Biological resource use

Actions:

Law and policy

- Assess impacts to shellfish restoration projects and determine if they are adversely affecting

restoration efforts. **Rank: 3**

- Identify harvest levels of benthic invertebrate species, Change statute to include currently unregulated species and harvest methods. **Rank: 3**
- Aquaculture, overfishing by catch and incidental take and disturbance. **Rank: 3**

Threat: Shipping lanes

Actions:

Law and policy

- 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. Disposal impacts should be considered. **Rank: 3**
- 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. **Rank: 3**

Threat: Transportation and service corridors

Actions: Research, survey, inventory, monitor populations;

- Assess the site fidelity of benthic invertebrates, whether they will relocate to spawn or not spawn at all following disturbance. **Rank: 2**
- Research life history data to locate species in their pre-emergent life stage. **Rank: 2**

Threat: Industrial and military effluents

Actions:

Law and policy

Incorporate best management practices to prevent or minimize contamination from ship bilge waters, antifouling paints, shipboard accidents, shipyard work, maintenance dredging. **Rank: 2**

Threat: Energy production and mining

Actions:

Training

- Increase number and training of response teams in the event of an accident. **Rank: 2**

Invertebrates-Estuarine

Threat: Lack of information

Actions:

Data collection and analysis

- 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. **Rank: 2**
- 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.

Rank: 2

- Database development; Identify and map critical areas and habitat types in the life history of species, particularly spawning areas, by incorporating estuarine invertebrates into other surveys.



TNC

Ribbed mussel in low marsh-a benthic invertebrate

Rank: 3

- Research, survey, inventory, monitor habitats; Assess the water quality of estuarine invertebrate habitats, identifying the need for additional conservation actions. **Rank: 3**

Threat: Residential and commercial development

Actions:

Land/water management

- Wherever possible, "soft" approaches (such as beach nourishment, vegetative plantings, and placement of large woody debris) to shoreline modifications should be used. **Rank: 3**

Planning

- Identify and characterize fishery habitat functions and service in the project area. **Rank: 3**

Threat: Lack of Planning

Actions:

Data collection and analysis

- Research environmental sensitivity for slight changes in environmental factors that may lead to large impacts to the resource. **Rank: 2**

Research, survey, inventory, monitor habitats

- Assess which species may be indicators of the health of the marsh / estuarine environment. **Rank: 2**

Threat: Pollution

Actions:

Law and policy

- Locate discharge points in coastal waters well away from shellfish beds, seagrass beds, reefs and other similar fragile and productive habitats. **Rank: 3**

Threat: Problematic native species

Actions:

Research, survey, inventory, monitor populations

- 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. **Rank: 2**

Threat: Shipping lanes

Actions:

Law and policy

- 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. **Rank: 3**

Threat: Transportation and service corridors

Actions:

Law and policy

- Avoid locating roads near wetlands and fish bearing streams. Roads should be sited to avoid sensitive areas such as wetlands, streams, steep slopes. **Rank: 3**

Threat: Energy production and mining

Actions:

Research, survey, inventory, monitor habitats

- Increase data bank on species habitat preferences and use in oil spill response planning and mapping. **Rank: 2**



Gregory Brees/USFWS

Atlantic Horseshoe Crab-both benthic and estuarine invertebrates

Invertebrates-Terrestrial

Threat: Natural system modifications; Plant succession

Actions:

Land/water protection

- Identify parcels needing seral stage management. **Rank: 2**

Data collection and analysis

- Evaluate effectiveness of management strategies. **Rank: 2**

Research, survey, inventory, monitor habitats

- Identify parcels to retain as core forest areas with minimal management. **Rank: 2**

Land/water management

- Manage important habitats as required. Develop fire prescriptions for priority parcels. **Rank:2**

Habitat and natural process restoration

- Implement burn management on priority parcels. **Rank: 2**

Alliance and partnership development

- Coordinate with other state and regional programs. **Rank: 2**

Outreach

- Expand public relations for fire management. **Rank: 2**

Planning

- Develop management strategy to maintain successional vegetation. **Rank: 2**

Threat: Pollution

Actions:

Technical assistance

- Coordinate chemical management with other state and regional programs. **Rank: 2**
- Technical assistance; Coordinate with mosquito abatement personnel for chemical management. **Rank: 2**

Data collection and analysis

- Identify chemical sources and compounds of concern. **Rank: 1**

Threat: Invasive and other problematic species and genes

Actions:

Alliance and partnership development

- Coordinate invasive species management with other state and regional programs. **Rank: 3**

Invasive/problematic species control

- Create and implement invasive species monitoring protocol. **Rank: 2**
- Research invasive species management and monitoring protocols. **Rank:2**

Threat: Lack of information

Actions:

Data collection and analysis

- 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. **Rank: 2**
- Conduct a literature search to identify and map critical areas in the life history of habitat specific invertebrates and identify other research needs. **Rank: 2**
- Research abundance and distribution of species for which status and habitat can be determined, by including additional data collection to existing surveys. **Rank: 2**

Threat: Residential and commercial development

Actions:

Land/water management

- Wherever possible, "soft" approaches (such as beach nourishment, vegetative plantings, and placement of large woody debris) to shoreline modifications should be used. **Rank: 3**

Law and policy

- Adequate compensatory mitigation should be provided for unavoidable impacts. **Rank: 3**

Threat: Transportation and service corridors

Actions:

Law and policy

- Adequate compensatory mitigation should be provided for unavoidable impacts. **Rank: 3**

Threat: Agriculture and aquaculture

Actions:

Law and policy

- Adequate compensatory mitigation should be provided for unavoidable impacts. **Rank: 3**

Invertebrates-Beetles, Moths, Butterflies, Bees, Flies

Threat: Lack of information

Actions:

Data collection and analysis

- Assess taxonomy/population relationships. **Rank: 1**
- Coordinate processing of specimens and conversion and storage of electronic data. **Rank: 3**

Research, survey, inventory, monitor populations;

- Determine geographic distribution of SGCN. **Rank: 2**
- Identify breeding locations and geographic distribution. **Rank: 3**
- Monitor spatial qualities of habitat. **Rank: 2**

Planning

- Identify suitable restoration projects for Lepidoptera. **Rank: 1**



USFWS

Aphrodite Fritillary on milkweed flower

Threat: Invasive and other problematic species and genes

Actions:

Research, survey, inventory, monitor populations

- Identify potential damaging exotic plants. **Rank: 3**

Research, survey, inventory, monitor habitats

- Identify priority areas for invasive plant management. **Rank: 2**

Education and awareness

- Develop and provide educational information about invasive species. **Rank: 1**

Planning

- Develop and implement invasive species management program. **Rank: 2**

Threat: Lack of planning

Actions:

Land/water protection

- Implement priority restoration projects for Lepidoptera habitat. **Rank: 2**

Habitat and natural process restoration

- Manage important habitats as required, especially for Lepidoptera habitat. **Rank: 3**

Planning

- Evaluate need for specialty cover types, especially for Lepidoptera, and identify priority sites for management. **Rank: 2**

Species and habitat management planning

- Develop management strategy to maintain successional vegetation and manage for target invertebrate groups, including pollinators. **Rank: 3**
- Identify parcels to retain as core forest areas with minimal management. **Rank: 3**
- Identify parcels needing seral stage management. Manage important habitats as required. **Rank: 3**
- Develop fire prescriptions for priority parcels. Implement burn management on priority parcels. **Rank: 3**
- Expand public relations for fire management. **Rank: 3**
- Coordinate with other state and regional programs. **Rank: 3**
- Evaluate effectiveness of management strategies. **Rank: 3**

Threat: Pollution

Actions: Outreach

- Outreach to golf courses in focal areas concerning impact of vegetation and chemical use. **Rank: 2**
- Outreach to nurseries in focal areas concerning chemical use. **Rank: 1**
- Discourage application of certain chemicals and other pest control techniques (bug zappers) by consumers in residential settings that impact non-target species. **Rank: 3**

Threat: Fire and fire suppression

Actions: Alliance and partnership development

- Coordinate burn management with other state and regional programs. **Rank: 1**

Threat: Residential and commercial development

Actions:

Habitat and natural process restoration

- Identify priority parcels needing seral stage management, especially for Lepidoptera habitat. **Rank: 2**

Invertebrates-Freshwater Mussels

Threat: Invasive and other problematic species and genes

Actions:

Invasive/problematic species control

- Assess pathways of introduction from water gardens and mail order. **Rank: 3**
- Develop and implement program to mitigate effect of aquatic exotics. **Rank: 2**
- Develop and implement sampling protocol for aquatic exotics. **Rank: 2**
- Identify potential damaging aquatic invasives and exotics. **Rank: 3**

Species management

- Evaluate need for predator control intervention for priority species. **Rank: 2**

Threat: Transportation and service corridors

Actions:

Technical assistance

- Establish discussions with state and local DOT. **Rank: 3**

Resource and habitat protection

- Enhance habitat connectivity for priority species with culverts. **Rank: 1**

Habitat and natural process restoration

- Conduct road mitigations where required. **Rank: 3**

Planning;

- Assess means to mitigate road effects. **Rank: 3**
- Identify areas of significant road effects in focal areas. **Rank: 3**



CT DEEP

Eastern Lampmussel

Threat: Pollution

Actions:

Technical assistance

- Coordinate water quality protection with appropriate DOT, regional and federal programs.

Rank: 3

Data collection and analysis

- Assess effects of sedimentation. **Rank: 3**
- Evaluate water quality effects on priority species. **Rank: 3**

Species and habitat management planning

- Develop strategies to mitigate aquatic degradation. **Rank: 3**

Threat: Dams and water management/use

Actions:

Data collection and analysis

- Assess effects of prolonged drawdowns. **Rank: 3**
- Assess effects of water releases at dams. **Rank: 2**
- Assess effects of water withdrawals. **Rank: 3**

Outreach

- Expand public awareness of fish passage issues. **Rank: 3**

Threat: Lack of information

Actions:

Alliance and partnership development

- Coordinate monitoring with other state and regional monitoring programs. **Rank: 2**

Data collection and analysis;

- Continue established long-term monitoring protocols. **Rank: 2**
Determine relative abundance of SGCN, especially freshwater fish and invertebrates. **Rank: 3**

Threat: Lack of information dissemination, outreach, education

Actions:

Technical assistance

- Outreach to golf courses in focal areas concerning impact of vegetation and chemical use. **Rank: 2**
- Outreach to nurseries in focal areas concerning chemical use. **Rank: 2**

Threat: Lack of planning

Actions:

Planning

- Enhance habitat connectivity for priority species with fish ladders. **Rank: 3**

Habitat and natural process restoration

- Implement priority restoration projects for Mussel habitat. **Rank: 2**

Threat: Biological resource use

Actions:

Law and policy

- Coordinate incidental take programs with regional or national initiatives. **Rank: 1**

Outreach

- Develop and provide educational program/materials to reduce incidental mortality and take from humans. **Rank: 1**

Threat: Human intrusions and disturbance

Actions:

Resource and habitat protection

- Assess effects of stream bank disturbance. **Rank: 2**

Threat: Invasive non-native/alien species

Actions:

Species management

- Develop predator control program to conduct intervention where appropriate for priority species. **Rank: 2**

Threat: Residential and commercial development

Actions:

Habitat and natural process restoration

- Identify suitable restoration projects for Mussel habitat. **Rank: 3**

Invertebrates-Dragonflies and Damselflies

Threat: Pollution; Degradation of water quality due to run-off and siltation in aquatic habitat (resulting from development/disturbance in surrounding upland): fertilizers, herbicides, pesticides, road salt, sand/silt, toxins

Actions:

Policies and regulations

- Strengthen wetland regulations to allow larger regulatory buffers in development projects. **Rank: 3**

Outreach

- Develop and provide educational program/materials to reduce incidental mortality and take from humans. **Rank: 2**

Site/area management

- Limit access/use of pond shores/river banks for recreation. **Rank: 2**



Dragonfly at Tristom Pond NWR

Tom Tetzner

Threat: Invasive and other problematic species and genes

Actions:

Technical assistance

- Coordinate aquatic exotic management with stocking agencies and mosquito abatement personnel. **Rank: 2**

Research, survey, inventory, monitor populations

- Identify potential damaging exotic plants. **Rank: 2**

Research, survey, inventory, monitor habitats

- Identify priority areas for invasive plant management. **Rank: 2**

Planning

- Develop and implement invasive species management program. **Rank: 2**
- Develop and implement program to mitigate effect of aquatic exotics. **Rank: 2**

Threat: Lack of information

Actions:

Data collection and analysis

- Assess threat from fish. **Rank: 2**
Determine relative abundance of SGCN, especially freshwater fish and invertebrates. **Rank: 2**
- Determine geographic distribution of SGCN, especially invertebrates. **Rank: 2**
- Identify breeding locations and geographic distribution, especially for invertebrates. **Rank: 2**

Research, survey, inventory, monitor habitats

- Monitor spatial qualities of habitat. **Rank: 2**

Threats: Transportation and service corridors

Actions:

Technical assistance

- Establish discussions with state and local DOT. **Rank: 2**

Data collection and analysis

- Identify areas of significant road effects in focal areas. **Rank: 2**

Habitat and natural process restoration

- Conduct road mitigations where required. **Rank: 2**

Planning

- Assess means to mitigate road effects. **Rank: 2**

Threat: Invasive non-native/alien species

Actions:

Research, survey, inventory, monitor populations

- Identify potential damaging aquatic invasives and exotics. **Rank: 2**

Education and awareness

- Develop and provide educational information about invasive species. **Rank: 2**

Planning

- Develop and implement sampling protocol for aquatic exotics. **Rank: 2**

Threats: Other ecosystem modifications; Introduction of fish in fishless ponds; Fish stocking programs

Actions:

Data collection and analysis

- Monitor fishless ponds for accidental introduction of fish. **Rank: 2**

Species management

- Monitor priority habitats for invasive plant species; Consider management/removal as appropriate. **Rank: 2**

Threat: Climate change and severe weather; Alteration of hydrology, water temperature, plant communities

Actions:

Land/water protection. Rank: 2

Law and policy. Rank: 2

Threat: Lack of planning; Inadequate wetland regulations

Actions:

Policies and regulations

- Strengthen wetland regulations to allow larger regulatory buffers in development projects. Site/area management. **Rank: 3**

Threat: Invasive non-native/alien species; especially aquatic plants (e.g., *Phragmites*, Purple Loosestrife)

Actions:

Species management

- Monitor priority habitats for invasive plant species; Consider management/removal as appropriate. **Rank: 2**

Threat: Residential and commercial development; Urbanization of watersheds: deforestation, development, & roads

Actions:

Land/water protection

- Protect aquatic habitats through purchase of surrounding uplands (via fee and conservation easements). **Rank: 2**

Priority Habitat Conservation Actions by Key Habitats – Tier 3

Actions were identified for all habitats at the type level. They are listed in the Key Habitat Profiles. These actions have been compiled here to the Community level to provide the following priority conservation actions were identified for habitats.

Agricultural

Threat - Housing and urban areas and commercial and industrial areas

Actions:

Site/area protection

- Identify and acquire key parcels for fee purchase and easement. **Rank: 2.5**

Resource and habitat protection

- Prepare site-specific management plans and determine proper management of grazing animals to protect nesting birds. **Rank: 2**

Policies and regulations

- Prepare management plans. **Rank: 2**

Site/area protection

- Continue efforts to preserve farmland through purchase of development rights, Farm, Forest and Open Space, and other programs. **Rank: 3**

Resource and habitat protection

- Support conservation programs implemented by NRCS and other agencies. **Rank: 3**

Policies and regulations

- Support policies that help farmers continue to farm their land. **Rank: 2**

Site/area protection

- Identify and acquire key parcels for fee purchase and easement. **Rank: 3**

Resource and habitat protection

- Prepare site-specific management plans and determine proper times for mowing/haying that protect nesting birds. **Rank: 3**

Policies and regulations

- Prepare management plans. **Rank: 2**

Threat - Nutrient loading from manure, etc.

Actions:

Site/area management

- Conduct field rotation of livestock to prevent buildup of manure, etc. **Rank: 2**

Policies and regulations

- Prepare management plans. **Rank: 2**



Pumpkin patch in West Kingston, RI

L. Gould

Threat - Grazing animals may encourage some invasives by diet selection. Example, barberry unpalatable to cows.

Actions:

Invasive/problematic species control

- Control invasives as needed. **Rank: 2**

Threat - Loss of habitat from plant succession

Actions:

Habitat and natural process restoration

- Develop fire prescriptions for priority parcels. **Rank: 2**
- Implement burn management on priority parcels. **Rank: 2**

Outreach

- Expand public relations for fire management. **Rank: 2**

Threat - Lack of information from research to address habitat and taxonomic issues

Actions:

Research, survey, inventory, monitor populations

- Evaluate use of migratory stopover/winter habitat. **Rank: 2**

Threat - Fertilizers and pesticides used on non-organic operations

Actions:

Site/area management

- Encourage farmers to utilize organic farming methodologies. **Rank: 2**

Policies and regulations

Provide expertise and research on the effects of pesticides and herbicides on wildlife. **Rank: 2**

Threat - Fertilizers and pesticides

Actions:

Site/area management

- Investigate organic methods for hay production. **Rank: 2**

Policies and regulations

Provide expertise and research on the effects of pesticides and herbicides on wildlife. **Rank: 3**

Invasive/problematic species control

- Control invasives when problems arise. **Rank: 2**

Threat - Loss of habitat from plant succession

Actions:

Habitat and natural process restoration

- Develop fire prescriptions for priority parcels. **Rank: 2**
- Implement burn management on priority parcels. **Rank: 2**

Outreach

- Expand public relations for fire management. **Rank: 2**

Threat - Lack of information from research to address habitat and taxonomic issues; Lack of research to guide threat assessment and prioritization of conservation planning

Actions:

Research, survey, inventory, monitor populations

- Evaluate use of migratory stopover/winter habitat. **Rank: 2**

Threat - Lack of information from research to address habitat and taxonomic issues

Actions:

Research, survey, inventory, monitor populations

- Evaluate use of migratory stopover/winter habitat. **Rank: 2**

Coastal Stream

Threat - All categories impact this habitat type

Actions:

Land/water protection

- Preserve and restore cover for streams, and mitigate runoff. **Rank: 3**

Threat - Inhibit the movement of fish, increase water temperature, and create lentic habitat

Actions:

Land/water protection

- Protect and manage land; mitigate runoff. **Rank: 3**

Threat - Competition

Education and awareness

- Educate the public. **Rank: 1**



P. August

Pawcatuck River, Westerly, RI

Coniferous Woodlands & Forests



Jim Kuhn

Atlantic White Cedar Swamp

Threat - Highly developable habitat type; large portions already fragmented by housing (e.g., Kingston Pine Barrens)

Actions:

Site/area protection

- Identify and acquire key parcels for fee purchase and easement. **Rank: 3**

Resource and habitat protection

- Identify and acquire key parcels for fee purchase and easement. **Rank: 3**

Policies and regulations

- Identify and influence mechanisms for incentivizing landowners for conservation and watershed protection (farm, forest and OS; local planning policies that make it possible for land owners to economically benefit). **Rank: 2**

Threat - Any alterations in groundwater, overland flow can impact this habitat

Actions:

Site/area protection

- Identify any land acquisition needs that limit this threat. **Rank: 2**

Policies and regulations

- Limit changes in hydrology of wetlands. **Rank: 2**

Threat - Wetlands used for illegal dumping

Actions:

Site/area protection

- Identify and acquire problem sites. **Rank: 2**

Site/area management

- Control public access by vehicles. **Rank: 2**

Threat - Woolly Adelgid

Actions:

Invasive/problematic species control

- Expand and fund early detection and response program; give towns tools to identify and manage invasives; develop BMPs for state and local transportation depts. (disposal sites, equipment cleaning etc.); (earthworms, may include an education component); increase funding for control programs. **Rank: 2**

Data collection and analysis

- Research into resistant hemlock ecotypes. **Rank: 2**

Threat - Demographic changes from excessive predation (animal)

Actions:

Invasive/problematic species control

- Encourage the taking of more deer (special permits, etc., allow hunters to take more, introduce more hunting capacity if existing hunter population is insufficient, get more people into hunting (women etc.); temporary regulations to reduce the population and then maintain it. **Rank: 2**

Threat - Fire-dependent community, therefore fire suppression is threat

Actions:

Site/area management

- Utilize controlled burns and selective harvesting. **Rank: 3**
- Habitat and natural process restoration; high, restore plants (e.g., lupine) for pollinators (Frosted Elfin, etc.). **Rank: 2**

Threat - This community has not been prone to the spread of invasives

Actions:

Invasive/problematic species control

- Early detection; Provide control where needed. **Rank: 2**

Threat - Demographic changes from excessive deer browsing

Actions:

Invasive/problematic species control

- Provide additional hunting opportunities in problem areas; Provide deer control where needed. **Rank: 2**

Deciduous Woodlands & Forests



West Greenwich Land Trust

Mixed age deciduous forest on Pratt Property, RI

Threat - Housing and urban areas and commercial and industrial areas; Most widespread upland forest type on highly developable upland soils

Actions:

Site/area protection

- Identify and acquire key parcels for fee purchase and easement. **Rank: 3**

Resource and habitat protection

- Identify and acquire key parcels for fee purchase and easement. **Rank: 3**

Policies and regulations

- Identify and influence mechanisms for incentivizing landowners for conservation and watershed protection (e.g., farm, forest and OS; local planning policies that make it possible for land owners to economically benefit). **Rank: 2**

Threat - New road construction causes fragmentation of habitat

Actions:

Site/area protection

Identify and acquire parcels; Identify any land acquisition needs that limit this threat. **Rank: 3**

Resource and habitat protection

- Provide opportunities for inland migration. **Rank: 3**

Policies and regulations

- Provide local municipalities and state with the information to locate transportation corridors in appropriate places; locate roads for potential abandonment; incorporate sufficient natural buffer widths into local subdivision regulations. **Rank: 2**

Threat - Causes fragmentation of habitat, but plans for new corridors have been limited

Actions:

Site/area protection

- Identify and acquire problem sites. **Rank: 2**

Resource and habitat protection

- Provide opportunities for inland migration. **Rank: 2**

Policies and regulations

- Restrict utility upgrades, lines/pipes to existing corridors; encourage underground placement of utility lines. **Rank: 2**

Threat - Threat to mature forests primarily at habitat edges, some incursion by woody species into interiors

Actions:

Invasive/problematic species control

- Expand and fund early detection and response program; give towns tools to identify and manage invasives; develop BMPs for state and local transportation depts. (disposal sites, equipment cleaning etc.). **Rank: 2**

Habitat and natural process restoration

- Allow for natural mature, functioning forests that will be resistant to invasives (limit cutting of snags, limit clearing, etc.). **Rank: 2**

Policies and regulations

- Develop nuisance plant list to limit sale and use of problematic species, firewood movement restrictions. **Rank: 3**

Threat - Clearing within forest core areas prevents forest maturation and increases threat from invasives.

Actions:

Habitat and natural process restoration. Rank: 2

Policies and regulations. Rank: 2

Threat - Deer browsing

Actions:

Invasive/problematic species control

- Encourage the taking of more deer (special permits, etc., allow hunters to take more, introduce more hunting capacity if existing hunter population is insufficient, get more people into hunting (women etc.); temporary regulations to reduce the population and then maintain it. **Rank: 2**

Threat - Habitat fragmentation and degradation from human disturbance

Actions:

Outreach

- Control public access at priority sites. **Rank: 2**

Threat - Woody invasives primarily, but mature maritime woodlands are relatively invasive-free

Actions:

Invasive/problematic species control

- Provide early detection and rapid response to problem situations. **Rank: 1**

Threat – Invasives are considered a low level threat given the current extent and distribution of this habitat.

Actions:

Site/area protection

- Identify and acquire parcels. **Rank: 2**

Resource and habitat protection

- Provide opportunities for inland migration. **Rank: 1**

Policies and regulations

- Prepare management plans. **Rank: 2**

Threat - Demographic changes from excessive deer browsing

Actions:

Invasive/problematic species control

- Provide additional hunting opportunities in problem areas; Provide deer control where needed. **Rank: 2**

Threat - Developable sites in NW part of state. Although much of this habitat protected, even small development projects can create significant fragmentation.

Actions:

Site/area protection

- Identify and acquire key parcels for fee purchase and easement. **Rank: 3**

Resource and habitat protection

- Identify and acquire key parcels for fee purchase and easement. **Rank: 3**

Policies and regulations

- Identify and influence mechanisms for incentivizing landowners for conservation and watershed protection (e.g., farm, forest and OS; local planning policies that make it possible for land owners to economically benefit). **Rank: 2**

Outreach

- Educate local planners, developers, and residents. **Rank: 2**

Threat - Although new primary roads unlikely, even access roads and driveways fragment habitat

Actions:

Site/area protection

Identify and acquire parcels; Identify any land acquisition needs that limit this threat. **Rank: 3**

Resource and habitat protection

- Provide opportunities for inland migration. **Rank: 3**

Policies and regulations

- Provide local municipalities and state with the information to locate transportation corridors in appropriate places; locate roads for potential abandonment; incorporate sufficient natural buffer widths into local subdivision regulations. **Rank: 2**

Threat - New ROWs unlikely, but some existing ones have already created fragmentation.

Actions:

Site/area protection

- Identify and acquire problem sites. **Rank: 2**

Resource and habitat protection

- Provide opportunities for inland migration. **Rank: 2**

Site/area management. Rank: 2

Policies and regulations

- Provide comments for new road planning. **Rank: 1**

Threat - Greatest threat along edges of roads, ROWs, etc. Threat to interior related to ATV and other vehicle use transporting seeds, etc. Also threats from insect pests to specific trees, etc.

Actions:

Invasive/problematic species control

- Expand and fund early detection and response program; give towns the tools to identify and manage invasives; Develop BMPs for state and local transportation depts. (disposal sites, equipment cleaning etc.). **Rank: 3**

Habitat and natural process restoration

- Allow for natural mature, functioning forests that will be resistant to invasives (limit cutting of snags, limit clearing, etc.). **Rank: 2**

Policies and regulations

- Develop nuisance plant list to limit sale and use of problematic species.

Awareness and communications

- Prepare materials to educate public about accidental transport of invasive species. Include outreach to municipalities and other road managers regarding transport of invasives. **Rank: 3**

Threat - Clearing within forest core areas prevents forest maturation and increases threat from invasives.

Actions:

Site/area management

- Allow natural processes to develop mature forest cores. **Rank: 2**

Habitat and natural process restoration

- Conduct limited tree-cutting to simulate natural blowdowns and development of understory vegetation; Restore populations of native plants. **Rank: 1**

Policies and regulations

- Prepare management plans and guidelines for other agencies. **Rank: 2**

Threat - Deer browsing of understory vegetation has caused declines in some plant populations

Actions:

Invasive/problematic species control

- Encourage the taking of more deer (special permits, etc., allow hunters to take more, introduce more hunting capacity if existing hunter population is insufficient, get more people into hunting (e.g., women etc.); temporary regulations to reduce the population and then maintain it. **Rank: 2.5**

Threat - Logging and wood harvesting; Clearing within core habitat creates fragmentation and inroads for invasive species; however, highly selective harvesting may be allowed to simulate natural blowdowns.

Actions:

Site/area management

- Provide management according to management plans. **Rank: 1**

Habitat and natural process restoration

- Allow natural processes to manage habitat. **Rank: 3**

Policies and regulations

- Prepare management plans. **Rank: 2**

Threat - Acid rain, heavy metals at edges; Improvement in recent years

Actions:

Policies and regulations

- Support stronger rules to control air pollution. **Rank: 1**

Threat - Climate impacts will affect individual species with replacement by others

Actions:

Data collection and analysis

- Conduct research on vulnerability of individual species to warming climate. **Rank: 2**

Threat - Invasive non-native/alien species; Impacted sites can be heavily infested with invasive plants.

Actions:

Invasive/problematic species control. Rank: 2

Habitat and natural process restoration. Rank: 2

Threat - Increased precipitation and flooding could alter disturbance regime that maintains this habitat

Actions:

Site/area protection. Rank: 2

Data collection and analysis

- Conduct monitoring of habitats. **Rank: 2**

Threat - Lack of information from research to address habitat and taxonomic issues

Actions:

Research, survey, inventory, monitor populations

- Evaluate use of migratory stopover/winter habitat. **Rank: 3**

Threat - Lack of information about loss of habitat from plant succession

Actions:

- Data collection and analysis **Rank: 2**

Threat - Habitat fragmentation and degradation from human disturbance

Actions:

Outreach

- Control public access at priority sites. **Rank: 2**

Threat - Habitat loss of critical micro-features

Actions:

Research, survey, inventory, monitor populations

- Evaluate existing significant hibernacula and nesting substrate; Identify priority sites for management. **Rank: 2**

Threat - Tends to be on ridges and rocky soils with more limited development potential.

Actions:

Site/area protection

- Identify and acquire key parcels for fee purchase and easement. **Rank: 3**

Resource and habitat protection

- Identify and acquire key parcels for fee purchase and easement. **Rank: 3**

Policies and regulations

- Identify and influence mechanisms for incentivizing land owners for conservation and watershed protection (farm, forest and OS; local planning policies that make it possible for land owners to economically benefit). **Rank: 2**

Outreach

- Educate local land owners. **Rank: 2**

Threat - New road construction causes fragmentation of habitat.

Actions:

Site/area protection

Identify and acquire parcels; Identify any land acquisition needs that limit this threat. **Rank: 3**

Resource and habitat protection

- Provide opportunities for inland migration. **Rank: 3**

Policies and regulations

- Provide local municipalities and state with the information to locate transportation corridors in appropriate places; locate roads for potential abandonment; incorporate sufficient natural buffer widths into local subdivision regulations. **Rank: 3**

Threat - Causes fragmentation of habitat, but plans for new corridors have been limited

Actions:

Site/area protection

- Identify and acquire problem sites. **Rank: 2**

Resource and habitat protection

- Provide opportunities for inland migration. **Rank: 2**

Policies and regulations

- Restrict utility upgrades, lines/pipes to existing corridors; encourage underground placement of utility lines. **Rank: 2**

Threat - Threat to mature forests primarily at habitat edges, some incursion by woody species into interiors

Actions:

Invasive/problematic species control

- Expand and fund early detection and response program; give towns the tools to identify and manage invasives; develop BMPs for state and local transportation depts. (disposal sites, equipment cleaning etc.). **Rank: 3**

Habitat and natural process restoration

- Allow for natural mature, functioning forests that will be resistant to invasives (e.g., limit cutting of snags, limit clearing, etc.). **Rank: 2**

Policies and regulations

- Develop nuisance plant list to limit sale and use of problematic species, firewood movement restrictions. **Rank: 3**

Threat - Clearing within forest core areas prevents forest maturation and increases threat from invasives.

Actions:

Habitat and natural process restoration. Rank: 3

Policies and regulations. Rank: 3

Threat - Habitat fragmentation and degradation from human disturbance

Actions:

Outreach

- Control public access at priority sites. **Rank: 2**

Research, survey, inventory, monitor populations

- Evaluate use of migratory stopover/winter habitat. **Rank: 2**

Threat - Habitat loss of critical micro-features

Actions: Research, survey, inventory, monitor populations

- Evaluate existing significant hibernacula and nesting substrate; identify priority sites for management. **Rank: 2**

Eutrophic (Lake)

Threat - All categories impact this habitat type

Actions: Land/water protection

- Mitigate runoff and nutrient input from defective septic systems. **Rank: 3**

Threat - Increased nutrients, stimulate plant growth

Actions: Land/water protection

- Protection and management of land, mitigate runoff. **Rank: 3**

Threat - Competition

Actions: Education and awareness

- Educate the public. **Rank: 2**

Forested Mineral Soil Wetlands



D. Payne

Vernal pool within Arcadia Management Area, Hopkington, RI

Threat - Legal buffer not adequate to protect habitat; changes in understory documented: sources include siltation of streams, non-native vegetation in edge habitat

Actions:

Site/area protection

- Identify and acquire as needed, focusing on upland buffers. **Rank: 2**

Resource and habitat protection

- Increase extent of undeveloped land in upland buffers. **Rank: 2**

Policies and regulation

- Increase protection and extent of upland buffers in wetlands regulations. **Rank: 2**

Threat - Any alterations in groundwater, overland flow can impact this habitat

Actions:

Site/area protection

- Identify any land acquisition needs that limit this threat. **Rank: 2**

Policies and regulations

- Support restrictions on changes in hydrology of wetlands. **Rank: 2**

Site/area management. Rank: 2

Threat - Hemlock Woolly Adelgid causing die-off of hemlock, resulting openings may provide areas for spread of invasive plants.

Actions:

Invasive/problematic species control

- Utilize current acceptable methods for controlling woolly adelgid. **Rank: 2**

Habitat and natural process restoration

- Allow natural succession of habitat in the event of loss of hemlock. **Rank: 2**

Policies and regulations. Rank: 2

Threat - Wetlands used for illegal dumping

Actions:

Site/area protection

- Identify and acquire problem sites. **Rank: 2**

Site/area management

- Control public access by vehicles. **Rank: 2**

Threat - Loss of habitat from plant succession

Actions: Research, survey, inventory, monitor habitats

- Identify priority parcels to retain as core forest areas with minimal management. **Rank: 3**

Threat - Most of these habitats are too small to be afforded adequate protection under current wetlands regulations

Actions:

Site/area protection

- Acquisition of clusters of pools when possible. **Rank: 2**

Resource and habitat protection

- Retain natural forest cover surrounding these wetlands. **Rank: 3**

Policies and regulations

- Amend wetlands regulations to support greater protection for small wetlands. **Rank: 2**

Threat - Vernal pools often used for illegal dumping.

Actions:

Site/area protection

- Identify and acquire problem sites. **Rank: 2**

Policies and regulations

- Support greater penalties for illegal dumping. **Rank: 2**

Threat - Heavy equipment use during logging operations; opening of tree canopy may alter habitat

Actions:

Training

- Foresters and loggers to avoid these habitats. **Rank: 3**

Awareness and communications

- Land owner education concerning values of vernal pools. **Rank: 3**

Threat - Water table drawdowns

Actions:

Site/area management

- Manage sites to maintain natural hydrology. **Rank: 2**

Policies and regulations

- Increase restrictions to alteration of natural hydrology. **Rank: 2**

Threat - This threat has been relatively minor in these habitats.

Actions: Invasive/problematic species control

- Identify and control of invasives as needed. **Rank: 2**

Threat - Household sewage and urban waste water; including salt and other road runoff.

Actions:

Resource and habitat protection;

- Greater protection of buffers. **Rank: 2**

Site/area management

- Management of adjacent land uses to prevent pollution. **Rank: 2**

Policies and regulations

- Increase restrictions in land use planning to prevent pollution. **Rank: 2**

Threat - Impacts in buffer areas; little known about this community. Small distribution; more work needed.

Actions:

Site/area protection

- Identify and acquire as needed, focusing on upland buffers. **Rank: 2**

Resource and habitat protection

- Increase extent of undeveloped land in upland buffers. **Rank: 2**

Policies and regulations

- Increase protection and extent of upland buffers in wetlands regulations. **Rank: 2**

Threat - Historically, floodplains heavily developed for industrial and commercial uses, landfills, low income housing, recreational fields, etc.

Actions:

Site/area protection

- Identify and acquire habitats as needed. **Rank: 2**

Resource and habitat protection

- Identify potential restoration sites. **Rank: 3**

Site/area management

- Conduct restoration projects. **Rank: 2**

Habitat and natural process restoration

- Allow natural flooding regimes to function. **Rank: 3**

Threat - Situated along major rivers, sediments may contain variable levels of pollutants.

Actions:

Site/area management

- Identify potential cleanup sites. **Rank: 3**

Habitat and natural process restoration

- Let some areas remain undisturbed to prevent release of pollutants from sediments. **Rank: 2**

Threat - These areas are often used for illegal dumping, and also capture large amounts of trash during flood events.

Actions:

Site/area management

- Control public access by vehicles. **Rank: 2**

Policies and regulations

- Support increases in fines for illegal dumping. **Rank: 2**

Threat - Increased flooding may alter habitat

Actions:

Site/area protection

- Identify upland areas that may support this habitat type in future years. **Rank: 2**

Data collection and analysis

- Monitor changes in habitat that may be caused by climate change. **Rank: 2**

Forested Peatlands

Threat - Water withdrawals; undersized/blocked culverts

Actions:

Habitat and natural process restoration

- Restore natural hydrologic processes where needed. **Rank: 2**

Policies and regulations

- Incorporate hydrologic functioning in permitting process. **Rank: 2**

Threat – Invasive Species has been relatively minor in these habitats.

Actions:

Invasive/problematic species control

- Identify and control invasives as needed. **Rank: 1**

Threat - Deer browsing, this threat has been relatively low in this habitat.

Actions:

Invasive/problematic species control

- Increase hunting opportunities for deer in problem areas. **Rank: 1**

Intertidal

Threat - Habitat shifting and alteration; Habitat considered the most vulnerable to impacts of sea level rise - increased salinity, storm damage, and limited migration opportunities

Actions:

Site/area protection

- Identify and protect areas for habitat migration. **Rank: 2**

Habitat and natural process restoration

- Ensure natural processes continue in event of sea level rise. **Rank: 2**

Policies and regulations

- Strengthen existing regulations to protect potential sites for habitat migration. **Rank: 3**

Education and awareness

- Outreach events to educate public about potential loss of biological resources from sea level rise and other climate change issues. **Rank: 2**



Mud flat in Galilee, RI

P. August

Threat - Invasive non-native/alien species; *Phragmites*, Japanese Knotweed, Tall Pepper weed, others

Actions:

Invasive/problematic species control

- Control spread of *Phragmites* using appropriate methods, control other invasives as needed. **Rank: 2**

Threat - Household sewage and urban waste water; high, but improving with cesspool phase out and wastewater treatment improvements

Actions:

Site/area protection

- Identify and protect sites, especially upland buffers. **Rank: 2**

Resource and habitat protection

- Maintain buffers. **Rank: 2**

Policies and regulations

- Strengthen existing regulations to protect wider upland buffers. **Rank: 2**

Threat - Industrial and military effluents

Actions:

Site/area protection

- Identify and protect sites, especially upland buffers. **Rank: 2**

Resource and habitat protection

- Maintain adequate upland buffers. **Rank: 2**

Policies and regulations

- Strengthen existing regulations to protect wider buffers. **Rank: 2**

Threat - Other ecosystem modifications; invasives control by chemical means can impact these systems

Actions:

Site/area management

- Control invasive species using mechanical methods. **Rank: 2**

Policies and regulations

- Prohibit use of chemical controls in these wetland habitats. **Rank: 2**

Threat - Lack of information from research to address habitat and taxonomic issues

Actions:

Research, survey, inventory, monitor populations

- Evaluate use of migratory stopover/winter habitat. **Rank: 3**

Threat - Habitat fragmentation and degradation from human disturbance

Actions:

Outreach

- Control public access at priority sites. **Rank: 3**

Threat - Recreational activities; disturbance to feeding shorebirds from boaters, shellfishers, etc.

Actions:

Site/area protection

- Identify and protect uplands adjacent to mudflats to control public intrusion. **Rank: 2**

Policies and regulations

- Establish regulations to control public intrusion on important feeding areas. **Rank: 2**
- Awareness and communications; include habitat sensitivities in boating instruction, shell fishing areas. **Rank: 2**

Threat - Invasive non-native/alien species; *Phragmites*

Actions:

Invasive/problematic species control

- Control spread of *Phragmites* using appropriate methods. **Rank: 2**

Threat - Habitat fragmentation and degradation from human disturbance

Actions:

Outreach

- Control public access at priority sites. **Rank: 3**

Threat - Invasive non-native species; Marine invasives (algae and invertebrates)

Actions:

Invasive/problematic species control

- Control problematic species where feasible. Rank: 3

Legislation

- Strengthen regulations concerning container vessels bringing in invasive alien species. Rank: 2

Threat - Habitat fragmentation and degradation from human disturbance

Actions:

Outreach

- Control public access at priority sites. **Rank: 3**

Threat - Habitat shifting and alteration; Threat considered greatest to high marsh type due to limited migration opportunities.

Actions:

Site/area protection

- Identify areas for protection that could potentially provide habitat migration opportunities. **Rank: 2**

Policies and regulations

- Incorporate potential migration areas into regulatory programs. **Rank: 2**

Habitat and natural process restoration

- Allow natural migration of habitat. **Rank: 2**

Research, survey, monitoring habitats

- Monitor changes in habitat caused by climate change. **Rank: 2**

Threat - Invasive non-native/alien species; *Phragmites*, Japanese Knotweed, Tall Pepper weed, and potentially others

Actions:

Invasive/problematic species control

- Identify and conduct control of invasives as needed. **Rank: 2**

Training

- Establish early detection and rapid response program for invasive species. **Rank: 3**

Threat - Household sewage and urban waste water; Pollutants accumulate in sediments in urban areas, along tidal portions of major rivers.

Actions:

Site/area protection

- Identify and acquire sites, especially upland buffers to these habitats. **Rank: 2**

Resource and habitat protection

- Maintain adequate upland buffers. **Rank: 2**

Policies and regulations

- Strengthen regulations to enhance protection of upland buffers. **Rank: 2**

Threat - Housing and urban areas; Commercial and industrial areas; Tourism and recreation areas; Historically, most of the 50% loss of this habitat type was due to filling for a variety of purposes. Today, threat curbed by regulation.

Actions:

Site/area protection

- Identify sites for protection, especially upland buffers. **Rank: 2**

Resource and habitat protection

- Maintain upland buffers. **Rank: 2**

Policies and regulations

- Strengthen regulations to protect upland buffers. **Rank: 2**

Threat - Recreational activities; Boating, shellfishing

Actions:

Site/area management

- Control public access to reduce impacts from intrusion. **Rank: 2**

Policies and regulations

- Strengthen existing regulations regarding boat motor size, no wake zone, etc. **Rank: 1**

Threat - Recreational activities; disturbance to feeding shorebirds from boaters, shellfishers, etc.

Actions:

Site/area protection

- Identify and protect uplands adjacent to sand flats to control public intrusion. **Rank: 2**

Policies and regulations

- Establish regulations to control public intrusion on important feeding areas. **Rank: 2**

Awareness and communications

- Include habitat sensitivities in boating instruction, shell-fishing areas. **Rank: 2**

Threat - Invasive non-native/alien species; Phragmites

Actions: Invasive/problematic species control

- Control spread of *Phragmites* using appropriate methods. **Rank: 2**

Lower Perennial (River)

Threat – Pollution- All categories impact this habitat type

Actions:

Land/water protection

- Preserving, restoring cover for streams, and mitigating runoff. **Rank: 3**

Threat – Dams and barriers-Inhibit the movement of fish, increase water temperature, and create lentic habitat

Actions:

Land/water protection

- Protection and management of land, mitigate runoff. **Rank: 3**

Threat – Competition from non-native species

Actions:

Education and awareness

- Educate the public. **Rank: 1**

Mixed Deciduous/Coniferous Forests

Threat - Highly developable habitat type; large portions already fragmented by housing.

Actions:

Site/area protection

- Identify and acquire key parcels for fee purchase and easement. **Rank: 3**

Resource and habitat protection

- Identify and acquire key parcels for fee purchase and easement. **Rank: 3**

Policies and regulations

- Identify and influence mechanisms for incentivizing land owners for conservation and watershed protection (farm, forest and OS; local planning policies that make it possible for land owners to economically benefit). **Rank: 2**

Outreach

- Educate private landowners and general public about the threat of “over-management” of forest lands (removal of understory, ground cover, and leaf litter for control of ticks). **Rank: 2**



L. Gould

Mixed oak and pitch pine forest in the Carolina Management Area

Site/area protection

- Identify and acquire parcels; Identify any land acquisition needs that limit this threat. **Rank: 3**

Resource and habitat protection

- Provide opportunities for inland migration. **Rank: 3**

Policies and regulations

- Provide local municipalities and state with the information to locate transportation corridors in appropriate places; locate roads for potential abandonment; incorporate sufficient natural buffer widths into local subdivision regulations. **Rank: 3**

Threat - Utility and service lines

Actions:

Site/area protection

- Identify and acquire problem sites. **Rank: 3**

Resource and habitat protection

- Control human access by fencing, patrols, etc. **Rank: 2**

Habitat and natural process restoration. Rank: 2

Site/area management. Rank: 2

Habitat and natural process restoration

- Allow for natural mature, functioning forests that will be resistant to invasives (limit cutting of snags, limit clearing, etc.). **Rank: 2**

Threat - A widespread upland forest type on highly developable upland soils.

Actions:

Site/area protection

- Identify and acquire key parcels for fee purchase and easement. **Rank: 3**

Resource and habitat protection

- Identify and acquire key parcels for fee purchase and easement. **Rank: 3**

Policies and regulations

- Identify and influence mechanisms for incentivizing landowners for conservation and watershed protection (farm, forest and OS; local planning policies that make it possible for land owners to economically benefit). **Rank: 2**

Outreach

- Educate private landowners and general public about the threat of “over-management” of forest lands (removal of understory, ground cover, and leaf litter for control of ticks). **Rank: 2**

Threat - New road construction causes fragmentation of habitat.

Actions:

Site/area protection

Identify and acquire parcels; Identify any land acquisition needs that limit this threat. **Rank: 3**

Resource and habitat protection

- Provide opportunities for inland migration. **Rank: 3**

Policies and regulations

- Provide local municipalities and state with the information to locate transportation corridors in appropriate places; locate roads for potential abandonment; incorporate sufficient natural buffer widths into local subdivision regulations. **Rank: 2**

Threat - Threat to mature forests primarily at habitat edges, some incursion by woody species into interiors

Actions:

Invasive/problematic species control

- Expand and fund early detection and response program; give towns tools to identify and manage invasives; develop BMPs for state and local transportation depts. (e.g., disposal sites, equipment cleaning etc.); (earthworms, may include an education component); increase funding for control programs. **Rank: 3**

Habitat and natural process restoration

- Allow for natural mature, functioning forests that will be resistant to invasives (e.g., limit cutting of snags, limit clearing, etc.). **Rank: 2**

Threat - Clearing within forest core areas prevents forest maturation and increases threat from invasives

Actions:

Habitat and natural process restoration. Rank: 2

Policies and regulations. Rank: 2

Threat - Deer browsing

Actions:

Invasive/problematic species control

- Encourage the taking of more deer (special permits, etc., allow hunters to take more, introduce more hunting capacity if existing hunter population is insufficient, get more people into hunting (e.g., women etc.); temporary regulations to reduce the population and then maintain it. **Rank: 2**

Nearshore

Threat - All categories impact this habitat type

Actions:

Land/water protection

- Mitigating impacts from runoff. **Rank: 2**

Threat - Nutrient loading and sediment runoff

Actions:

Land/water protection

- BMPs for agriculture will mitigate impacts. **Rank: 2**

Threat - Structure can be targeted by fishing and overexploited

Actions:

Site/area protection

- Marine protected areas can be created to protect particularly sensitive areas. **Rank: 2**



L. Gould

Maritime Beach Strand, Moonstone Beach, S. Kingstown, RI

Threat - Fishing techniques can impact habitats (i.e. trawling, dredging)

Actions:

Site/area protection

- Marine protected areas can be created to protect particularly sensitive areas. **Rank: 2**

Threat - Loss of riparian vegetation, fringe wetlands due to shore line development, bulkheads, and poor urban development

Actions:

Site/area management

- Minimize the loss of riparian habitats as much as possible; Avoid locating roads near wetlands and fish bearing streams; Roads should be sited to avoid sensitive areas such as wetlands, streams, and steep slopes; Where ever possible, "soft" approaches (such as beach nourishment, vegetative plantings, and placement of large woody debris) to shoreline modification should be used. **Rank: 2**

Site/area management

- Avoid placing pipelines and accessory equipment used in conjunction with construction or dredging operations close to kelp beds, eelgrass beds, estuarine/salt marshes and any other high value habitat. **Rank: 2**

Law and policy

- The diking and draining of tidal marshlands and estuaries should not be undertaken unless a satisfactory compensatory mitigation plan is in effect and monitored. **Rank: 2**

Threat - Dredging, dredge disposal and other benthic disturbances such as trawling

Actions:

Data collection and analysis

- Undertake multi season, pre- and post- dredging biological surveys to assess impacts to animal and submerged aquatic vegetation communities. **Rank: 2**
- Identify and characterize fisher habitat functions and service in the project area. **Rank: 2**

Threat - Structure can be targeted by fishing and overexploited for certain species impacting biodiversity

Actions: Site/area protection

- Marine protected areas can be created to protect particularly sensitive areas. **Rank: 2**

Threat - Sewage pollution: combined sewage overflow, failing and inadequate systems, boat waste

Actions:

Data collection and analysis

- Identify areas in greatest need of storm and waste water infrastructure improvements. **Rank: 2**

Compliance and enforcement

- Enforce marine waste water disposal regulations. **Rank: 2**

Outreach

- Provide educational opportunities and video advertisement that explains effects of storm water runoff and importance of proper boat waste disposal. **Rank: 2**

Threat - Fishing techniques can impact habitats (i.e. trawling, dredging)

Actions:

Site/area protection

- Marine protected areas can be created to protect particularly sensitive areas. **Rank: 2**

Threat - These areas are often seen as viable for offshore dumping of waste (i.e. dredge materials)

Actions:

Land/water protection

- Perform bio-assessments of areas before dumping can take place. **Rank: 2**

Threat - Fishing techniques can impact habitats (i.e., trawling with rockhopper gear)Actions:

Site/area protection

- Marine protected areas can be created to protect particularly sensitive areas. **Rank: 2**

Threat - Overexploitation can impact biodiversity in these habitats

Actions:

Species management

- Careful management can mitigate the impacts of this threat. **Rank: 2**

Offshore



Shannon Alexander

Offshore Rhode Island-marine habitat

Threat - Fishing techniques can impact habitats (i.e., trawling with rockhopper gear, fish pots)

Actions:

Site/area protection

- Marine protected areas can be created to protect particularly sensitive areas and regulations can help maintain biodiversity in areas. **Rank: 2**

Threat - All categories impact this habitat type

Actions:

Land/water protection

- Mitigating impacts from runoff. **Rank: 2**

Threat - Nutrient loading and sediment runoff

Actions:

Land/water protection

Best management practices for agriculture and aquaculture will mitigate impacts. **Rank: 2**

Threat - Structure can be targeted by fishing and overexploited for certain species impacting biodiversity

Actions:

Site/area protection

- Marine protected areas can be created to protect particularly sensitive areas. **Rank: 2**

Threat - Dredging, dredge disposal and other benthic disturbances such as trawling

Actions:

Data collection and analysis

- Undertake multi-season, pre- and post- dredging biological surveys to assess impacts to animal and submerged aquatic vegetation communities; Address cumulative impacts of past and current dredging operations on fisher resources by considering them as part of the permitting process; identify and characterize fishery habitat functions and service in the project area. **Rank: 2**

Site/area management

- Adequate compensatory mitigations should be provided for unavoidable impacts; 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. **Rank: 2**

Law and policy

- 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. **Rank: 2**

Threat - Oil spills, marine accidents, ocean dumping

Actions:

Data collection and analysis

- Increase data bank on species habitat preferences and use in oil spill response planning and mapping. **Rank: 2**

Law and policy

- Increase number and training of response teams in the event of an accident. **Rank: 2**

Threat - These areas are often seen as viable for offshore dumping of waste (i.e. dredge materials)

Actions:

Land/water protection;

- Perform bio-assessments of areas before dumping can take place. **Rank: 2**

Threat - Fishing techniques can impact habitats (i.e. trawling with rockhopper gear, fish pots)

Actions:

Site/area protection

- Marine protected areas can be created to protect particularly sensitive areas and regulations can help maintain biodiversity in areas. **Rank: 2**

Threat - Overexploitation can impact biodiversity in these habitats

Actions:

Species management

- Regulations can help maintain biodiversity in areas. **Rank: 2**

Threat - Dredging, dredge disposal and other benthic disturbances

Actions:

Data collection and analysis

- Undertake multi-season, pre- and post- dredging biological surveys to assess impacts to animal and submerged aquatic vegetation communities. **Rank: 2**
- Address cumulative impacts of past and current dredging operations on fishery resources by considering them as part of the permitting process; Identify and characterize fishery habitat functions and service in the project area. **Rank: 2**

Site/area management

- Adequate compensatory mitigation should be provided for unavoidable impacts; 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. **Rank: 2**

Law and policy

- 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. **Rank: 2**

Threat - Oil spills, marine accidents, ocean dumping

Actions:

Data collection and analysis

- Increase data bank on species habitat preferences and use in oil spill response planning and mapping. **Rank: 2**

Law and policy

- Increase number and training of response teams in the event of an accident. **Rank: 2**

Oligotrophic (Lake)

Threat - All categories impact this habitat type

Actions:

Land/water protection;

- Mitigate runoff and nutrient input from defective septic systems. **Rank: 3**

Threat - Increased nutrients, stimulate plant growth

Actions:

Land/water protection

- Protection and management of land, mitigate runoff. **Rank: 3**

Threat - Competition

Actions:

Education and awareness

- Educate the public. **Rank: 2**

Open Mineral Soil Wetlands

Threat - Any alteration of hydrology; groundwater flow; water table fluctuation.

Actions:

Site/area protection

- Identify and acquire sites, focusing on extending upland buffers. **Rank: 2**

Resource and habitat protection

- Ensure natural regulation of water levels in wetlands. **Rank: 2**

Policies and regulations

- Support strengthening of wetlands regulations regarding minimal size of wetlands and extending buffer limits. **Rank: 2**



L. Gould

Coastal plain pondshore, Long Pond, Matunuck Hills, S. Kingstown, RI

Threat - *Phragmites*, Purple Loosestrife, other aquatics.

Actions:

Invasive/problematic species control

- Identify problem areas and conduct control measures. Several Loosestrife infestations are using insect control. **Rank: 2**

Threat - A chronic background problem varying by location.

Actions:

Site/area management

- Conduct management practices that do not impact wetland hydrology or introduce chemicals into wetland systems. **Rank: 2**

Policies and regulations;

- Adopt best management practices that limit wetland pollution. **Rank: 2**

Threat - Habitat shifting and alteration and storms and flooding; Could be issues with increased precipitation, flooding, etc.

Actions:

Data collection and analysis

- Monitor sites and document any changes in wetland systems caused by climate change. **Rank: 2**

Site/area management

- Conduct management necessary based on monitoring information. **Rank: 2**

Threat - Habitat degradation from impairment of water quality

Actions:

Research, survey, inventory, monitor populations

- Evaluate water quality effects on priority species. **Rank: 3**

Planning

- Develop strategies to mitigate aquatic degradation. **Rank: 3**

Threat - Lack of research to guide threat assessment and prioritization of conservation planning; Lack of information from research to address habitat and taxonomic issues

Actions:

Research, survey, inventory, monitor populations

- Identify concentration areas for non-breeding populations. **Rank: 2**

Threat - Primarily runoff from roads and other impervious surfaces.

Actions:

Site/area management

- Install drainage areas and other controls of road runoff. **Rank: 2**

Policies and regulations

- Increase penalties for illegal dumping. **Rank: 1**

Threat - Lack of research to guide threat assessment and prioritization of conservation plan; Lack of information from research to address habitat and taxonomic issues

Actions:

Data collection and analysis. Rank: 2

Threat - Loss of habitat from plant succession

Actions:

Habitat and natural process restoration

- Develop fire prescriptions for priority parcels. **Rank: 2**
- Implement burn management on priority parcels. **Rank: 2**

Outreach

- Expand public relations for fire management. **Rank: 2**

Threat - Larger examples are in impounded areas along major rivers where sediments may contain sizable amounts of chemicals, heavy metals, and other effluents.

Actions:

Site/area management

- Clean up, remove contaminated sediments; identify marsh habitats within existing clean-up sites. **Rank: 1**

Policies and regulations

- Consider reducing existing discharge limits. **Rank: 1**

Threat - Primarily *Phragmites*, Water Chestnut, and Purple Loosestrife.

Actions:

Invasive/problematic species control

- Identify problem areas and conduct control measures. Several loosestrife infestations are using insect control. **Rank: 2**

Policies and regulations

- Support regulated buffers of small wetlands to reduce spread of invasives from surrounding uplands. **Rank: 2**

Education and awareness

- Guidelines to limit unintended transport of invasives (boater guides, boot cleaning, aquaria draining, etc.). **Rank: 3**

Threat - Primarily chemicals from croplands. A chronic background problem varying by location.

Actions:

Site/area management

- Establishment of vegetative setbacks and/or livestock excluders between marsh and development area by landowner. **Rank: 3**

Policies and regulations

- Support the promulgation of buffer zones around small marshes; develop and enforce BMPs. **Rank: 2**

Threat - Habitat shifting and alteration and storms and flooding; Increased flooding may alter riverine habitats

Actions:

Site/area protection

- Protect upland habitats to provide migration opportunities. **Rank: 2**

Data collection and analysis

- Monitoring for community changes due to changing water regime. **Rank: 3**

Site/area management

- Road salt control; sediment management; stormwater system improvements and maintenance; septic system upgrades and maintenance; cesspool phase out (especially in lake communities). **Rank: 3**

Policies and regulations

- Support and enforce existing regulations and ordinances and BMPs. **Rank: 2**

Threat - Loss of habitat from plant succession

Actions:

Habitat and natural process restoration

- Develop fire prescriptions for priority parcels. **Rank: 2**

Habitat and natural process restoration

- Implement burn management on priority parcels. **Rank: 2**

Outreach

- Expand public relations for fire management. **Rank: 2**

Threat - Primarily chemicals from croplands. A chronic background problem varying by location.

Actions:

Site/area management

- Establishment of vegetative setbacks and/or livestock excluders between marsh and development area by landowner. **Rank: 3**

Policies and regulations

- Support the promulgation of buffer zones around small marshes; develop and enforce BMPs. **Rank: 2**

Threat - Habitat shifting and alteration and storms and flooding; Increased flooding may alter riverine habitats

Actions:

Site/area management

- Protect upland habitats to provide migration opportunities. **Rank: 2**

Data collection and analysis

- Monitoring for community changes due to changing water regime. **Rank: 3**

Site/area management

- Road salt control; sediment management; stormwater system improvements and maintenance; septic system upgrades and maintenance; cesspool phase out (especially in lake communities). **Rank: 3**

Policies and regulations

- Support and enforce existing regulations and ordinances and BMPs. **Rank: 2**

Threat - The historic elimination of this community type was caused by construction of dams that impeded tidal flow in rivers.

Actions:

Habitat and natural process restoration

- Dam removals. **Rank: 2**

Policies and regulations

- Assistance to permitting agencies regarding dam removal projects. **Rank: 2**

Threat - Canada Goose browsing of aquatic plants.

Actions:

Invasive/problematic species control

- Investigate methods for reducing goose use. **Rank: 2**

Threat - Boating on larger ponds and ATV traffic on beaches/shorelines.

Actions:

Policies and regulations

- Some regulation may be needed to limit boat motor size and access by ATVs. **Rank: 2**

Threat - Alteration of hydrologic cycle may affect regular fluctuation of pond water levels on which this community depends.

Actions:

Data collection and analysis

- Develop an appropriate monitoring scheme to detect changes in the physical and biological characteristics of the ponds caused by climate change. **Rank: 3**

Threat - Any alteration of hydrology; groundwater flow; water table fluctuation.

Actions:

Site/area protection

- Identify and acquire sites, focusing on extending upland buffers. **Rank: 2**

Resource and habitat protection

- Ensure natural regulation of water levels in wetlands. **Rank: 2**

Policies and regulations

- Support strengthening of wetlands regulations regarding minimal size of wetlands and extending buffer limits; Implement and enforce 2010 stormwater regulations. **Rank: 2**

Open Peatlands

Threat - *Phragmites* a dominant feature at one location.

Actions:

Invasive/problematic species control

- Control *Phragmites* using mechanical (non-chemical) methods. **Rank: 2**

Threat - May not be able to shift landward with rising sea level

Actions:

Site/area protection

- Identify opportunities for habitat migration. **Rank: 3**

Data collection and analysis

- Monitor habitats for changes caused by climate change. **Rank: 3**



Richard Enser

Graminoid Fen at Great Swamp

Threat - Groundwater seepage from uplands is key element of this community; disruption of flow is threat.

Actions:

Site/area protection

- Identify and protect upland sources of groundwater. **Rank: 2**

Resource and habitat protection;

- Maintain adequate buffers for upland freshwater sources. **Rank: 2**

Threat - May result in loss of plants with northern affinities, including Black Spruce.

Actions:

Data collection and analysis

- Monitor site for changes in physical and biological characteristics caused by climate change. **Rank: 3**

Threat - Development in adjacent uplands causing siltation and other impacts.

Actions:

Site/area protection

- Identify and acquire habitats as needed. **Rank: 2**

Policies and regulations

- Increase size of upland buffers. **Rank: 2**

Threat - Groundwater pumping

Actions:

Site/area protection

- Identify and acquire sites that provide additional protection to water sources. **Rank: 2**

Policies and regulations

- Increase extent of upland buffers. **Rank: 2**

Threat - This threat has been relatively minor in these habitats.

Actions:

Invasive/problematic species control

- Identify and conduct control of invasives as needed. **Rank: 2**

Threat - Some potential for this threat in conjunction with nearby development.

Actions:

Site/area protection

- Identify and acquire sites that increase protection for these wetlands. **Rank: 2**

Resource and habitat protection

- Manage upland areas to reduce effluent flow to wetlands. **Rank: 2**

Habitat and natural process restoration

- Allow natural processes to restore impacted habitats. **Rank: 1**

Policies and regulations

- Strengthen regulations regarding septic systems. **Rank: 2**

Threat - Nutrients and pesticides/herbicides

Actions:

Site/area protection

- Identify and acquire problem sites. **Rank: 2**

Policies and regulations

- Strengthen regulations regarding runoff. **Rank: 1**

Threat - Development in adjacent uplands causing siltation and other impacts.

Actions:

Site/area protection;

- Identify and acquire sites, focusing on extending upland buffers. **Rank: 2**

Policies and regulations

- Increase protection of buffer areas by wetlands regulations. **Rank: 2**

Threat - Groundwater pumping

Actions:

Site/area protection

- Identify and acquire sites that provide additional protection to water sources. **Rank: 3**

Policies and regulations

- Strengthen regulations to restrict impacts to water resources. **Rank: 2**

Threat - This threat has been relatively minor in these habitats.

Actions:

Invasive/problematic species control

- Identify and control invasives as needed. **Rank: 1**

Threat - Some potential for this threat in conjunction with nearby development.

Actions:

Site/area protection

- Identify and acquire sites as needed, focusing on upland buffers. **Rank: 2**

Resource and habitat protection

- Maintain natural buffers. **Rank: 2**

Habitat and natural process restoration

- Allow natural processes to restore degraded sites. **Rank: 1**

Policies and regulations

- Strengthen regulations to prevent pollution. **Rank: 2**

Threat - Nutrients and pesticides/herbicides

Actions:

Site/area protection

- Identify and acquire sites as needed, focusing on upland buffers. **Rank: 2**

Policies and regulations

- Strengthen regulations to control runoff. **Rank: 2**

Threat - Loss of habitat from plant succession

Actions:

Habitat and natural process restoration;

- Develop fire prescriptions for priority parcels. **Rank: 2**
- Implement burn management on priority parcels. **Rank: 2**

Outreach

- Expand public relations for fire management. **Rank: 2**

Threat - Development in adjacent uplands causing siltation and other impacts.

Actions:

Site/area protection

- Identify and acquire sites, focusing on extending upland buffers. **Rank: 3**

Policies and regulations

- Increase protection of buffer areas by wetlands regulations. **Rank: 3**

Threat - Groundwater pumping

Actions:

Site/area protection

- Identify and acquire sites that provide additional protection to water sources. **Rank: 3**

Policies and regulations

- Strengthen regulations to restrict impacts to water resources. **Rank: 2**

Threat - This threat has been relatively minor in these habitats.

Actions:

Invasive/problematic species control

- Identify and control invasives as needed. **Rank: 1**

Threat - Some potential for this threat in conjunction with nearby development.

Actions:

Site/area protection

- Identify and acquire sites as needed, focusing on upland buffers. **Rank: 2**

Resource and habitat protection

- Maintain natural buffers. **Rank: 2**

Habitat and natural process restoration

- Allow natural processes to restore degraded sites. **Rank: 1.5**

Policies and regulations

- Strengthen regulations to prevent pollution. **Rank: 2**

Threat - Nutrients and pesticides/herbicides

Actions:

Site/area protection

- Identify and acquire sites as needed, focusing on upland buffers. **Rank: 2**

Policies and regulations

- Strengthen regulations to control runoff. **Rank: 2**

Threat - Loss of habitat from plant succession

Actions:

Habitat and natural process restoration;

- Develop fire prescriptions for priority parcels. **Rank: 2**

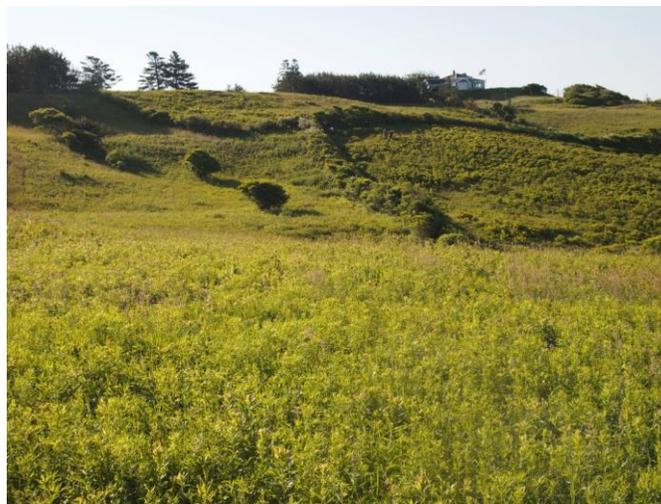
Habitat and natural process restoration

- Implement burn management on priority parcels. **Rank: 2**

Outreach

- Expand public relations for fire management. **Rank: 2**

Open Uplands (Grassland & Shrubland)



Grassland on The Nature Conservancy preserved land

Threat - Habitat shifting and alteration and storms and flooding; Rapid sea level rise reduces habitat and limits reestablishment; increases in storm severity

Actions:

Site/area protection

- Ensure opportunities for inland migration with sea level rise. **Rank: 2**

Resource and habitat protection

- Identify and acquire key parcels for fee purchase and easement. **Rank: 2**

Site/area management;

- Ensure opportunities for inland migration with sea level rise. **Rank: 2**

Invasive/problematic species control

- Early detection and rapid response to control spread of invasives into habitat. **Rank: 3**

Habitat and natural process restoration

- Allow natural processes to restore habitats if needed. **Rank: 2**

Threat - Beachgoers and dogs trampling habitat

Actions:

Site/area protection

- Habitat already protected as conservation land but infill sites may still be available. **Rank: 2**

Resource and habitat protection

- Habitat already protected as conservation land but infill sites may still be available. **Rank: 2**

Site/area management

- Identification and eventual protection of areas for inland migration of this habitat. **Rank: 2**

Awareness and communications

- Public awareness can be effective in controlling overuse. **Rank: 2**

Threat - Although potential for new development is low, a large amount of this habitat is already built on.

Actions:

Site/area protection

- This habitat already protected by regulation, but many homes are currently present; Opportunities exist for more inland locations where this habitat may eventually extend. **Rank: 2**

Resource and habitat protection

- This habitat already protected by regulation, but many homes are currently present. Opportunities exist for more inland locations where this habitat may eventually extend. **Rank: 2**

Site/area management

- This habitat already protected by regulation, but many homes are currently present; Opportunities exist for more inland locations where this habitat may eventually extend. **Rank: 2**

Habitat and natural process restoration

- Allow natural processes to rehabilitate sites when structures are removed. **Rank: 2**

Threat - Sea level rise may reduce habitat, with little opportunity for migration.

Actions:

Site/area protection

- Identify and acquire key parcels for fee purchase and easement. **Rank: 1**

Resource and habitat protection;

- Identify and acquire key parcels for fee purchase and easement. **Rank: 1**

Threat - Threat considered relatively low in this habitat. Actions: **Invasive/problematic species control**

- Provide control where needed. **Rank: 1**

Threat - Sea level rise may reduce habitat, with little opportunity for migration.

Actions:

Site/area protection

- Identify and acquire key parcels for fee purchase and easement. **Rank: 1**

Resource and habitat protection

- Identify and acquire key parcels for fee purchase and easement. **Rank: 1**

Threat - Some trampling of habitat

Actions:

Site/area protection

- Identify and acquire parcels. **Rank: 1**

Site/area management

- Control public access. **Rank: 1**

Threat - Trampling of sensitive species by hikers.

Actions:

Site/area protection

- Identify and acquire key parcels for fee purchase and easement. **Rank: 1**

Resource and habitat protection

- Control public access. **Rank: 1**

Threat - Reduction in open rocky habitat from plant succession

Actions: Site/area management

- Management to maintain open conditions. **Rank: 1**

Threat - Primarily by ATV and other vehicle use.

Actions:

Site/area protection

- Control public access. **Rank: 2**

Resource and habitat protection

- Control public access. **Rank: 2**

Policies and regulations

- Support regulations to control public access. **Rank: 1**

Outreach

Educate private landowners and general public about the threat of “over-management” of forest lands (removal of understory, ground cover, and leaf litter for control of ticks). **Rank: 2**

Threat - Herbicide use for managing woody vegetation.

Actions:

Site/area management

- Ecologists should work with utility companies to manage these habitats. **Rank: 2**

Threat - Spread of invasives in ROWs can pose threat to adjacent natural habitats.

Actions:

Invasive/problematic species control

- Early detection and rapid response to identified invasive sites. Many invasive plants have initially been found on ROWs. **Rank: 2**

Threat - These habitats are highly desirable for development.

Actions:

Site/area protection

- Identify and acquire key parcels for fee purchase and easement. **Rank: 2**

Resource and habitat protection

- Development of management plans for protected sites. **Rank: 2**

Policies and regulations

- Recognition of wildlife importance of this habitat within policies, rules, etc. **Rank: 2**

Outreach

Educate private landowners and general public about the threat of “over-management” of forest lands (removal of understory, ground cover, and leaf litter for control of ticks). **Rank: 2**

Threat - Requires periodic management by mechanical means (e.g., mowing, brush cutting) to maintain open conditions.

Actions:

Site/area management;

- Conduct management. **Rank: 2**

Policies and regulations

- Prepare site-specific management plans. **Rank: 2**

Threat - Suppression of natural fire considered a low threat, can be replaced by mechanical management and controlled burns.

Actions:

Site/area management

- Conduct controlled burning where allowed. **Rank: 2**

Habitat and natural process restoration

- Restore associated natural habitats that support similar wildlife values; i.e., maritime shrublands. **Rank: 2**

Threat - Widespread invasions can reduce plant diversity; but, some invasives may be beneficial

Actions: Invasive/problematic species control

- Identify problem sites and conduct control when needed. **Rank: 2**

Threat - Problematic native species; Deer may be an issue by selective browsing

Actions: Invasive/problematic species control;

- Provide additional hunting opportunities in areas suffering from over-browsing. **Rank: 2**

Threat - Loss of habitat from plant succession

Actions:

Habitat and natural process restoration

- Develop fire prescriptions for priority parcels. **Rank: 3**

Habitat and natural process restoration

- Implement burn management on priority parcels. **Rank: 3**

Outreach

- Expand public relations for fire management. **Rank: 3**

Threat - These habitats are desirable for development in conjunction with old field and other habitats.

Actions:

Site/area protection

- Identify and acquire key parcels for fee purchase and easement. **Rank: 2**

Resource and habitat protection

- Conduct management where needed. **Rank: 2**

Threat - May need some mechanical management, but not as intensive as neighboring old fields.

Actions:

Site/area management

- Conduct management. **Rank: 2**

Policies and regulations

- Prepare site-specific management plans. **Rank: 2**

Threat - Threat very low as many hedgerows formed of invasive shrubs

Actions:

Invasive/problematic species control

- Control invasives where needed. **Rank: 2**

Threat - These habitats are highly desirable for development.

Actions:

Site/area protection

- Identify and acquire key parcels for fee purchase and easement. **Rank: 2**

Resource and habitat protection

- Prepare site-specific management plans. **Rank: 2**

Threat - Requires tree cutting.

Actions:

Site/area management

- Conduct tree-cutting. **Rank: 3**

Policies and regulations

- Prepare site-specific management plans. **Rank: 3**

Threat - Invasion threat influenced by disturbance, proximity and land management (or lack of).

Actions:

Invasive/problematic species control

- Control invasives where needed. **Rank: 2**

Threat - Deer may selectively browse woody species

Actions:

Invasive/problematic species control

- Provide additional hunting opportunities in problem area. **Rank: 2**

Threat - Uplands near the coast are prime areas for development.

Actions:

Site/area protection;

- Much of this habitat is protected by The Nature Conservancy, State and Federal agencies, but still opportunities for infilling. **Rank: 2**

Resource and habitat protection

- Identify and acquire key parcels for fee purchase and easement. **Rank: 2**

Policies and regulations

- Recognition of wildlife importance of natural maritime shrublands within policies, rules, etc. Rank: 2

Threat - Degree of threat depends on level of disturbance, management (or lack of), and potential value of invasive shrubs to migratory and wintering birds.

Actions:

Invasive/problematic species control

- Invasives in this habitat are mostly woody shrubs that may need regular control in situations where their presence is compromising wildlife values. Rank: 2

Threat - Deer

Actions:

Invasive/problematic species control

- Provide control where needed. Rank: 2

Resource and habitat protection

Identification and eventual protection of areas for inland migration of this habitat. Rank: 2

Site/area management

Identification and eventual protection of areas for inland migration of this habitat. Rank: 2

Habitat and natural process restoration

- Monitor habitat and provide restoration support where needed. Rank: 2

Threat - Advance of invasives on this habitat type has been slowed due to harsher conditions.

Actions:

Invasive/problematic species control

- Provide early detection and rapid response to problem situations. Rank: 2

Site/area protection

- Low priority as most examples of habitat have been protected. Rank: 2

Site/area management

- Ensure opportunities for inland migration with sea level rise. Rank: 2

Site/area protection

- Conduct protection as needed. Rank: 2

Resource and habitat protection

- Provide opportunities for inland migration. Rank: 2

Site/area management

- Little need for this action. Rank: 2

Threat - May be some shifting of habitat with stronger storms and sea level rise; however, habitat may also benefit from climate alteration

Actions:

Site/area protection

Identification and eventual protection of areas for inland migration of this habitat. Rank: 2

Resource and habitat protection

Identification and eventual protection of areas for inland migration of this habitat. Rank: 2

Site/area management

Identification and eventual protection of areas for inland migration of this habitat. Rank: 2

Habitat and natural process restoration

- Monitor habitat and provide restoration support where needed. **Rank: 2**

Threat - Loss of habitat from plant succession

Actions:

Habitat and natural process restoration

- Develop fire prescriptions for priority parcels. **Rank: 2**
- Implement burn management on priority parcels. **Rank: 2**

Outreach

- Expand public relations for fire management. **Rank: 2**

Threat - Habitat shifting and alteration and storms and flooding; Rapid sea level rise reduces habitat and limits re-establishment; increases in storm severity

Actions:

Site/area protection

- Ensure opportunities for inland migration with sea level rise. **Rank: 2**

Resource and habitat protection

- Identify and acquire key parcels for fee purchase and easement. **Rank: 2**

Site/area management

- Ensure opportunities for inland migration with sea level rise. **Rank: 2**

Habitat and natural process restoration. Rank: 2

Threat - Japanese Sand Sedge (*Carex kobomugi*)

Actions:

Invasive/problematic species control

- Control of current populations and early detection of new incursions. **Rank: 2**

Habitat and natural process restoration

- Control of current populations and early detection of new incursions. **Rank: 2**

Site/area management

- Control of current populations and early detection of new incursions. **Rank: 2**

Threat - Recreational activities; Beachgoers and dogs trampling habitat, disturbing nesting birds

Actions:

Site/area protection

- Control human access by fencing, patrols, etc. **Rank: 3**

Resource and habitat protection

- Control human access by fencing, patrols, etc. **Rank: 3**

Site/area management

- Control human access by fencing, patrols, etc. **Rank: 3**

Awareness and communications

- Signage, etc. **Rank: 3**

Threat - Oil spills

Actions:

Policies and regulations

- Support regulations to curtail threat. **Rank: 2**

Resource and habitat protection

- Intensify clean-up actions in event of spill. **Rank: 2**

Threat - Habitat shifting and alteration and storms and flooding; Rapid sea level rise reduces habitat and limits re-establishment; increases in storm severity

Actions:

Site/area protection

- Ensure opportunities for inland migration with sea level rise. **Rank: 2**

Resource and habitat protection

- Identify and acquire key parcels for fee purchase and easement. **Rank: 2**

Site/area management

- Ensure opportunities for inland migration with sea level rise. **Rank: 2**

Threat - Japanese Sand Sedge (*Carex kobomugi*) on foredune

Actions:

Invasive/problematic species control

- Control of current populations and early detection of new incursions. **Rank: 2**

Habitat and natural process restoration

- Control of current populations and early detection of new incursions. **Rank: 2**

Site/area management

- Control of current populations and early detection of new incursions. **Rank: 2**

Threat - Although potential for new development is low, a sizable amount of this habitat is already built on.

Actions:

Site/area protection

- Support regulations to curtail threat. **Rank: 2**

Resource and habitat protection

- Intensify clean-up actions in event of spill. **Rank: 2**

Threat - ATV use, trampling of habitat.

Actions:

Site/area protection

- Identify and acquire key parcels for fee purchase and easement. **Rank: 2**

Resource and habitat protection

- Control public access. **Rank: 1**

Site/area management

- Control public access. **Rank: 1**

Threat - Lack of disturbance (natural and anthropogenic) to maintain community.

Actions:

Habitat and natural process restoration

- Identify methods for restoring this habitat. **Rank: 2**

Site/area management

- Conduct management by methods identified in 2.3. **Rank: 2**

Threat - The potential for this threat is considered low in this habitat.

Actions:

Invasive/problematic species control

- Provide control where needed. **Rank: 1**

Pelagic

Threat - Runoff can impact water quality making the habitat unusable for pelagic species

Actions:

Land/water protection

- Mitigating impacts from runoff. **Rank: 2**

Threat - Nutrient loading and sediment runoff

Actions:

Land/water protection

- Best management practices for agriculture and aquaculture will mitigate impacts. **Rank: 3**



I. Stuckey

Winnepaug Pond, Westerly, RI

Threat - Pelagic species can be targeted and harvested by multiple gear types in these areas (i.e. trawl, gillnets, rod and reel)

Actions: Species management

- Careful management can mitigate the impacts of this threat. **Rank: 2**

Threat - Large volume fisheries for important secondary consumers (i.e. herring) can impact this habitat type

Actions:

Species management

- Careful management can mitigate the impacts of this threat. **Rank: 2**

Policies and regulations. Rank: 2

Threat - Lack of information from research to address habitat and taxonomic issues

Actions:

Data collection and analysis

- Evaluate use of migratory stopover/winter habitat. **Rank: 2**

Plantation & Ruderal Forest

Threat - Many wooded tracts within urban areas remain unprotected; however, larger tracts exist in parks, cemeteries, etc.

Actions:

Site/area protection

- Identify and acquire key parcels for fee purchase and easement. **Rank: 3**

Resource and habitat protection

- Identify and acquire key parcels for fee purchase and easement. **Rank: 3**

Policies and regulations

- Identify and influence mechanisms for incentivizing landowners for conservation and watershed protection (e.g., farm, forest and OS; local planning policies that make it possible for land owners to economically benefit). **Rank: 2**

Outreach

Educate private landowners and general public about the threat of “over-management” of forest lands (e.g., removal of understory, ground cover, and leaf litter for control of ticks). **Rank: 2**



D.Payne

Tree plantation, Shartner Farms, RI

Threat - Ruderal forests are generally heavily infested with invasives.

Actions:

Invasive/problematic species control

- Conduct invasive control projects and restore sites with native species. **Rank: 2**

Policies and regulations

- Implement and enforce nuisance plant regulations. **Rank: 2**

Threat - Deer browsing contributes to reduced shrub and herb density and diversity, favoring spread of invasive plants.

Actions: Invasive/problematic species control

- Investigate other methods for controlling deer populations in urbanized settings. **Rank: 2**

Threat - Situated in populated portions of the state, wooded tracts are heavily impacted by trampling, illegal dumping, and other intrusions

Actions: Site/area protection

- Identify and acquire unprotected sites. **Rank: 2**

Policies and regulations

- Implement and enforce regulations to prevent illegal dumping, access by ATVs, and other intrusions. **Rank: 2**

Threat - Because plantations typically consist of a single tree (usually a conifer) species, they are highly susceptible to insect and other pest damage.

Actions:

Site/area management

- Control invasive species. **Rank: 2**

Threat - Deer may cause browsing impact on community establishment and composition.

Actions:

Invasive/problematic species control

- Provide more hunting opportunities in problem areas. **Rank: 1**

Threat - Many of these habitats are on protected land, especially state management areas and parks.

Actions:

Site/area protection

- Identify and acquire parcels. **Rank: 2**

Shoreline

Threat - Dams and water management/use

Actions:

Habitat and natural process restoration

- Restore natural hydrologic processes where needed. **Rank: 2**



RI Shoreline Access Coalition

Rhode Island shoreline

Threat - Industrial and military effluents; especially in impounded areas along major rivers where

sediments may contain sizable amounts of chemicals, heavy metals, and other effluents

Actions:

Site/area management

- Clean up, remove contaminate sediments; identify marsh habitats within existing clean-up sites. **Rank: 1**

Policies and regulations

- Consider reducing existing discharge limits. **Rank: 1**

Threat - Invasive non-native/alien species

Actions:

Invasive/problematic species control

- Identify problem areas and conduct control measures. **Rank: 2**

Policies and regulations

- Support regulated buffers of small wetlands to reduce spread of invasives from surrounding uplands. **Rank: 1**

Education and awareness

- Guidelines to limit unintended transport of invasives (boater guides, boot cleaning, aquaria draining, etc.). **Rank: 3**

Threat - Storms and flooding; Increased flooding may alter riverine habitat

Actions: Data collection and analysis

- Monitoring for community changes due to changing water regime. **Rank: 2**

Subtidal

Threat - Dams and water management/use; can affect natural hydrology

Actions:

Habitat and natural process restoration

- Remove dams to allow maximum natural tidal flow. **Rank: 2**

Threat - Invasive non-native/alien species; Chinese Mitten Crab, etc.

Actions: Invasive/problematic species control

- Identify and control invasives as needed. **Rank: 2**

Threat - Household sewage and urban waste water; improving with cesspool phase-out and wastewater treatment improvements

Actions:

Site/area protection

- Identify and protect sites, especially upland buffers. **Rank: 2**

Resource and habitat protection

- Maintain adequate upland buffers. **Rank: 2**

Policies and regulations

- Strengthen existing regulations to protect wider upland buffers. **Rank: 2**

Threat - Industrial and military effluents

Actions:

Site/area protection

- Identify sites for protection, especially upland buffers. **Rank: 2**

Policies and regulations

- Strengthen existing regulations to protect wider buffers. **Rank: 2**

Threat - Agricultural and forestry effluents

Actions:

Site/area protection

- Identify and protect sites, especially upland buffers. **Rank: 2**

Resource and habitat protection

- Maintain adequate upland buffers. **Rank: 2**

Policies and regulations

- Strengthen existing regulations to protect wider upland buffers. **Rank: 2**

Threat - Habitat shifting and alteration; Sea level rise may diminish habitat, need to provide opportunities for migration.

Actions:

Site/area protection

- Identify areas for potential habitat migration. **Rank: 2**

Data collection and analysis

- Monitor habitat condition to detect changes caused by climate change. **Rank: 2**



Tidal creek of Moonstone Beach, S. Kingston, RI

L. Gould

Threat - Recreational activities; damage from boating

Actions:

Awareness and communications

- Provide public with information regarding habitat values and potential damages caused by human intrusion. **Rank: 2**

Policies and regulations

- Determine need for regulations to limit damage by public intrusion. **Rank: 2**

Threat - Habitat shifting and alteration; Unknown impacts at this time

Actions:

Site/area protection

- Identify sites for potential habitat shifting. **Rank: 2**

Data collection and analysis

- Monitor habitat for changes caused by climate change. **Rank: 2**

Threat - Habitat shifting and alteration; Sea level rise may reduce protective barriers, alter salinity levels in ponds, etc.

Actions:

Site/area protection

- Identify sites to support potential migration of habitat. **Rank: 2**

Policies and regulations

- Provide additional regulatory protection for potential migration sites. **Rank: 2**

Other

- Monitor habitat for changes caused by climate change. **Rank: 2**

Threat - Other ecosystem modifications; Management needed on some ponds to open/close breachways.

Actions: • Site/area management

- Manage breachways as needed. **Rank: 2**

Threat - Invasive non-native/alien species; *Phragmites* and other aquatic plants.

Actions: Invasive/problematic species control

- Identify and control invasives as needed. **Rank: 2**

Threat - Problematic native species; Over-browsing of aquatic plants by Canada Geese and Mute Swans.

Actions:

Invasive/problematic species control

- Expand hunting opportunities for geese and expand population control measures for swans. **Rank: 1**

Policies and regulations

- Expand hunting seasons, bag limits, etc. **Rank: 2**

Threat - Agricultural and forestry effluents; Runoff from adjacent croplands primarily.

Actions:

Site/area management

- Maintain adequate upland buffers. **Rank: 2**

Policies and regulations

- Strengthen existing regulations to support wider upland buffers. **Rank: 2**

Threat - Household sewage and urban waste water; Runoff from lawns, septic systems of nearby residential development.

Actions:

Site/area protection

- Identify and protect sites, especially upland buffers. **Rank: 3**

Policies and regulations

- Strengthen existing regulations to provide for wider protected buffers. **Rank: 2**

Threat - Recreational activities; damage from boating

Actions:

Awareness and communications

- Inform public of potential impacts of intrusion. **Rank: 2**

Policies and regulations

- Determine need for regulations to curb public intrusion (i.e., limiting boat motor size, etc.). **Rank: 2**

Threat - Habitat shifting and alteration; Sea level rise increases salinity, increased damage from storms.

Actions:

Site/area protection

- Identify and protect areas for potential habitat migration. **Rank: 2**

Data collection and analysis

- Monitor changes in habitat caused by climate change. **Rank: 2**

Threat - Household sewage and urban waste water; Runoff from adjacent uplands; stormwater overflow

Actions:

Site/area management

- Maintain adequate upland buffers. **Rank: 2**

Policies and regulations

- Strengthen existing regulations to provide wider buffers. **Rank: 2**

Threat - Agricultural and forestry effluents; Runoff from adjacent croplands primarily.

Actions:

Site/area management

- Maintain adequate upland buffers. **Rank: 2**

Policies and regulations

- Strengthen existing regulations to provide for wider buffers. **Rank: 2**

Invasive/problematic species control. Rank: 2

Data collection and analysis

- Early detection. **Rank: 2**

Threat - Loss of wetlands due to shore line development, bulkheads, and poor urban development

Actions:

Site/area management

- Avoid locating roads near wetlands and fish bearing streams; Roads should be sited to avoid sensitive areas such as wetlands, streams, steep slopes, etc.; Where ever possible, "soft" approaches (such as beach nourishment, vegetative plantings, and placement of large woody debris) to shoreline modifications should be used. **Rank: 2**

Policies and regulation

- The diking and draining of tidal marshlands and estuaries should not be undertaken unless a satisfactory compensatory mitigation plan is in effect and monitored. **Rank: 2**

Site/area management

- Use an adaptive management plan with ecological indicators to oversee monitoring and ensure mitigation objectives are met; Take corrective action as needed. **Rank: 2**

Threat - Dredging, dredge disposal and other benthic disturbances such as trawling

Actions:

Data collection and analysis

- Undertake multi season, pre- and post- dredging biological surveys to assess impacts to animal and submerged aquatic vegetation communities. **Rank: 2**
- Address cumulative impacts of past and current dredging. **Rank: 2**

Policies and regulations. Rank: 2

Upper Perennial (River)

Threat - All categories impact this habitat type

Actions: Land/water protection

- Preserving, restoring cover for streams, and mitigating runoff. **Rank: 3**

Threat - Inhibit the movement of fish, increase water temperature, and create lentic habitat

Actions:

Land/water protection

- Protection, management, mitigate runoff. **Rank: 3**

Threat - Competition

Actions: Education and awareness

- Educate the public. **Rank: 1**



Hunt River in Rhode Island

Coalition for Water Security

Species Focused Threats and Actions – Tier 4

Species focused threats and actions are presented in the Species Profiles.

Citations and Sources

- Anderson, M.G., M. Clark, C.E. Ferree, A. Jospe, and A. Olivero Sheldon. 2013. Condition of the Northeast Terrestrial and Aquatic Habitats: a geospatial analysis and tool set. Submitted to the Regional Conservation Needs Grants Program of the Northeast Association of Fish and Wildlife Agencies. The Nature Conservancy, Eastern Conservation Science.
<http://easterndivision.s3.amazonaws.com/Geospatial/ConditionoftheNortheastTerrestrialandAquaticHabitats.pdf>
- Association of Fish and Wildlife Agencies (AFWA). 2009. Voluntary guidance for states to incorporate climate change into state wildlife action plans and other management plans. A Collaboration of the AFWA Climate Change and Teaming With Wildlife Committees, Association of Fish and Wildlife Agencies 50 pp.
- AFWA. 2011. Measuring the Effectiveness of State Wildlife Grants Final Report. 186 pp.
- AFWA. Teaming With Wildlife Committee, State Wildlife Action Plan (SWAP) Best Practices Working Group. 2012. Best Practices for State Wildlife Action Plans—Voluntary Guidance to States for Revision and Implementation. Washington (DC): Association of Fish and Wildlife Agencies. 80 pp.
- Aquatic Nuisance Task Force. 2007. Rhode Island Aquatic Invasive Species Management Plan
http://anstaskforce.gov/State%20Plans/RI_SMP_Approved.pdf
- Beardmore, T. and R. Winder. 2011. Review of science-based assessments of species vulnerability: contributions to decision-making for assisted migration. *The Forestry Chronicle* 87(6):745-754.
- Chaffee, C. 2014. Using SLAMM to inform coastal wetland restoration and adaptation. Coastal Resources Management Council. Presentation at public stakeholder meeting of October 22, 2014. Available online at: <https://www.youtube.com/watch?v=C8xv2qKJ8Q>
- Crisfield, E and the Northeast Fish and Wildlife Diversity Technical Committee (NEFWDTTC). 2013. The Northeast Lexicon: Terminology Conventions and Data Framework for State Wildlife Action Plans in the Northeast Region. A report submitted to the Northeast Fish and Wildlife Diversity Technical Committee. Terwilliger Consulting, Inc., Locustville, VA.
- Eschtruth, A.K. and J.J. Battles. 2008. Acceleration of exotic plant invasion in a forested ecosystem by a generalist herbivore. *Conservation Biology*.
- Forman R.T.T. and Deblinger R. 2000. The ecological road-effect zone of a Massachusetts (U.S.A.) suburban highway. *Conservation Biology* 14(1): 36-46.
- Gregory R., L. Failing, M. Harstone, G. Long, T. McDaniels, D. Ohlson . 2012. *Structured Decision Making: A Practical Guide to Environmental Management Choices*. Wiley-Blackwell 312 p.
- IUCN. 2008. Red List: Species Susceptibility to Climate Change Impacts.
- Karraker N.E. 2008. Impacts of road deicing salts on amphibians and their habitats. Pp 211-23 In: J.C. Mitchell, R.E. Jung Brown and B. Bartholomew, (eds.). *Urban Herpetology*. Society for the Study of Amphibians and Reptiles.
- Klemens, M. W. 1993. Amphibians and reptiles of Connecticut and adjacent regions. Bulletin 112. State Geological and Natural History Survey of Connecticut. 1-318.
- Lagory K.E., Walston L.J., Goulet C., Van Lonkhuyzen R.A., Najjar S., Andrews C. 2009. An examination of scale-dependent resource use by Eastern Hognose Snakes in Southcentral New Hampshire. *Journal of Wildlife Management* 73(8): 1387-93.
- Lambeck, R. J. 1997. Focal species: A multi-species umbrella for nature conservation. *Conservation Biology* 11:849-856.

- Landres, P.B., Verner, J., Thomas, J.W., 1988. Critique of vertebrate indicator species. *Conservation Biology* 2, 316-328.
- Libby, A. D. 2013. Inland fishes of Rhode Island. *RI Div. Fish and Wildlife*. 1-287.
- Lovejoy, T. E., and D. C. Oren. 1981. The minimum critical size of ecosystems. In *Forest Island Dynamics in Man-Dominated Landscapes*, ed. R. L. Burgess and D. M. Sharpe. Springer-Verlag, New York.
- National Wildlife Federation (NWF) and Manomet Center for Conservation Studies (MCCS). 2013. Implementing climate-smart conservation in Northeastern upland forests. Northeastern Upland Forest Expert Panel. 9pp.
- Plummer, M.V. and N.E. Mills. 2000. Spatial ecology and survivorship of resident and translocated hognose snakes (*Heterodon platirhinos*). *Journal of Herpetology* 34:565-575.
- Reh W. and Seitz A. 1990. The influence of land use on the genetic structure of populations of the Common Frog *Rana temporaria*. *Biological Conservation* 54: 239-249.
- RI DEM Office of Water Resources. 2012. Nonpoint Source Water Pollution Management Program Report of Activities October 1, 2011 – September 30, 2012 (FY2012). 27pp. Available online at: <http://www.dem.ri.gov/programs/benviron/water/quality/nonpoint/pdfs/acts12.pdf>
- Rouse J.D., Willson R.J., Black R., Brooks R.J. 2011. Movement and spatial dispersion of *Sistrurus catenatus* and *Heterodon platirhinos*: Implications for interactions with roads. *Copeia* 2011(3): 443-456.
- Rout, T.M., E.McDonald-Madden, T.G. Martin, N.J. Mitchell, H.P. Possingham, and D.P. Armstrong. 2013. How to decide whether to move species threatened by climate change. *PLOS one*. 8(10). 1-7.
- Rowland, E. L., M. S. Cross, and H. Hartmann. 2014. Considering Multiple Futures: Scenario Planning To Address Uncertainty in Natural Resource Conservation. USFWS Report for the National LCC Network. http://www.fws.gov/home/feature/2014/pdf/Final_Scenario_Planning_Document.pdf
- Rubinoff, P, C. Rubin, J. Riccitelli, C. Collins, D. Robadue, C. Damon, K. Ruddock, P. August, C. Chaffee, E. Horton-Hall, and A. Ryan. 2013. Building Capacity to Adapt to Climate Change through Local Conservation Efforts: A South Kingstown Land Trust Pilot Project. Technical Report. Rhode Island Sea Grant, Narragansett, RI. Available online at: www.seagrant.gso.uri.edu
- Salit, R. 2014. Block Island culling deer herd with hunting-by-lottery, bait and shoot effort. *Providence Journal*, January 24, 2014.
- Schlesinger, M. D., P. N. Manley, and M. Holyoak. 2008. Distinguishing stressors acting on land bird communities in an urbanizing environment. *Ecology* 89:2302-2314.
- Staudinger, M.D., Carter, S., Cross, M., Dubois. N., Duffy, E., Enquist, C., Griffis, R., Hellmann, J., Lawler, J., Morrison, S., O’Leary, J., Stein, B., and W. Turner. 2013. Biodiversity in a changing climate: A synthesis of current and projected trends in the United States. *Frontiers in Ecology and the Environment*, 11(9): 465-473.
- Staudinger, Michelle D. 2015. (Science Coordinator, DOI Northeast Climate Science Center) Personal communication of March 24, 2015.
- Stein, B. A., A. Staudt, M.S. Cross, N.S. Dubois, C. Enquist, R. Griffis, L.J. Hansen, J.J. Hellmann, J.J. Lawler, E.J. Nelson, and A. Pairis. 2013. Preparing for and managing change: climate adaptation for biodiversity and ecosystems. *Frontiers in Ecology and the Environment*. 11(9):502-510.

- The Nature Conservancy. 2014. Living shorelines. Fact Sheet. 2pp. Available online at: <http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/rhodeisland/rhode-island-living-shoreline-fact-sheet.pdf>
- Trombulak S.C., Frissell C.A. 2000. Review of ecological effects of roads on terrestrial and aquatic communities. *Conservation Biology* 14(1): 18-30.
- USFWS. 2014. Draft environmental assessment: Narrow River estuary resiliency restoration program. Rhode Island National Wildlife Refuge Complex and Center for Ecosystem Restoration. 57pp.
- Watershed Counts. 2014. Narragansett Bay watershed report with a spotlight on marine and freshwater beaches. U.R.I. Coastal Institute and Narragansett Bay Estuary Program. 33pp. Available online at: http://www.watershedcounts.org/documents/Watershed_Counts_Report_2014.pdf