

Rhode Island Aquatic Invasive Species Management Plan

Approved by the Aquatic Nuisance Species Task Force
November 7, 2007



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Top photo: Colonial tunicates (*Didemnum lahillei*) attached to mussel cages in British Columbia. Photo by Gordon King

Middle photo: Ballast water discharge. Source: CA State Lands Commission

Bottom photo: (*Phragmites australis*) invasion front at the Montezuma National Wildlife Refuge, New York. Photograph by B. Blossey.

Acknowledgements

The Rhode Island Aquatic Invasive Species Management Plan (RIAIS Plan) is promulgated under the authority of the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (NANPCA) as amended by the National Invasive Species Act of 1996 (NISA). The Plan will be implemented by the Rhode Island Aquatic Invasive Species Working Group (RIAIS Working Group) which was established for this purpose under the auspices of the Plan. The first draft of the RIAIS Plan was produced through a partnership between the Coastal Resources Management Council (CRMC), University of Rhode Island (URI), and the Rhode Island Natural History Survey (RINHS). Special thanks go to Kevin Cute (Marine Resources Specialist, CRMC), David Alves (Aquaculture Coordinator, CRMC), Lisa Gould (Senior Scientist, RINHS), David Gregg (Executive Director, RINHS) and Laura Meyerson (Assistant Professor, URI Department of Natural Resources Science) for their initial efforts without which this Plan would not exist. Thanks to Erik Endrulat (Data Manager, RINHS) and Dave Viola (Research Associate, URI) who provided considerable technical and moral support. Thanks also go to Marta Gomez-Chiarri (Professor, URI) who provided significant assistance with data for introduced aquatic pathogens. URI graduate student Cathy McNally also contributed to various components of the Plan.

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Executive Summary

The introduction of non-native species into the state of Rhode Island is not a new phenomenon. European settlers intentionally introduced numerous non-native plants and animals upon their arrival in the New World. Non-intentional introductions also occurred early in the settlement process. Rocks used as ship's ballast that were discarded in New England's coastal waters are a likely vector for the introduction of European marine species such as the common periwinkle that dominates most rocky beaches in Rhode Island today. However, the recent globalization of our economy and the attendant increase and movement of goods via established and new trade routes have produced a corresponding spike in the rate of non-native species introductions. While many of these introductions have apparently caused no known impacts to date, others have resulted in significant environmental and economic damage that requires costly control or remediation measures.

Under the National Aquatic Nuisance Prevention and Control Act of 1990, an aquatic nuisance species or "invasive species" is defined as *a nonindigenous species that threatens the diversity or abundance of native species or the ecological stability of infested waters, or commercial, agricultural, aquacultural or recreational activities dependent on such waters*. Invasive species are considered to be second only to direct habitat destruction as a cause of declining biodiversity in the United States. While Rhode Island has been fortunate thus far to avoid the introduction of well-known aquatic invasive species like the zebra mussel (*Dreissena polymorpha*) and the Chinese mitten crab (*Eriocheir sinensis*), many other species have already invaded and impacted the state's marine and freshwater ecosystems. The zebra mussel and Chinese mitten crab may not be far behind. Since its introduction to Lake St. Clair, a small lake between Lake Erie and Lake Huron in 1988, the zebra mussel has been continuously spreading eastward and has now reached our neighboring state of Connecticut. Zebra mussels in the Great Lakes region have cost nuclear power plants an average of \$800,000 annually for control. Even smaller municipalities in affected areas spend about \$20,000 per year on control efforts. The zebra mussel and the quagga mussel are similar freshwater invasive species that clog water intake pipes, water filtration, and electric generating plants; it is estimated that they cause \$1 billion/year in damages and associated control costs per year.¹

Marine aquatic invaders that have become established in Rhode Island include the European green crab (*Carcinus maenas*), Asian shore crab (*Hemigrapsus sanguineus*), lace bryozoan (*Membranipora membranacea*), codium (*Codium fragile*), the red macroalgae (*Grateloupia turuturu*), and various species of sea squirts and shellfish pathogens. A 1999 Cornell University study estimates a \$44 million per year economic loss to New England and the Canadian Maritime Provinces due to predation on commercially valuable shellfish by the European green crab. Marine species of concern (due to their proximity to Rhode Island and/or high potential for environmental and

¹ Army, 2002. Economic Impacts of Zebra Mussel Infestation. http://www.wes.army.mil/el/zebra/zmis/zmis/zmishelp/economic_impacts_of_zebra_mussel_infestation.htm (December 4).

economic damage include the veined rapa whelk (*Rapana venosa*), nori (*Porphyra spp.*), Chinese mitten crab (*Eriocheir sinensis*), the Suminoe oyster (*Crassostrea ariakensis*), the Pacific oyster (*Crassostrea gigas*), Caulerpa sp., and the Japanese kelp (*Undaria pinnatifida*). Marine invaders also include microscopic organisms that pose human health risks. The bacteria that causes cholera in humans, *Vibrio cholerae*, has been discovered in very high numbers in the ballast water tanks of ships that have transited from foreign ports and landed at ports in Chesapeake Bay (Ruiz et. al., 2000). In Alabama, a South American strain of human cholera bacteria was found in ballast tanks in the port of Mobile in 1991, and when cholera strains were subsequently found in shellfish samples, a public health advisory against the consumption of raw shellfish was issued.

On the freshwater front, aquatic macrophytes such as variable watermilfoil (*Myriophyllum heterophyllum*) and curly pondweed (*Potamogeton crispus*) have become established and are spreading in lakes and ponds. In addition, introduced phragmites (*Phragmites australis ssp. australis*) and purple loosestrife (*Lythrum salicaria*) are spreading rapidly, clogging waterways and out competing native species. Although the zebra mussel has yet to be documented in Rhode Island, it is found in the Connecticut side of the Housatonic watershed, very close to the Massachusetts border. The Asian clam (*Corbicula fluminea*) has been found in Rhode Island waters and is spreading, and in the summer of 2006, Eurasian watermilfoil (*Myriophyllum spicatum*) was first documented in the state. An economic study in New Hampshire showed that the value of property adjacent to lakes choked with aquatic weeds like Eurasian water milfoil is reduced by 15% or more. Other species of aquatic macrophytes such as hydrilla (*Hydrilla verticillata*), water chestnut (*Trapa natans*), and giant salvinia (*Salvinia molesta*) are causing problems in nearby states and have a reasonable chance of making it to Rhode Island if not actively prevented. The potential impacts of these species are evident in that \$500,000 is spent annually to manage and prevent the lake wide spread of water chestnut in Lake Champlain on the Vermont/New York border. The threat of these species to Rhode Island is also evident as water chestnut has been found in Massachusetts and Connecticut, and hydrilla was recently found on Cape Cod, Massachusetts. Hydrilla has proven to be a particularly damaging species: the State of Florida spends millions of dollars annually on herbicides and mechanical harvesters in an effort to keep hydrilla, under “maintenance control.”

Throughout the United States, responses to the spread of aquatic invasive species have generally been slow and poorly coordinated. The introduction and subsequent spread of freshwater macrophytes has probably received the most attention from natural resource managers due to the impacts of these invasions on boating, fishing, and other recreational uses. On a lake by lake basis, landowner groups, with support from the state, have tried to control further species spread with limited success. In New England marine waters, the European green crab has caused the most tangible impacts and thus is best known. Attempts to eradicate and/or control this voracious shellfish predator have proven ineffective. Outside of fishery and aquaculture circles, the general public is not aware of the impact that invasive species have on our marine ecosystem and local economy. State and federal agencies have limited jurisdiction and/or mandate to address aquatic species issues and small or non-existent budgets to deal with the wide range of species impacts that face local waterways.

The RIAIS Plan is the first comprehensive effort to assess the impacts and threats of aquatic invasive species in Rhode Island. In response to the identified impacts and threats, the RIAIS Plan lays out a series of management strategies intended to prevent the introduction and curb the spread of AIS.

The RIAIS Plan outlines a five-year plan intended to for aquatic invasive species management in Rhode Island with the goal of *implementing a coordinated approach to minimizing the economic, environmental and social impacts of AIS on the marine and freshwater ecosystems and resources of Rhode Island.*

The plan is constructed around seven strategies: 1) coordination and communication; 2) monitoring; 3) education, outreach, and training; 4) research and development; 5) planning and assessments; 6) prevention and control; and, 7) legislation and regulation. A total of 37 tasks listed in Table 3 outline the comprehensive approach of the RIAIS Plan to the numerous problems posed by AIS.

The RIAIS Plan prioritizes state agency leadership for administration and implementation, continuation of current research on the relative risks of various transport vectors, coordination with industry to minimize invasions, development of a regional web page and database on AIS distribution, and various educational initiatives.

The RIAIS Plan was created under the auspices of the federal Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990, as amended by the National Invasive Species Act of 1996 (NISA). In order to achieve its goals, NISA authorizes the creation of Regional Panels to coordinate aquatic invasive species (AIS) activities throughout the United States. To that end, the Northeast Aquatic Nuisance Species Panel (NEANS Panel) was created upon its approved by the federal Aquatic Nuisance Species Task Force (ANS Task Force) in 2002 to address the problem of AIS in the six New England states, the State of New York, and the Canadian Maritime Provinces New Brunswick, Nova Scotia, and Quebec. In conjunction with the other federally approved state AIS management plans in the NEANS Panel region, the RIAIS Plan is the direct means by which the goals of NISA are implemented.

The RIAIS Plan follows guidance provided by the federal Aquatic Nuisance Species Task Force, which is co-chaired by the National Oceanic and Atmospheric Administration and the U.S. Fish and Wildlife Service. Once a state plan is approved, the Task Force provides limited funds to support plan implementation. The first draft of the RIAIS Plan was produced by a partnership of the Coastal Resources Management Council, the University of Rhode Island, the Rhode Island Natural History Survey, and the Rhode Island Invasive Species Council. These partners met for approximately 12 months to create the draft RIAIS Plan; they will continue to work toward the plan's implementation in concert with members of the RI Aquatic Invasive Species Working Group (Appendix A). The Working Group includes a wide range of government, academic, not-for-profit, and industry representatives, who made significant contributions toward producing the final RIAIS Plan.

The threat of invasive species appears overwhelming and some believe that such species expansion is inevitable. Due to this sense of powerlessness, many resource managers and agencies have been reluctant to take on the issue, despite pressure from affected user groups. In Rhode Island, we believe that by working together and maximizing limited resources we can stem the flow of species across our borders by educating the public and affected industries on the threat and impacts of these species. It is important to acknowledge that most of the pathways that species use to move from place to place—ballast water, boat fouling, private and public aquaria, aquaculture, seafood industry, horticulture, etc.—are controllable human activities already undertaken within substantial regulatory regimes, but regimes which for the most part are mute or impotent with regard to preventing species invasions. By creatively raising awareness of these pathways, by changing behaviors of different users and industries, and by additional key regulatory tools, the likelihood of introductions can be significantly reduced and the environmental and economic costs of damage and remediation avoided. This Plan provides a blueprint for Rhode Island to make headway in protecting our natural systems and economy from the potentially devastating effects of aquatic invasive species.

Given its leadership in developing the RIAIS Plan, and its position as Co-chair of the NEANS Panel, the CRMC will administer the annual federal grant allocated to the state to fund the implementation of the RIAIS Plan. The CRMC will also Co-chair the RIAIS Working Group and be responsible for organizing and scheduling its meetings, ensuring the continued implementation of the RIAIS Plan, and updating it as needed.

List of Acronyms	
AIS	Aquatic Invasive Species
ANS	Aquatic Nuisance Species
ANSTF	Aquatic Nuisance Species Task Force
APHIS	Animal and Plant Inspection Service
CAPS	Cooperative Agricultural Pest Survey
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CIG	Conservation Innovation Grants
cpDNA	chloroplast DNA
CRMC	Coastal Resources Management Council
CSP	Conservation Security Program
CZMA	Coastal Zone Management Act
DEM-OWR	(RI) Department of Environmental Management- Office of Water Resources
EPA	US Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
GOMC	The Gulf of Maine Council on the Marine Environment
IMO	International Marine Organization
IPANE	Invasive Plant Atlas of New England
IPCC	Interstate Pest Control Compact
MEPC	Marine Environmental Protection Committee
MIT	Massachusetts Institute of Technology
mitIS	MIT Marine Invader Tracking Information System
MOU	Memoranda of Understanding
NANPCA	Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990
NASA	National Aeronautical and Space Administration
NBEP	Narragansett Bay Estuary Program
NBNERR	Narragansett Bay National Estuarine Research Reserve
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEAMGLL	Northeast Association of Marine and Great Lakes Laboratories
NEANS	Northeast Aquatic Nuisance Species
NEMESIS	National Exotic Marine and Estuarine Species Information System
NEP	National Estuary Program
NEPA	National Environmental Policy
NEPCoP	New England Plant Conservation Program
NGOs	Nongovernmental Organizations
NHS	National Highway System
NIPGro	New England Invasive Plant Group
NISA	National Invasive Species Act of 1996
NISC	National Invasive Species Council
NOAA	National Oceanic and Atmospheric Administration
NOBOBs	No (declarable) Ballast On Board
NRCS	Natural Resource Conservation Service
NROC	Northeast Regional Oceans Committee
RAS	Rapid Assessment Survey
RIAIS	Rhode Island Aquatic Invasive Species
RIDEM	Rhode Island Department of Environmental Management
RIDEM-AG	Rhode Island Department of Environmental Management, Division of Agriculture
RIDEM-FW	Rhode Island Department of Environmental Management, Division of Fish and Wildlife

RIDEM-OWR	Rhode Island Department of Environmental Management, Office of Water Resources
RIEMC	Rhode Island Environmental Monitoring Collaborative
RIISC	Rhode Island Invasive Species Council
RIMFC	Rhode Island Marine Fisheries Council
RINHS	Rhode Island Natural History Survey
RIPDES	Rhode Island Pollution Discharge Elimination System
RIRAS	Rhode Island Rapid Assessment Survey
RIWPS	Rhode Island Wild Plant Society
RWU	Roger Williams University
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act -A Legacy for Users
STP	Surface Transportation System
TBT	Tributyl tin (anti-fouling agent)
TMDLs	Total Mass Daily Loads
TNC	The Nature Conservancy
URI	University of Rhode Island
URI-CE	University of Rhode Island Continuing Education
URI-WW	University of Rhode Island Watershed Watch
USAID	US Agency for International Development
USCG	US Coast Guard
USDA	US Department of Agriculture
USFWS	US Fish and Wildlife Service
USGS	US Geological Service
WHIP	Wildlife Habitat Incentive Program
WPR	Wetlands Preserve Program
WPWA	Wood-Pawcatuck Watershed Association

List of Terms

algae - organisms with no true roots, stems, or leaves that range in size from single celled organisms to large, plant-like organisms

aquaculture - the controlled cultivation and harvest of aquatic animals and plants

aquatic - relating to fresh or saltwater systems, including both open waters and wetlands

ballast water - any water that is placed in a tank or the hold of a ship for the purposes of maintaining stability

benthic - relating to the substrate (bottom) of a lake, pond, ocean, or other water bodies, which often provide habitat for a variety of organisms

biogeographic region - the area defining the geographic boundary of organisms, determined by a combination of climate, water temperature, or geologic boundaries

cryptogenic species - an organism of unknown origin; may be introduced or native

cultch - crushed shells deposited in a waterway to attract the spawn of reef building shellfish such as oysters

epibenthic - relating to organisms that exist exposed on the substrate (bottom) of a lake, pond, ocean, or other water bodies

epiphyte - an organism that grows on another plant or animal upon which it depends for mechanical support but not for nutrients

eradicate - to completely eliminate a population from a geographic area

exotic species - see nonindigenous species

fouling - entanglement, clogging, or obstruction by an undesired organism often resulting in diminished functioning of ships, intake pipes, and other submerged equipment or machinery

hydrology - the study or description of the behavior of atmospheric, surface, or groundwater

invasive species (invader) - nonindigenous or cryptogenic organisms that may threaten the diversity or abundance of native species or the ecological stability and/or uses of infested waters

macrophyte - a plant or plant-like protist (such as kelp) that is visible with the unaided eye; generally used to refer to floating or rooted aquatic plants, or plant-like organisms attached by a holdfast

native - existing within a historical ecological range, usually within a balanced system of coevolved organisms

nonindigenous species - (non-native species) a species transported intentionally or accidentally from another region

nuisance species - (as defined by the federal ANS Task Force) animal and plant species that have been introduced into new ecosystems throughout the United States and the world and are having harmful impacts on the natural resources in these ecosystems and the human use of these resources

pathogen - any agent that causes disease in plants or animals; typically referring to microbes such as bacteria, viruses, or protozoan parasites

parasite - an organism that grows, feeds, and is sheltered on or in a different organism while contributing nothing to the survival of its host

population - all individuals of a single species within a defined habitat or geographic area such as a pond or watershed

propagules - any of various usually vegetative portions of a plant, such as a bud or other offshoot, that aid in dispersal of the species and from which a new individual may develop; may also refer generally to the number of organisms (e.g., bacteria cells) transported to a new area

seafood - any fish, shellfish, or other aquatic species harvested for the purposes of human consumption

vector - the physical means by which a species is transported from one area to another, usually referring to transport by humans

watershed - the geographic area that drains to a single water body or hydrographic unit such as a lake, stream reach, or estuary

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I. Introduction

The introduction and spread of aquatic invasive species (AIS) in the marine and freshwater environments of Rhode Island pose a serious threat to the ecology of native ecosystems, and may have significant impacts on the Rhode Island economy. These nonindigenous species have the potential to establish and spread rapidly, due to a lack of physical and biological constraints in their introduced habitats. These organisms can have an extensive range of impacts on aquatic systems, including declines in habitat and community diversity, the localized or complete extinction of rare and endangered species, the spread of plant, animal, and human pathogens, and the choking of waterways, water intakes, aquaculture gear, and wetland systems.

Seasonal management of some AIS has become a standard operating procedure at great cost to many states. While no comprehensive study of economic impacts has been conducted in Rhode Island, nearby states have expended significant funds to manage certain AIS, and have incurred the indirect costs associated with the impacts of these species. In Rhode Island, the DEM Division of Agriculture reports that 177 permits to control freshwater AIS were issued between the years 2004 -2007.

Cost associated with AIS in other Eastern seaboard states provide some insights into the economic costs that Rhode Island may be facing. In Maryland and Virginia, oyster production is 4% of the maximum historical landings. The pathogens Dermo and MSX are large contributors to that decline, but other pathogens are also responsible. In Connecticut, MSX caused production to go from a high of 894,000 bushels of oysters in 1992 to 32,000 in 2002, a decline of more than 96%. Rhode Island shellfisheries landings have steadily decreased from reported landings of 116.3 metric tons in 1997 to 22.2 metric tons in 2006. These diseases were found in wild Rhode Island populations, and likely contributed to population collapse (Oviatt, 1998). However, it is difficult to distinguish how much of this decline is due to disease and what can be attributed to fishing pressure with no added seed, since good sets occur only occasionally in Rhode Island. Disease does not appear to affect aquaculture production in RI at this time, but this may change as aquaculture production continues to increase in the state; in Massachusetts, diseases caused 90% losses in some oyster farms in Wellfleet and Barnstable during the fall of 2006.

A Cornell University study (Pimentel, 1999) estimates a loss of \$44 million per year to New England and the Canadian Maritime Provinces due to predation on commercially valuable shellfish by the introduced European green crab (*Carcinus maenas*). During the drafting of this plan the aquatic invasive plant Eurasian Water-milfoil (*Myriophyllum spicatum*) was identified for the first time in Rhode Island, in a pond in the southern part of the state. This aggressive invader can spread rapidly within and between lakes and ponds, quickly altering the balance of aquatic systems. In addition to established invaders, nonindigenous species known to have had disastrous effects on the ecosystems and economies of other states, such as the zebra mussel (*Dreissena polymorpha*), are rapidly encroaching upon the borders of Rhode Island and its watersheds (Figure 1).

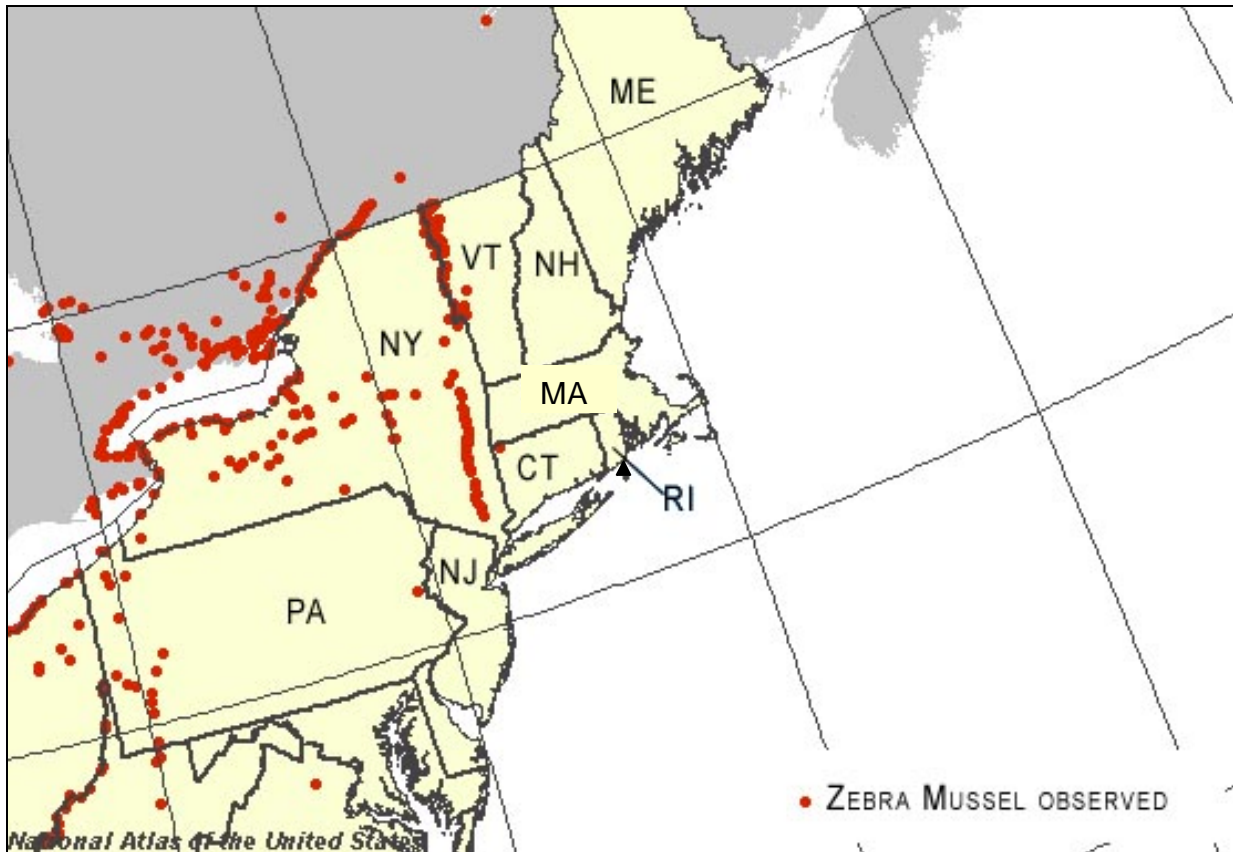


Figure 1: 2006 Zebra Mussel Distribution in the Northeastern US (USGS, 2006)

Interest in and public concern with AIS issues have been growing in Rhode Island. In recent years, DEM reports an increase in the number of inquiries and complaints about nuisance aquatic weeds in lakes, particularly in the northern portion of the state. In 2000, CRMC and the Narragansett Bay Estuary Program, and others, organized the first surveys of marine aquatic invasive species in the state. That same year, the Rhode Island Natural History Survey, in cooperation with the Rhode Island Agricultural Experiment Station and the University of Rhode Island's Cooperative Extension Program, established the Rhode Island Invasive Species Council. The Council brought together government and non-governmental entities in a non-regulatory effort to enhance the identification, tracking and management of invasive species, both aquatic and terrestrial.

The Rhode Island Aquatic Invasive Species Management Plan (RIAIS Plan) represents the efforts of the above groups and has been developed as a framework that coordinates state government activities with those of federal agencies, non-governmental entities and academic institutions in order to achieve the overarching goal of *implementing a coordinated approach to preventing the introduction of and minimizing the ecological and socio-economic impacts of aquatic invasive species in the marine and freshwater environments of Rhode Island*. The RIAIS Plan is the first comprehensive effort to assess the impacts and threats of aquatic invasive species in Rhode Island. The RIAIS Plan is designed to fulfill requirements of the federal Nonindigenous Aquatic Nuisance Prevention and Control Act (1990) and support related mandates in state law. The Plan

describes existing programs and activities, identifies impacts and threats and lays out a series of management strategies intended to prevent the introduction and curb the spread of invasive species. Full implementation of the RIAIS Plan will require increased commitment and investment by the organizations involved in AIS management in Rhode Island.

1. Goals of the RI Aquatic Invasive Species Management Plan

The overarching goal of the RIAIS Plan is to implement *a coordinated approach to preventing the introduction of and minimizing the ecological and socio-economic impacts of aquatic invasive species in the marine and freshwater environments of Rhode Island*. More specific goals are addressed through the development and implementation of this management plan as follows:

- 1) Prevent the introduction and establishment of aquatic invasive species in Rhode Island.
- 2) Control the growth and spread of aquatic invasive species in Rhode Island.
- 3) Abate the impacts and minimize the harmful effects of aquatic invasive species.

For the purposes of this plan, aquatic invasive species are defined as nonindigenous or cryptogenic species that threaten the diversity or abundance of native species or the ecological stability of infested waters, or commercial, agricultural, aquacultural or recreational activities dependent on such waters (adapted from the National Aquatic Nuisance Prevention and Control Act of 1990). The term aquatic refers to open waters of marine and freshwater environments as well as coastal and freshwater wetlands.

2. Scope of the Aquatic Invasive Species Management Plan

The RIAIS Plan has been developed as a framework for state government to coordinate with federal agencies, non-governmental entities and academic institutions in order to ensure a coordinated approach to the management of aquatic invasive species in Rhode Island waters. Applicable to both freshwaters and marine waters, it acknowledges both the central regulatory role that state government plays as well as the contributions of non-governmental entities to addressing AIS threats. The Plan reflects the need for the state to coordinate with other entities working at the local, regional, federal and, as needed, international level to prevent and control the spread of AIS. Rhode Island has recognized the limited success worldwide in the eradication of established populations of aquatic invaders, as well as the potentially detrimental impacts to native populations resulting from some invasive species control efforts. As a result, management objectives and actions outlined in the plan are heavily weighted towards the prevention of new introductions and the education of interest groups and the general public regarding their role in minimizing the spread and transport of these species.

3. Process and Participation

In 2002, the Northeast Aquatic Nuisance Species Panel (NEANS Panel) was created to address the problem of AIS in the six New England states, the State of New York, and

the Canadian Maritime Provinces New Brunswick, Nova Scotia, and Quebec. The panel is authorized by the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990, as amended by the National Invasive Species Act of 1996 (NISA) as part of a network of regional panels intended to coordinate aquatic invasive species (AIS) activities throughout the United States. The NEANS Panel encourages states to develop state AIS plans and assists in the distribution of limited federal grant funds for the implementation of approved state plans. Accordingly, the RIAIS Plan closely follows the *Guidance for State and Interstate Aquatic Nuisance Species Management Plans* developed by the ANS Task Force, and was modeled after the previously approved Massachusetts AIS management plan in order to maximize the potential for the regional coordination encouraged by the NEANS Panel. In coordination with other federally approved state AIS management plans in the northeast region, the RIAIS Plan is the primary mechanism by which national AIS management goals are achieved under the auspices of the NEANS Panel.

An initial working draft of the RIAIS Plan was produced by a partnership of the Coastal Resources Management Council, the University of Rhode Island, and the Rhode Island Natural History Survey during 2006. This original group was expanded to include numerous other partners in early 2007, the new partnership forming the RI Aquatic Invasive Species Working Group (RIAIS Working Group – see Appendix A). The RIAIS Working Group members serve on additional committees involved in invasive species management initiatives in Rhode Island and the region, including the Northeast Aquatic Nuisance Species Panel (NEANS Panel), the Invasive Plant Atlas of New England (IPANE), the New England Invasive Plant Group (NIPGro), Rhode Island Environmental Monitoring Collaborative (RIEMC), and the Narragansett Bay Estuary Program (NBEP) Management Committee. The RIAIS Working Group took on the task of editing the working draft through several versions until producing and submitting a draft to the federal Aquatic Nuisance Species Task Force (ANS Task Force) in September 2007. The RIAIS Working Group will remain as a permanent committee that will meet at least annually to review and implement the federally approved RIAIS Plan.

Following the production of the first draft of the RIAIS Plan, the RIAIS Writing Group was significantly expanded for the purpose of creating and implementing the RIAIS Plan, and subsequently renamed the RIAIS Working Group. The participation of the various Working Group members on the above committees help to ensure that management measures outlined in this plan represent a fully integrated approach for the state.

Public comment during the development of this document has been an important component of the planning process. The RIAIS Working Group led public scoping meetings throughout Rhode Island during 2007 (see Appendix A). Participants represented a range of organizations and interests. Scoping meetings were successful in offering the Working Group a local perspective on AIS issues, and wherever possible, comments received at these meetings have been incorporated into the Management Objectives and Actions of Section IV. A summary of questions, comments, and responses given at each public scoping meeting is included in Appendix B. The AIS Working

Group will continue to incorporate suggestions received through outreach efforts into future revisions of this Plan.

4. Relationship to Existing Management Efforts

Currently, multiple initiatives in Rhode Island and the northeastern United States are underway to address AIS issues in the state and region. Several of these initiatives have been developed concurrently with this Rhode Island AIS Management Plan, underscoring the heightened awareness of AIS problems and concerns in the region over the past year. These existing and developing management efforts have been beneficial to the development of the RIAIS Plan by identifying needs within the region, state, and in local watersheds, many of which have been addressed by the RIAIS Working Group in this document. Each of the efforts listed below also represent significant opportunities for continuing collaborations which will be investigated and fostered by the RIAIS Working Group.

a) Regional Efforts

Northeast Aquatic Nuisance Species Panel (NEANS Panel)

The RIAIS Plan has been developed as an initiative of the NEANS Panel and will be a significant means by which national goals to minimize the impact of AIS will be implemented in Rhode Island and the northeast region. The mission of the NEANS Panel is to *protect the marine and freshwater resources of the Northeast from invasive aquatic nuisance species through commitment and cohesive coordinated action*. The NEANS Panel was established in 2001 when it was approved by the federal ANS Task Force under authority of the National Aquatic Nuisance Prevention and Control Act of 1990 (as amended). The NEANS Panel represents all six New England states, the State of New York, and the Canadian Provinces New Brunswick, Nova Scotia, and Quebec. The NEANS Panel membership includes state, federal, and provincial government representatives, academics, commercial and recreational fishing interests, recreational boaters, commercial shipping, power and water utilities, environmental organizations, aquaculture, nursery and aquarium trades, tribal concerns, lake associations, and the bait industry, among others. The panel has four working committees: Shipping; Communications, Education, and Outreach; Policy and Legislation; and Science and Technology. The NEANS Panel website is located at <http://www.northeastans.org/>

Northeast Regional Oceans Committee

The Northeast Regional Oceans Committee (NROC) was formed during the 29th Annual Conference of New England Governors and Eastern Canadian Premiers in 2005 and represents the New England states and the five Eastern Canadian provinces. Several strong links exist between NROC and the NEANS Panel. Both promote regional and international cooperation on marine resource issues, and under Resolution 29-3 “Resolution Concerning Oceans,” NROC formed an Oceans Working Committee to:

- (i) *foster international cooperation and collaboration on all aspects of marine and oceans-related research and development, education, exploration, observation, and oceans management;*

- (ii) *facilitate the exchange of information, including reports, discussions, initiatives and plans which may be developed or considered;*
- (iii) *seek partnerships and synergies to facilitate existing initiatives such as the Gulf of Maine Council on the Marine Environment and encourage new initiatives and partnership;*
- (iv) *address related environmental issues such as major oil spills, ports of refuge, **invasive species**, and the deliberate dumping of bilge oil at sea; and provide a vehicle for cooperation on all aspects of oceans management.*

Given the overarching role of the NEANS Panel regarding the development and implementation of the RIAIS Plan, and the significant linkages between NROC and the NEANS Panel, the RIAIS Working Group considers a partnership with NROC among its highest priorities. To that end, the Chair of the RIAIS Working Group has requested that the NEANS Panel draft a Proclamation announcing its interest in forming a partnership with NROC.

MIT Sea Grant (mitIS database)

The Marine Invader Tracking Information System (mitIS) is a service of the MIT Sea Grant College Program's Center for Coastal Resources. mitIS is a collection point for information on marine invasive species in the northeast United States and beyond.

The New England Invasive Plant Group (NIPGro)

The Silvio O. Conte Refuge administers the New England Invasive Plant Group (NIPGro). NIPGro is a networking link among the organizations and agencies involved with terrestrial and freshwater aquatic invasive plant issues in the region. Priorities of the group include:

- 1) *Minimizing new introductions to the region via an early detection/ rapid response system.*
- 2) *Using the NIPGro network to exchange information, share educational materials, identify research needs, and establish links with researchers.*
- 3) *Developing standardized criteria for creating priority species lists.*
- 4) *Coordinating control efforts.*

Invasive Plant Atlas of New England

A US Department of Agriculture grant supports the development of an Invasive Plant Atlas of New England (IPANE), which is the foundation of an early warning and response system for the region. The University of Connecticut oversees the Atlas work, assisted by the New England Wild Flower Society. The grant also provided the salary for the NIPGro coordinator from 2002–2005. Rhode Island and the NEANS Panel will work closely with NIPGro on various AIS management issues, and, in particular, on the sharing and organization of invasive species distribution information. Leslie J. Mehrhoff, Ph.D., Director, Invasive Plant Atlas of New England, University of Connecticut, Box U-43, 75 North Eagleville Road, Storrs, CT 06269-3043; Office phone (860) 486-5708; FAX (860) 486-6364; les.mehrhoff@uconn.edu

b) Nongovernmental Organizations (NGOs) in RI

Rhode Island Natural History Survey (RINHS)

The RINHS is funded by several different sources to provide invasive species training to volunteer groups, data to agencies, and to organize outreach and research efforts on certain key areas. RINHS is also authorized in legislation to provide data and advice on the biota and natural communities of Rhode Island to state agencies. The RINHS is also engaged in regular data exchanges with key regional partners including the New England Wildflower Society (NEWFS), IPANE, and others. RINHS is the exclusive NatureServe data partner for the jurisdiction of RI.

Rhode Island Invasive Species Council (RIISC)

The Rhode Island Invasive Species Council was established in 2000, to serve as a clearinghouse for invasive species information in Rhode Island. Its mission is to protect native biodiversity in Rhode Island. The RIISC gathers and conveys information on the presence, distribution, ecological and economic impacts, and management of invasive species; promote uses of native species and non-invasive alternatives throughout Rhode Island; and 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 Nature Conservancy (TNC)

The Nature Conservancy has developed an Invasive Species Initiative and leads Conservation Learning Networks on invasive species assessment, prevention, management and monitoring.

The Initiative partners with various groups on science-based strategies, public policy, and communications to prevent and abate invasive species threats to biological diversity. A dataset for global assessment of marine invasive species, their impacts, and degree of risk is in development.

URI Rhode Island Watershed Watch Program (URIWW)

The University of Rhode Island Watershed Watch Program works with volunteers to monitor marine and freshwater water resources, including identification and mapping of aquatic plants. An expanded AIS monitoring effort is planned for the summer of 2007 in cooperation with the RINHS.

Rhode Island Wild Plant Society

The RI Wild Plant Society has members who conduct field investigations to locate, identify, and develop inventories of both terrestrial and aquatic invasive plants.

Wood-Pawcatuck Watershed Association (WPWA)

The Wood-Pawcatuck Watershed Association has an ongoing purple loosestrife program that consists of a two major parts. In the first part, the WPWA has established a volunteer-based effort to determine the distribution of purple loosestrife along the Wood and Pawcatuck Rivers. During the summer of 2006 volunteers were trained to identify the plant and educated on its various impacts. Volunteers were assigned to specific sections of the rivers, provided with maps, and instructed to conduct surveys by canoe during August while the plants are in bloom. The volunteers submitted their completed maps with notations of purple loosestrife sightings at the conclusion of the survey period. A WPWA intern will create a GIS map of all the locations of purple loosestrife found along the Pawcatuck River. In addition, a poster showing the results will be created as part of the intern's URI Coastal Fellow program, to be presented in December, 2006. This project is ongoing with final results expected to be reported at the end of 2007. The initial results from the survey were both positive and negative. There was no purple loosestrife identified on the Wood River, which is the most important river for biodiversity we have in the state. Also, there are no sightings of the plant along the Chipuxet River or the beginning of the Pawcatuck River, where it empties out of Wordens Pond, and up to the Route 2 Bridge. After that however, there are numerous sightings along almost every section of the Pawcatuck River. Most of these sightings are in small clumps or individual plants. There appears to be no area where purple loosestrife is dominant.

The second part of the program includes a partnership over the past two summers with the URI Plant Science Department to conduct a biological control study on a section of the Pawcatuck River. A transect was established on a wetland adjacent to the river in Carolina where the largest concentration of purple loosestrife occurs to document the effectiveness of the project. Galerucella beetles were then released along the transects and a few nearby sections of the river. After two years some reduction in stem heights has been noted, the number of inflorescence has decreased, and plant vigor appears to be in decline. Analysis for statistical significance has not yet been completed. It is planned to continue releasing beetles for another year or two at this site, before deciding whether or not to expand the program.

For more information on this program please use the following link and select "Newsletters" from the WPWA website: www.wpwa.org, select Newsletters. There are articles in the Summer and Fall 2005 and Summer 2006 newsletters. A preliminary report will be published during the winter of 2006-07.

Save The Bay, Inc.

Save The Bay is currently developing a volunteer monitoring project by which individuals will be trained to conduct scientific surveys at various floating docks in Narragansett Bay to determine the presence, distribution, and density of AIS. This project includes training in species identification, quantitative scientific field methods, and data collection and analysis.

II. Problems and Concerns

1. Aquatic Invasive Species Impacts

The problem of aquatic invasions poses unique challenges to managers of aquatic systems as well as those developing policy affecting aquatic environments. Unlike other sources of pollution, established populations of aquatic invaders are self-sustaining. As a result, resources must be devoted to both prevention of new introductions and to the control of existing populations of invaders. The introduction of only a few organisms or, in the case of aquatic plants and algae, a fraction of an organism, can result in the infestation of a water body, watershed, or an entire biogeographic region. These introductions can occur through any number of transport vectors, further complicating preventative measures. The following section highlights some of the major impacts of past introductions, identifies priority pathways by which these species may have been imported, and identifies established and threatening species of greatest concern to Rhode Island.

Impacts from AIS generally include:

- Reduced diversity of native plants and animals
- Impairment of recreational uses such as swimming, boating, and fishing
- Degradation of water quality
- Degradation of wildlife habitat
- Increased threats to public health and safety
- Diminished property values
- Declines in finfish and shellfish populations
- Loss of coastal infrastructure due to habits of fouling and boring organisms
- Local and complete extinction of rare and endangered species
- Economic impacts on aquaculture and other water dependent industries
- Increased expenditures on prevention, eradication or control

The import or translocation of certain aquatic native or exotic animals such as frogs and fish can cause negative impacts to certain ecosystems. In Rhode Island, examples would be the importation or translocation of bullfrogs onto Jamestown, Aquidneck or other Narragansett Bay islands. Bullfrogs (*Rana catesbeiana*) were not present in those areas before the islands were isolated from the mainland and have not been introduced to date. Success of the leopard frog (*Rana pipiens*) in these places may be attributed to reduced competition and predation in the absence of bullfrogs. Future establishment of bullfrog populations on these islands threatens the abundance and distribution of other frog species in these ecosystems. The handful of fishless ponds around RI support some of the most robust and diverse populations of aquatic insects (specifically dragonflies and damselflies), are important breeding sites for amphibians and foraging areas for waterfowl. The introduction of finfish of any kind into permanent, fishless ponds would alter these rare ecosystems. Further, Block Island is another example where the introduction of certain species native to the mainland would be detrimental.

Since its introduction to Lake St. Clair (Michigan) in 1988, the zebra mussel (*Dreissena polymorpha*) has been continuously spreading eastward and has now reached our neighboring state of Connecticut. Although it has yet to be documented in Rhode Island, it is found in the Housatonic watershed (CT), very close to the Massachusetts border. The zebra mussel and the quagga mussel, a similar freshwater invasive species, disrupt ecosystems by out-competing native species, damaging boats and harbors, clogging water intake pipes, water filtration, and electric generating plants. It is estimated that they cause \$1 billion/year in damages and associated control costs per year. The Asian clam (*Corbicula fluminea*), a similar invasive freshwater mollusk, has been found in waters of Rhode Island waters and continues to spread.

Invasive aquatic plants (macrophytes) such as variable watermilfoil (*Myriophyllum heterophyllum*) and curlyleaf pondweed (*Potamogeton crispus*) have become established and are spreading in lakes and ponds around Rhode Island, reducing the diversity of native plants, degrading water quality and impeding recreational activities. Just upland, introduced phragmites (*Phragmites australis ssp. australis*) and purple loosestrife (*Lythrum salicaria*) are spreading rapidly in Rhode Island, clogging waterways and out competing native species. An economic study by the University of New Hampshire documented that there may be up to a 20% decline in lakefront property values attributed to the presence of exotic aquatic plants (Halstead et al., 2003). Other species continue to be documented in Rhode Island, such as Eurasian watermilfoil (*Myriophyllum spicatum*) which was first found in 2006. This notorious invader can spread rapidly within and between lakes and ponds, quickly altering the balance of aquatic systems.

Other species of aquatic macrophytes such as hydrilla (*Hydrilla verticillata*), water chestnut (*Trapa natans*), and giant Salvinia (*Salvinia molesta*) are causing problems in nearby states and have a reasonable chance of making it to Rhode Island if not actively prevented. Approximately \$500,000 is spent annually to manage and prevent spread of water chestnut just in Lake Champlain (NY/VT); however the species has also been found in Massachusetts and Connecticut. Hydrilla has been found in Connecticut and on Cape Cod, MA and has proven to be a particularly damaging species. The state of Florida alone spends millions of dollars annually on herbicides and mechanical harvesters in an effort to keep hydrilla under control.

Marine aquatic invaders that have become established in Rhode Island include the European green crab (*Carcinus maenas*), Asian shore crab (*Hemigrapsus sanguineus*), lace bryozoan (*Membranipora membranacea*), codium (*Codium fragile*), the red macroalgae *Grateloupia turuturu*, and various species of sea squirts and shellfish pathogens. A 1999 Cornell University study estimates a \$44 million per year economic loss to New England and the Canadian Maritime Provinces due to predation on commercially valuable shellfish by the European green crab. Marine species of concern (due to their proximity to Rhode Island and/or high potential for environmental and economic damage include the veined rapa whelk (*Rapana venosa*), nori (*Porphyra spp.*), Chinese mitten crab (*Eriocheir sinensis*), the Suminoe oyster (*Crassostrea ariakensis*), the Pacific oyster (*Crassostrea gigas*), *Caulerpa sp.*, and the Japanese kelp (*Undaria pinnatifida*).

Marine invaders also include microscopic organisms that pose human health risks. The bacteria that causes cholera in humans, *Vibrio cholerae*, has been discovered in very high numbers in the ballast water tanks of ships that have transited from foreign ports and landed at ports in Chesapeake Bay (Ruiz et. al., 2000). In Alabama, a South American strain of human cholera bacteria was found in ballast tanks in the port of Mobile in 1991, and when cholera strains were subsequently found in shellfish samples, a public health advisory against the consumption of raw shellfish was issued.

2. Transport Vectors

The movement and dispersal of invasive species across the landscape may be mediated by several modes of transportation. Distribution methods such as passive transport through the air by winds or on water currents are natural transport vectors. Other natural means of movement outside of human control may be from “hitchhikers” on migrational birds or other wildlife. However the spread of invasive species has been exacerbated by accidental introductions due to the expansion of human transportation. Increased speed of movement via the mechanization of travel (improvements to road, air, and sea travel) has also increased the volume of cargo and human traffic.

Ballast water has long been recognized as perhaps the most significant vector for the introduction of AIS. However, Rhode Island has recognized the need to evaluate a variety of transport vectors to explain the prevalence of invaders in the region. A coalition of scientists from MIT Sea Grant, Williams College, Northeastern University, and Smith College are working to assess the risk of introduction through a variety of potential pathways including seafood companies, aquaculture facilities, bait shops, pet stores, public aquaria, marine research facilities, and wetland restoration efforts (The New England Transport Vector Study, Smith et al., 1999). The research team has developed a database of companies and organizations involved in the transport and trade of both native and nonindigenous organisms and distributed a survey to industry representatives to determine the type, quantity, and frequency of nonindigenous species imports and exports. The survey also inquired about the industry specific handling techniques that could result in AIS introductions. Transport vectors of particular interest in Rhode Island are discussed below.

a. Aquaculture

The aquaculture industry is a small but rapidly growing segment of the Rhode Island economy and will likely see significant growth due to increasing constraints to wild fish harvests in the United States and worldwide. While intensive culture of both finfish and shellfish reduces environmental impacts resulting from the harvest of wild stocks, concerns related to water quality impairment, growth and distribution of pathogens, escape of non-indigenous species, and genetic dilution indicate the need for careful planning for this industry.

The United States Department of Agriculture Natural Resources Conservation Service is assisting producers to improve environmental quality in concert with aquaculture

production in Rhode Island and Massachusetts. Through the Environmental Quality Incentives Program, NRCS is providing cost incentives for producers to address the following resource issues:

- protect water quality by controlling oil and gasoline emissions from outboard motors and biofouling residue discharges from cage culture wash operations;
- protect endangered species and marine mammals from entanglement through enhanced gear management, and
- improve the health of wild and farmed shellfish populations through better marine biofouling monitoring, environmental monitoring, and disease monitoring to prevent the spread of harmful pathogens.

Assistance to aquaculturists, including shellfish farmers, was authorized through the 2002 Farm Bill in the Environmental Quality Incentives Program (EQIP) final rule, stating “Livestock means animals produced for food or fiber such as dairy cattle, beef cattle, poultry, turkeys, swine, sheep, horses, fish and other animals raised by aquaculture.” With over 1 billion dollars in 2006, EQIP is one of our nation’s largest conservation cost share programs.

Certain activities undertaken in aquaculture operations offer transport vector opportunities, including the following:

Shellfish seed import

Shellfish seed are commonly grown in hatcheries and imported to Rhode Island for use in shellfish culture operations. The RI Coastal Resources Management Council carefully regulates the importation of seed for this industry, as there is the potential for the import of shellfish pathogens and other organisms associated with shellfish, such as boring organisms. Enhanced culture of local seed stocks in Rhode Island, and an enhanced capacity to identify and manage shellfish diseases will be necessary to minimize the loss of shellfish due to these threats.

Finfish culture

Growth and maintenance of finfish in open systems such as raceways, flow-through tanks, and net pens expose surrounding aquatic systems to pathogens associated with cultured fish populations. While there are no private finfish culture operations in Rhode Island, DEM maintains four hatcheries that collectively produce rainbow, brook, and brown trout, including a sea run strain of the brown trout, Atlantic salmon, small mouth bass, and shiners.

Regarding finfish culture, RIDEM hatcheries are regularly inspected and regulations require that all fish, eggs and fry that enter state hatcheries or are imported to the state for the purpose of release are certified disease-free. Additionally the best management practice (BMP) for the state hatcheries requires that raceways and any other flow through system are cleaned of any accumulated solids and the discharge be tested regularly. Disease is also a concern for finfish in the state and every measure possible is taken to

ensure that diseases are not carried over the border. This is a concern however that fish may be released or escape into the wild without the knowledge or consent of the RIDEM.

b. Commercial Shipping

Commercial shipping is often considered the most important means of unintentional introductions of AIS to coastal and estuarine waters of the United States and worldwide (Thresher, 2000). The steady rise of global commerce, increased shipping activities, and shorter transport times suggest that the threat of introductions through this pathway is likely increasing. The AIS Working Group has identified ballast water discharge and hull fouling as high priorities for management in this plan.

Ballast Water

To date, ballast water introductions from the shipping industry has dominated the field of AIS research in the United States. Shipping vessels commonly fill and release ballast tanks with seawater from harbors as a means of stabilizing loads. Although Rhode Island recognizes the threat from ballast water discharge, ports in the state may receive relatively little ballast water as compared to other major ports in the US due to local trade patterns (Smith et al., 1999). Shipping vessels commonly fill and release ballast tanks with seawater from harbors as a means of stabilizing loads. Research clearly indicates that live marine organisms ranging from plankton to adult fish are regularly transported and released via this pathway (Cohen and Carlton, 1995). The US Coast Guard voluntary ballast water management program was superseded in 2004 with the publication of regulations establishing a mandatory ballast water program for most vessels equipped with ballast water tanks that enter or operate within U.S. waters. These regulations also require vessels to maintain a ballast water management plan that is specific for that vessel and assigns responsibility to the master or appropriate official to understand and execute the ballast water management strategy for that vessel.

Hull Fouling

Hull fouling may rival ballast water discharge as the leading historical cause of harmful AIS introductions (Thresher, 2000). Organisms with sedentary life history stages can attach themselves to the hulls of commercial vessels or become entangled in submerged ship components. These organisms can survive for extended periods on vessels of any size and be introduced through dislodging, disentanglement, or by spawning in the ports to which they are transported. Increased awareness by the commercial shipping industry of the threats posed by transported fouling organisms will be necessary to limit introductions through this pathway. In addition, research into environmentally safe and effective antifouling methods will be necessary as traditional Tributyltin (TBT) antifouling agents are gradually phased out in many countries worldwide.

c. Recreational Boating

Lakes, ponds, and coastal waters of Rhode Island provide recreational opportunities for a large population of boaters. DEM reports that 43,243 boats were registered in Rhode Island as of September 2007, with a large majority being recreational vessels. The transportation of boats and their trailers between water bodies poses a risk of introduction through hull fouling, entanglement, and water discharge from bilge pumps and bait buckets (Hellquist, 2001, Thresher, 2000). The use of recreational boats for fishing poses the additional risk of the release of imported bait species or species that serve as hosts for nonindigenous organisms. With respect to freshwater lakes and ponds, this is a priority transport vector of concern.

Rhode Island does not currently have specific regulations regarding cleaning boat motors or hulls to ensure that they are clean of AIS and also has no regulations prohibiting the introduction of non-native baitfish into local waters.

While some educational materials are distributed to the public via boating manuals and other documents, there is no regulatory infrastructure to address this issue on either the freshwater or marine fronts. As such, there is a need to address this deficiency.

d. Bait Industry/Recreational Fishing

The shipment of live organisms into the state for use as bait may serve as pathways of introduction through their release (fish or invertebrates). Packing materials are often comprised of plant or algal matter and could harbor additional organisms.

e. Seafood Import and Sale

The Rhode Island Department of Health regulates the sale of all food products in Rhode Island including seafood. Its program, which involves inspections of food establishments and vendors, has not historically included a focus on the threat of invasive species. Through cross-training, there may be an opportunity to improve surveillance for AIS via food vendors and establishments.

f. Aquarium/Water Garden Trade

Nonindigenous marine and freshwater organisms can be introduced accidentally or purposefully after being imported for use in aquaria and water gardens (Crow and Hellquist, 2000). There is a potential for the introduction of nonindigenous species to Rhode Island waters via the aquarium and water garden industry. Certain koi varieties that are capable of over wintering and reproducing in the state are currently available via retail sale. Regarding the potential spread of certain AIS already present in the state, the DEM Division of Fish and Wildlife (DFW) prohibits the sale of fish taken from the fresh waters of the state and prohibits the release of any fish without a DFW permit.

However, the mislabeling of imported organisms, particularly aquatic plants, which may then be confused with native or innocuous species and released represents a potential problem beyond the scope of the DFW's prohibitions regarding freshwater finfish.

Marine species potentially introduced via the aquarium trade have also arrived in Rhode Island's coastal waters. The November / December 2006 issue of the Divers Alert Network (DAN) magazine reported that a juvenile red lionfish (*Pterois volitans*) was captured during the New England Aquarium Dive Club annual tropical fish hunt on Sunday, Sept. 17, 2006. This was the first documented case of this species for New England waters, and represents the northernmost record for this species in the Atlantic Ocean. Given that the habitat and distribution of this species is limited to reef habitats of the Indo-Pacific, it is unlikely that this specimen arrived in Rhode Island directly from this part of the world. A red lionfish was first discovered in the Atlantic in August 2002 off the coast of North Carolina. Since that time, this species has been reportedly moving steadily northward via the Gulf Stream.

g. Research and Supply

Marine and freshwater species can be ordered from research and education supply companies around the world through catalogue or Internet web sites. While these organisms are generally supplied for research purposes, multiple companies supply species for use in home aquaria. Few organism suppliers, including marine labs and research facilities, require documentation of use and handling practices prior to shipping. Rhode Island has limited capacity to monitor and regulate the import of these species, particularly those that are obtained through mail order or via the Internet. Control of introductions via this pathway is likely a federal responsibility, though states can play a role by ensuring that providers carefully monitor their shipments and provide recommendations for care and handling.

Once organisms are delivered, improper handling techniques may result in the release of nonindigenous imports. Both lab and field routines present the opportunity for accidental or purposeful release through wastewater discharge, disposal of unwanted organisms, poorly contained studies, etc. At least one invasion has been documented in Massachusetts via this pathway (Whitlatch et al. 1995).

The Marine Biological Laboratory at Woods Hole is currently developing guidelines for both distribution and handling of nonindigenous organisms. Through the implementation of the RIAIS plan the State of Rhode Island will participate in efforts to help to ensure that safe management practices are considered by research facilities and laboratories maintaining and distributing live aquatic organisms in the northeast region.

3. Priority Species

The species listed below were designated as high priorities by the AIS Working Group based on the following priority species designation criteria:

- 1) Severity of the problem posed to Rhode Island by an introduced species or one with a high probability for introduction.
- 2) Existing capabilities for management (species for which management options are currently available are given higher priority).
- 3) Associated costs and benefits of management.

Species were selected based on a review of the most current lists of aquatic species that are nonindigenous to Rhode Island (Appendix I). In addition to AIS impacts already experienced in Rhode Island, the potential for new species to invade RI must also be considered when developing management priorities. For example, Rhode Island has yet to be significantly impacted by fouling invertebrates such as the zebra mussel in freshwater systems. However, if introduced, such species could have dramatic impacts on water intakes, power generation, and wastewater treatment facilities as has occurred elsewhere in the U.S.

Table 1. Priority Established and Potentially Invasive Aquatic Species

Established Aquatic Invasive Species		
Freshwater Species	<u>common name</u>	<u>classification</u>
<i>Cabomba caroliniana</i>	fanwort	plant
<i>Corbicula fluminea</i>	Asian clam	mollusk
<i>Ctenopharyngodon idella</i>	grass carp	finfish
<i>Glossostigma diandrum</i>	mud mat	plant
<i>Iris pseudacorus</i>	yellow iris	plant
<i>Lythrum salicaria</i>	purple loosestrife	plant
<i>Myosotis sp.</i>	forget-me-not	plant
<i>Myriophyllum aquaticum</i> (<i>brasiliense</i>)	parrot feather	plant
<i>Myriophyllum heterophyllum</i>	variable watermilfoil	plant
<i>Myriophyllum spicatum</i>	Eurasian watermilfoil	plant
<i>Nelumbo lutea</i>	American lotus	plant
<i>Phalaris arundinacea</i>	reed canary grass	plant
<i>Phragmites australis</i>	common reed	plant
<i>Potamogeton crispus</i>	curly leaf pondweed	plant
<i>Rorippa nasturtium-aquaticum</i>	watercress	plant
<i>Trapa natans</i>	water chestnut	plant
<i>Urticularia inflata</i>	inflated bladderwort	plant
Ocean and Coastal Species		
<i>Ascidians</i>	sea squirt	tunicata
<i>Carcinus maenus</i>	European green crab	crustacean
<i>Codium fragile ssp. tomentosoides</i>	codium	algae
<i>Grateloupia turuturu</i>	red algae	algae
<i>Haplosporidian costalis</i>	SSO	shellfish pathogen
<i>Haplosporidian nelsoni</i>	MSX	shellfish pathogen
<i>Hemigrapsus sanguineus</i>	Asian shore crab	crustacean
<i>Membranipora membranacea</i>	lace bryozoan	bryozoan
<i>Perkinsus marinus</i>	derma	shellfish pathogen
Quahog Parasite Unknown	QPX	shellfish pathogen

Potentially Invasive Aquatic Invasive Species

Freshwater Species

	<u>common name</u>	<u>classification</u>
<i>Channa micropeltes</i>	giant snakehead	finfish
<i>Clarias batrachus</i>	walking catfish	finfish
<i>Dreissena polymorpha</i>	zebra mussels	mollusk
<i>Egeria densa</i>	Brazilian waterweed	plant
<i>Eichhornia crassipes</i>	water hyacinth	plant
<i>Hydrilla verticillata</i>	hydrilla	plant
<i>Hydrocharis morsus-ranae</i>	European frogbit	plant
<i>Najas minor</i>	European water nymph	plant
<i>Nymphoides peltata</i>	yellow floating heart	plant
<i>Pistia stratiotes</i>	water lettuce	plant
<i>Salvinia molesta</i>	giant salvinia	plant
<i>Scardinius erythrophthalmus</i>	rudd	finfish

Ocean and Coastal Species

<i>Caulerpa taxifolia</i>	caulerpa	algae
<i>Crassostrea gigas</i>	Pacific oyster	mollusk
<i>Eriocheir sinensis</i>	Chinese mitten crab	crustacean
<i>Porphyra yezoensis</i>	nori	algae
<i>Rapana venosa</i>	veined rapa whelk	mollusk

a. Freshwater Species

Aquatic Macrophytes

To date, invasive freshwater plants have received little attention in Rhode Island, in spite of their dramatic and widespread impacts on lakes and ponds in other New England states. Many of these species are able to propagate through both seed dispersal and fragmentation, resulting in rapid colonization through a variety of natural and human vectors (Crow and Hellquist, 2000). These species often form dense mats at the water's surface, significantly altering the original community structure, blocking shipping lanes, restricting swimming and fishing, and generally rendering the waterway unusable.

Evidence for the possible introduction of freshwater plant species is seen in the discovery of water lettuce (*Pistia stratiotes*) at the Turner Reservoir in East Providence and the Chipuxet River at Taylor's Landing in West Kingston. In addition, while water hyacinth (*Eichhornia crassipes*) has been found in the Biscuit City of the Pawcatuck River, it has not yet been documented to survive the winter. More recently, a field investigation conducted by the DEM Office of Water Resources documented the presence of invasive macrophytes in 26 of 33 lakes and ponds surveyed during the summer of 2007. The most common plant species identified was variable watermilfoil, with Eurasian water milfoil

and fanwort also reported. This tends to indicate a widespread problem throughout Rhode Island's freshwater habitats.

Common reed (*Phragmites australis*): Invading both fresh and saline marshes, introduced *Phragmites* forms dense monocultures, displacing native vegetation and reducing habitat value of many wetland systems (Crow and Hellquist, 2000, Meyerson et al., 2000). Often responding to modified drainage, *Phragmites* can impede access to water bodies and completely clog channels and drainage ditches. Removal is by mechanical harvesting, application of herbicides, or restoration of natural tidal hydrology and salinity regimes, and can be difficult and costly. Genetic evidence confirms that both native and introduced *Phragmites* lineages are found today in North America (Saltonstall, 2002, Saltonstall, 2003a, b). Using chloroplast DNA (cpDNA), Saltonstall (2002) showed that two different forms of *Phragmites* occur across much of the continent. One type, hereafter referred to as introduced *Phragmites*, belongs to a single lineage, or cpDNA haplotype M. The lineage is common throughout Europe and Asia and closely related to other haplotypes found there and clearly not native to North America. In contrast, 13 native North American *Phragmites* cpDNA haplotypes have been identified (hereafter referred to in a group as native *Phragmites*, Saltonstall 2002, unpub. data), all of which share several mutations not found in *Phragmites* populations elsewhere in the world. These 13 native haplotypes are distributed around the continent, except along the Gulf Coast, and genetic structuring can be seen between Atlantic Coast, Midwestern, and southwestern populations (Saltonstall, 2003a).

Purple loosestrife (*Lythrum salicaria*): This now prolific wetland species was introduced as early as 1824 in New England and Canada, likely escaping from flower gardens (Crow and Hellquist, 2000). This plant, which is still sold in nearby Massachusetts retail nurseries, is dispersed through seed and rhizomes, and forms dense mats excluding all other plant species in many types of freshwater and brackish wetlands (Hellquist, 2001). While its presence reduces the ecological value of wetland systems, purple loosestrife serves as an important pollen source for bees and commercial beekeeping operations. Currently, research and management efforts are focused on experimental biological controls using *Galerucella* beetles.

Mollusks

Established Mollusks

Asian clam (*Corbicula fluminea*): The Asian clam was first reported in the United States in Washington's Columbia River in the 1930s. It was likely introduced intentionally for harvest and consumption purposes (Counts, 1986). Since then it has spread across the country and has been documented in the Connecticut River just a few miles south of the Massachusetts border (Smith et al., 2001). RI Department of Environmental Management biologist Charles Brown collected the first Asian clam recorded in RI in Tiogue Lake, Coventry, Kent Co. in July 2000; the specimen was probably 2 years old at the time. Ray Hartenstine of RI College reported that it had been found in the outflow from Tiogue Lake into the Pawtuxet River in 2005. More recently, it was found in large numbers in

Worden Pond located in the Town of South Kingstown in 2007. The most prominent economic impacts of the Asian clam introduction in the United States have been related to biofouling of power plant water intakes and other municipal and industrial water intake and supply systems (Isom et al., 1986, Williams and McMahon, 1986). Ecological impacts result from competition with native species for space and other limited resources. The Asian clam has been blamed for the decline and local extinctions of several native freshwater mussel species (Williams, 1997).

Potentially Invasive Mollusks

Zebra mussel (*Dreissena polymorpha*): Introduction of the zebra mussel into the Great Lakes and the resulting impacts such as fouling, alteration of community structure, and competition with rare species led to an increased awareness of the AIS problem at the national level, and the passage of the National Invasive Species Prevention and Control Act. Since its introduction in 1988, the zebra mussel has spread throughout many of the major drainage basins of the Midwest and Northeast, including the Mississippi River down to the Gulf of Mexico (USGS, 2002). The zebra mussel has yet to be documented in Rhode Island, but in 1998 was found in Connecticut in the Housatonic watershed and is widespread in the Hudson River system in New York, an area popular with local fishers and boaters. Clearly, keeping the zebra mussel out of RI is a high priority. Increased efforts towards monitoring for this species, increasing public awareness, and development of a rapid response strategy will be essential to minimize its impacts on the aquatic environments of the state.

Finfish

Established Finfish

Common carp (*Cyprinus carpio*): The common carp is an herbivorous fish that originates from Eastern Europe and Asia. Carp were first introduced into Rhode Island in 1880 by the Commissioners of Inland fisheries (Commissioners on Inland Fisheries 1881, Tenth Annual Report made to the General Assembly at its January Session, 1881.E. L. Freeman & Company, Printers to the State, Providence, RI). These fish were stocked in numerous states to provide anglers with additional opportunities to obtain fish for food and sport because native populations of fish could not recover from fishing pressures exerted on them at the time. Since that time the destructive nature of common carp on native habitat and fish populations has prompted state agencies to prohibit stocking of these fish. The feeding habits of the common carp can be devastating to a pond. They destroy vegetation that is habitat for juvenile fish, increase turbidity which makes it more difficult for plants to reestablish, and resuspend sediments which provides nutrients for algae to grow (Threinen and Helm, 1954, Ross, 2001). Common carp are tolerant of numerous environmental variables, including a high tolerance of salinity, temperature and dissolved oxygen (Panek, 1987). Carp can carry disease that can affect other fish species. Spring viremia of carp of SVC is a viral disease that can affect native species including roach, pike, guppy, pumpkinseed, goldfish and golden shiner (Miller, 2003). In Rhode Island common carp is found in isolated locations. A ten-year statewide survey of 360 sampling

sites found carp in 14 urban locations, primarily in the Pawtuxet and Blackstone watersheds (Libby, 2004).

Potentially Invasive Finfish

Rudd (*Scardinius erythrophthalmus*): The rudd was originally imported from Europe in the late 1800s to be used as a baitfish. The species has since been found in freshwater and estuarine habitats in at least 20 states, including most of the Northeastern United States. Reproducing populations of rudd have been found in the lower Charles River in Boston. Dispersal appears to be through interstate traffic from the bait and aquaculture industries rather than new European imports. The impact of the rudd is largely unknown, but it is able to hybridize with the native golden shiner. The rudd will likely compete for invertebrate food sources with native fish species (Burkhead and Williams, 1991).

Walking catfish (*Clarias batrachus*): The walking catfish first escaped from a Florida aquarium fish farm in the mid-1960s. It has since invaded the entire southern region of Florida and has also been found in Connecticut, California, Georgia, Massachusetts, and Nevada. An extremely opportunistic species that will feed on any available food source, it can cause serious damage to native species (USGS, 2002). This species is also readily available through Internet web sites as an aquarium fish. The walking catfish is mentioned here as it has been found in Connecticut and Massachusetts, nonetheless, it is questionable whether viable populations can be established in Rhode Island.

Giant Snakehead (*Channa micropeltes*): The giant snakehead was first reported in the United States in 1968 by the RI Division of Fish and Wildlife when a single specimen was taken from Johnston Pond in Coventry, Rhode Island. While specimens have recently been found in Maryland, there are no current reports of the giant snakehead in Rhode Island. Massachusetts and Maine, the other New England states that have reported the giant snakehead in the past, also have no current records of its presence (<http://nas.er.usgs.gov>, last updated 6/7/05). Snakeheads have been imported into the US as aquarium fish and food fish and can disrupt an ecosystem's predator-prey balance if established in a water body (<http://www.in.gov/dnr/fishwild/fish/ais/snakehead.htm>, last updated 3/05). The RI Department of Environmental Management promulgated an emergency regulation in 2002 prohibiting the importation, transfer, release, cultivation, and/or dispersal of all species of "Snakehead Fish" (*Family Channidae, Genera Parachanna, Genera Channa*) into and within the State of Rhode Island. The Giant Snakehead is mentioned here as a live specimen has been found in Rhode Island, nonetheless, it is questionable whether viable populations can be established in the state.

b. Ocean and Coastal Species

The following species are found in the marine and estuarine environments of RI. Though most are well established, reductions in the populations of organisms, like the green crab and shellfish pathogens, could result in measurable economic benefits, and a shift towards historical biological communities in Rhode Island. The following marine and estuarine species have been documented in the United States, but not yet in New

England. Several of these species listed below have had dramatic ecological and economic impacts outside of their respective native ranges.

Algae and Plant Species

Established Algae and Plants

Codium (*Codium fragile* ssp. *tomentosoides*): The green algae *Codium fragile* was first documented in the Gulf of Maine in 1964 at Boothbay Harbor, Maine (Harris and Mathieson, 1999, Boerner, 1972, Coffin and Stickney, 1966). *Codium* can now be found in rocky intertidal and subtidal habitats from the Gulf of St. Lawrence in Canada to North Carolina. Where found, *Codium* can radically change community composition, structure, and function (Harris and Mathieson, 1999). It has been blamed for lower abundances of limpets, chitons, and brittle stars in Nova Scotia (Scheibling, 2001). This alga has also devastated kelp beds off the coasts of Nova Scotia and Maine, and disrupted cyclical synergistic interactions between kelp and several sea urchin species (Scheibling, 2001). These disruptions are expected to have major impacts on subtidal systems, but they are not yet well documented or understood (Harris and Mathieson, 1999). Impacts may also include change in water flow and sedimentation rate, lower water and light qualities, altered food webs, and lowered productivity. Ecologically and economically important species such as finfish, sea urchins, and lobsters may be affected, as they utilize kelp for food, habitats, and nurseries (Scheibling, 2001).

Red algae (*Grateloupia turuturu*): The large red macrophyte *Grateloupia turuturu* was first reported in Rhode Island (and the U.S.) when it was discovered on the lower rocky intertidal zone at the southernmost point of Beavertail State Park in the Town of Jamestown in 1994 (Harlin and Villalard-Bohnsack, 2002). It was identified at nine other sites by 1997. The contention that *Grateloupia* was introduced to RI via ballast water is supported by its distribution being coincident with shipping traffic and water circulation patterns in Narragansett Bay. That the organisms established in the Bay share more DNA similarities with each other than they do with the same species in other countries, also supports the belief that the introduction was a one-time inoculum. While impacts on native species are currently unknown, it has been observed that *Chondrus crispus* (Irish moss) is less dense where it grows with *Grateloupia turuturu*. *Grateloupia turuturu* is now a dominant macroalgae species, especially in parts of the mid and lower Narragansett Bay.

Potentially Invasive Algae and Plants

Nori (*Porphyra yezoensis*): Red algae of the genus *Porphyra* are the most widely consumed seaweed in the world (Ohio Sea Grant, 2000), and several species of *Porphyra* are commonly found along the Massachusetts coast. An effort to grow a nonindigenous species of the algae, *Porphyra yezoensis*, for commercial purposes is underway in the coastal waters of southern Maine. Current research is largely focused on developing a variety that is better adapted to the waters of the Gulf of Maine but will not sexually reproduce nor out-compete native species in vegetative growth. There is concern in the

region over the potential escape and proliferation of this and other cultivated algal species.

Caulerpa (*Caulerpa taxifolia*): Dubbed “the killer algae,” this aquatic plant with a feather-like appearance has caused tremendous ecological damage in the regions where it has invaded. This alga is associated with the aquatic pet industry and public aquariums. In the late 1980s, a hybrid strain of *Caulerpa taxifolia* invaded the Mediterranean coast, believed to have been accidentally released by a public aquarium (Meinesz, 1999). The invasive hybrid strain was recently discovered along the California coast, but was quickly eradicated thanks to early detection and rapid response. Although primarily a warm-water species, this hybrid can thrive in temperatures as low as 5° Celsius (Makowka, 2000). *Caulerpa taxifolia* has been banned for importation into the United States yet it is still sold in many areas and is available through the Internet trade. No record for this species currently exists in Rhode Island.

Mollusks and Crustaceans

Established Mollusks and Crustaceans

European green crab (*Carcinus maenus*): The European green crab was probably introduced to New England via ballast water in the mid-1800s. Now one of the most prolific crab in Rhode Island coastal waters, the green crab is a voracious predator of aquatic macroinvertebrates, and has been blamed by some for the collapse of the New England soft-shelled clam industry (Pimentel et al., 1999). At this time, eradication of this species is not possible. However, reductions in the overall population size may allow populations of displaced native species to recover. Continued research on commercial uses and biological controls are necessary to develop effective management of this population.

Asian Shore Crab (*Hemigrapsus sanguineus*): The Asian shore crab was first documented in North America along the coast of southern New Jersey in 1988 (Williams and McDermott, 1990). Likely introduced via ballast water, this crab has expanded its range southward to North Carolina and north to northern Maine at the Canadian border. Little is known about the role this species could play in changing coastal ecosystem structure. However, in rocky intertidal areas dominated by boulder and cobble substrates, this species has been found in densities of 80 to 100 individuals/m² (L.D. Smith as quoted by Blake, 2001) suggesting that it may be having dramatic impacts on the intertidal community. Continued research on the life history and impacts of this species will be important to determine appropriate next steps in its management. This species is now the dominant intertidal crab species in many areas of Narragansett Bay (Deacutis, personal communication).

Potentially Invasive Mollusks and Crustaceans

Veined rapa whelk (*Rapana venosa*): Native to the Sea of Japan, the veined rapa whelk was introduced to the Black Sea in the 1940s from where it spread to the Mediterranean

Sea and subsequently the Chesapeake Bay, where it was discovered in 1998 (Harding and Mann, 1999). This species feeds on reef forming and epibenthic bivalves and has caused major damage to the shellfish industry in the Black Sea. There is serious concern about the impact this species could have on similar Atlantic Coast fisheries as well as native benthic community structures. Rapa whelks—with their pelagic larval stages, a broad salinity tolerance, and broad diet—have been deemed highly likely to expand their range in coming decades so if they are found from Cape Cod to Cape Hatteras (Mann and Harding, 2003). Additional research regarding their ability to tolerate cold-water conditions will be necessary to determine the need for additional preventative measures in Rhode Island.

Chinese mitten crab (*Eriocheir sinensis*): The Chinese mitten crab is a catadromous species which lives in freshwaters and moves into salt waters for reproduction. It has undergone explosive growth along the California coast since its discovery in San Francisco Bay in 1992. More recently, this species has been found in the Chesapeake Bay. A highly valued food item throughout China, it is unclear if this species was intentionally introduced, or was released in ballast water originating in the Yellow Sea or Europe (Wynn et al., 2000). Threats from this species include clogging of fish collection devices, fish-ways and hydropower intakes; damage to levees and other coastal structures that result from its burrowing habits; and alteration of the native community structure through predation (Washington Sea Grant, 2001). The dramatic ability of this species to reproduce in great numbers as seen in central California indicates the need to prevent the introduction of this species to New England waters and to develop a response protocol in the event that it is discovered here. Undammed freshwater streams and rivers may be the most vulnerable, but this species can get around some dam obstructions.

Pacific oyster (*Crassostrea gigas*): The Pacific oyster was intentionally introduced to the United States from Japan for commercial culture in the early 1900s. Though this species is able to survive in cold Pacific waters, it spawns at about 18 degrees Celsius and thus only sporadically in wild populations along the Pacific Coast of the United States (Pacific States Marine Fisheries Commission, 2001). This species would likely survive and reproduce in the warmer coastal waters of Rhode Island where water temperatures often exceed 20° Celsius during summer months (Estrella and Glenn, 1999)

<http://omp.gso.uri.edu/doee/science/physical/cycle1.htm>. Concerns about this species are that the Pacific oyster may out compete the eastern oyster (*Crassostrea virginica*) for space, dilute the local genetic stock through interbreeding, and potentially introduce a variety of shellfish pathogens native to the Pacific (Hickey, 1979). There is current concern over the intentional introduction of this species by shellfish growers or unintentional discard by a member of the general public. Additional measures for prevention include education targeted at the aquaculture industry regarding threats to native oyster species.

Other Established Ocean and Coastal Species

Lace Bryozoan (*Membranipora membranacea*): Initially settling on kelp where it forms flat colonies, this species is a calcareous bryozoan whose growth weakens the alga and

causes it to break. The lace bryozoan has contributed to the declines of kelp beds in the Gulf of Maine since the early 1990s, facilitating colonization by another invader, *Codium fragile* ssp. *tomentosoides*. The introduction of these organisms has caused declines in available habitat for important finfish such as juvenile cod, the green sea urchin (*Strongylocentrotus droebachiensis*), and numerous invertebrate species (Scheibling 2001). An introduced opisthobranch or predatory snails may graze this species. More research into specific predators, effects of local predators on the population, and better documentation of ecological effects are necessary to understand the impacts and management of this organism (Harris and Mathieson, 2000, Chavanich and Harris, 2000, Harris and Tyrell, 2001).

Ascidians

Also called tunicates or sea squirts, ascidians are sessile organisms that are able to rapidly colonize marine substrates as solitary organisms or in colonies. Potential impacts of these organisms include competition with native species for suitable substrate, direct impacts to organisms on which they settle and attach, and fouling of vessels and coastal infrastructure (pipes, traps, etc.). To date, six nonindigenous species of tunicates have been documented in New England waters: *Styela clava*, *Styela canopus*, *Diplosoma listerianum*, *Ascidiella aspersa*, *Botryllus schlosseri*, and *Botrylloides violaceus*, *Didemnum*. Ecological impacts of these organisms remain largely unknown, though concern has been raised by their ability to rapidly spread over vast geographic areas. *Styela* and *Botrylloides* were documented to have spread from Connecticut to Maine in fewer than 10 years (Whitlatch and Osman, 2000). *Didemnum* sp. has been observed in high density colonies at the University of Rhode Island Bay Campus dock (Auker M.S. thesis, 2006). This species has been shown to rapidly colonize large areas of benthic cobble offshore (George's Bank) in recent years, potentially disrupting important juvenile finfish and scallop habitat. (<http://woodshole.er.usgs.gov/project-pages/stellwagen/didemnum/>). Research into means of transport and control technologies will be necessary to manage impacts from these organisms.

Established Shellfish Pathogens

Shellfish pathogens have periodically decimated shellfish stocks throughout the United States, particularly in the Chesapeake Bay region. Shellfish pathogens of concern in the Northeast include both cryptogenic species (i.e., species of unknown origin) and species thought to have been recently introduced to Rhode Island coastal waters. Difficulty in identifying these species makes tracking their distribution difficult. Range expansion of these organisms is generally attributed to the planting of contaminated shellfish seed and the warming of near shore ocean temperatures. The following are several examples of important shellfish pathogens in Rhode Island:

Multinucleated Sphere X or MSX (*Haplosporidian nelsoni*): MSX is one of several diseases that affect bivalves on the East Coast of the United States, and it has been identified as one of the major constraints to the expansion of the bivalve aquaculture industry in Rhode Island. (Ford and Tripp, 1996). The devastating effects of

Multinucleated Sphere X (or MSX, caused by the parasite *Haplosporidium nelsoni*) on wild and farmed oyster populations in the Mid-Atlantic region have led to record low landings and severely affect restoration efforts (Ewart and Ford, 1993). Although MSX originated in waters south of Rhode Island in Delaware Bay, it has been continually reported in state waters since its first report during the 1980s. It has thus far proven impossible to eradicate MSX in the field. Rather, careful screening and disease testing of seed stock, and strict management of intrastate movement of adult stock are the best present strategies to control its potential impacts. In Rhode Island, MSX has been detected in wild oyster populations in Barrington River, Wickford Cove, Ninigret Pond, Green Hill Pond, and Block Island. The disease has not been detected in farmed oysters in Rhode Island.

Perkinsus marinus (“Dermo disease”): *Perkinsus marinus*, commonly referred to as dermo, as it was initially, and erroneously, identified as Dermocystidium. Nonetheless, the incorrect term dermo has become an accepted colloquialism. It was first reported during the 1940s in the Gulf of Mexico as the result of an investigation into a significant oyster mortality event (Mackin, 1966). It has been associated with similar oyster die-offs in Chesapeake Bay, and in the northeast is now known to have spread to Southern Maine (Ford, 1996). Like MSX, there have been no successful methods yet developed to kill this organism in the field. Management practices described above for MSX are the best current options to control its spread. Dermo disease was first detected in a few wild oyster populations of Rhode Island in 1998, and was a major contributor (with a lack of successful sets and fishing pressure) to the severe decline of these populations. Dermo levels in wild populations peaked in 2000 – 2001, and have decreased since then; it is still prevalent in the few remnant wild oysters. Levels of Dermo in cultured oysters have remained low to moderate from 1998 - 2007; the percent prevalence ranged from 0% to 44%. The highest levels of Dermo in 2006 were observed in some farms in the Coastal Ponds and Block Island. Dermo could be responsible for low levels of oyster mortality at these farms, since 8 – 20% of oysters had high levels of infection, and these levels of infection are commonly associated with oyster mortalities. In general, the average prevalence and intensity of Dermo disease in cultured oysters is significantly lower than that in wild oysters (Gomez-Chiarri, 2006).

Quahog Parasite Unknown or QPX: QPX is a disease of the Northern quahog (*Mercenaria mercenaria*), and has been associated with mortalities in cultured quahogs in Canada, Massachusetts, Virginia, New York (Hickey et al., 2002), and most recently in Rhode Island (Lyons et al., submitted). Quahogs affected by QPX show a variety of gross signs of disease, including decreased new shell growth, swollen retracted mantle, and occasional small round yellow-tan nodules in the mantle tissue (Ragone Calvo et al., 1998, Smolowitz et al., 1998). Infected quahogs populations can exhibit high mortality, usually just before quahogs reach market size (Hickey et al., 2002).

Juvenile Oyster Disease (JOD): JOD is caused by an alpha-proteobacterium known as *Roseovarius crassostreae*, and it has had a variable impact on Northeastern oyster stocks since it first appeared in 1980. Outbreaks tend to be sporadic and the disease can be managed most of the time. However, when outbreaks do occur they have a large impact

and lead to high levels of mortality (up to 100%) in susceptible oysters. The disease affects Eastern oysters (*Crassostrea virginica*) mostly at the juvenile stage between 2 – 4 mm in length. Resistance to the disease increases as oysters increase in size. JOD was first noted in Maine in the mid-1980s and caused significant mortalities in nursery operations in the Long Island area of New York. Since then, it has caused recurrent mortalities in different areas of the Northeast, from Long Island to Maine. Sporadic episodes of mortality due to JOD have affected cultured juvenile oysters in Rhode Island coastal ponds in the late 1980s and then again in 2007. A disease with similar signs has been reported in Eastern oysters cultured in France (Gomez- Chiarri, 2006).

III. Legislation

The legal framework for aquatic invasive species in the United States includes federal, regional, and state authorities, with linkages to international organizations as well. These various authorities are described briefly in this section, with an emphasis on those laws and programs most related to the aquatic invasive species issues in Rhode Island. This Plan is intended to be responsive to both federal and state legal mandates that Rhode Island state government, working in collaboration with many partners, develop an effective approach for the management of AIS. Coordinating the implementation actions and tasks of this RIAIS Plan within the context of the existing framework will help to create a much needed network of partners that collectively dedicate their resources to the task of managing the aquatic invasive species in the state. Effective management of AIS, as reflected in the recommended implementation actions (Section X) will require an increased commitment from both state government and various organizations responsible for or interested in particular aspects of the aquatic invasive species problem in Rhode Island.

1. Federal Legislation and Executive Orders

At the federal level, no single agency has authority over the management of AIS. Rather, multiple agencies have developed invasive species programs, largely in reaction to severe AIS issues. Federal legislation is in place to direct the coordination of the AIS activities of multiple federal agencies. Effective invasive species management in the United States will require federal agencies to expand existing efforts to deter nonindigenous species introductions through the oversight of international and interstate trade and commerce and associated transport vectors such as commercial shipping and the trade of organisms via mail order and the Internet (Section III). Pertinent federal legislation pertaining to AIS includes:

- a. The Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (NANPCA, PL 101-646) and National Invasive Species Act of 1996

The federal government first responded to the invasive species issue in reaction to the devastating economic and ecological impacts of the zebra mussel introduction to the Great Lakes. The Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (NANPCA, PL 101-646), amended and broadened in scope as the National Invasive Species Act of 1996, establishes the federal interagency Aquatic Nuisance Species Task Force. The Act outlines the following objectives (Section 1002):

- 1) To prevent further unintentional introductions of nonindigenous aquatic species.
- 2) To coordinate federally funded research, control efforts and information dissemination.
- 3) To develop and carry out environmentally sound control methods to prevent, monitor, and control unintentional introductions.
- 4) To understand and minimize ecological damage.
- 5) To establish a program of research and technology development to assist state governments.

Section 1201 of NANPCA establishes the federal interagency Aquatic Nuisance Species Task Force. The ANS Task Force is charged with coordinating federal aquatic nuisance species management efforts with the efforts of the private sector and other North American interests. The ANS Task Force is responsible for initiating research programs, planning initiatives, and policy direction for the prevention, detection and monitoring, and control of aquatic nuisance species, and operates through regional panels as well as issue-specific working groups that address particularly problematic invaders.

Additionally the Act calls for the development of state aquatic nuisance species management plans and improved coordination of implementation actions through regional panels. Section 1203 directs the federal ANS Task Force to encourage the development and use of regional panels to:

- 1) Identify priorities for each region with respect to aquatic nuisance species.
- 2) Make recommendations to the Task Force regarding education, monitoring (including inspection), prevention, and control of nuisance species.
- 3) Coordinate, whenever possible, other aquatic nuisance species program activities in each region.
- 4) Develop an emergency response strategy for federal, state, and local entities for stemming new invasions of aquatic nuisance species in the region.
- 5) Provide advice to public and private individuals and entities concerning methods of preventing and controlling aquatic nuisance species infestations.
- 6) Submit an annual report to the Task Force describing activities within the region related to aquatic nuisance species prevention, research, and control.

The Act also directed the U.S. Secretary of Transportation to develop mandatory ballast water guidelines for the Great Lakes (and later for the upper Hudson River). This task was delegated to and completed by the U.S. Coast Guard, the lead federal agency for ballast water management issues. Amendments to NANPCA in 1996 (Appendix C) directed the Secretary to extend ballast water management regulations to the remainder of U.S. waters. Developed and implemented by the Coast Guard in July of 1999, the Voluntary National Guidelines apply to waters outside of the Great Lakes Ecosystem.

b. Executive Order 13112

This order establishes the National Invasive Species Council, a federal interagency organization charged with the biennial development of a National Invasive Species Management Plan. The National Invasive Species Council is composed of 13 Federal Departments and Agencies. The NISC is co-chaired by the Departments of Agriculture, Commerce, and Interior, with the remaining council members representing the Department of Defense, the EPA, Homeland Security, Health and Human Services, NASA, the Office of the U.S. Trade Representative, the State Department, the Department of Transportation, the Treasury Department, and USAID.

The National Invasive Species Council is responsible for providing national leadership regarding invasive species, and shall:

(a) oversee the implementation of this order and see that the Federal agency activities concerning invasive species are coordinated, complementary, cost-efficient, and effective, relying to the extent feasible and appropriate on existing organizations addressing invasive species, such as the Aquatic Nuisance Species Task Force, the Federal Interagency Committee for the Management of Noxious and Exotic Weeds, and the Committee on Environment and Natural Resources;

(b) encourage planning and action at local, tribal, State, regional, and ecosystem-based levels to achieve the goals and objectives of the Management Plan in section 5 of this order, in cooperation with stakeholders and existing organizations addressing invasive species;

(c) develop recommendations for international cooperation in addressing invasive species;

(d) develop, in consultation with the Council on Environmental Quality, guidance to Federal agencies pursuant to the National Environmental Policy Act on prevention and control of invasive species, including the procurement, use, and maintenance of native species as they affect invasive species;

(e) facilitate development of a coordinated network among Federal agencies to document, evaluate, and monitor impacts from invasive species on the economy, the environment, and human health;

(f) facilitate establishment of a coordinated, up-to-date information-sharing system that utilizes, to the greatest extent practicable, the Internet; this system shall facilitate access to and exchange of information concerning invasive species, including, but not limited to, information on distribution and abundance of invasive species; life histories of such species and invasive characteristics; economic, environmental, and human health impacts; management techniques, and laws and programs for management, research, and public education; and

(g) prepare and issue a national Invasive Species Management Plan as set forth in section 5 of this order.

Additionally, there are a number of federal statutes adopted for purposes natural resource management, environmental protection and other purposes that indirectly provide authority or authorize programs that may support AIS management. A summary of other federal laws and programs is in Appendix E.

2. RI State Legislation

Several Rhode Island state laws address the issue the aquatic invasive species. The need to plan for and coordinate state government AIS activities is reflected in the mandate to the Narragansett Bays, Rivers and Watersheds Coordination Team. Both CRMC and RIDEM exercise regulatory powers that contribute to controlling the introduction and

spreading of AIS. However, there appear to be gaps in the state statutory framework that should be addressed to strengthen the state legal framework as it related to AIS. Relevant existing statutes are described below:

a. RIGL 46-31 “ The Rhode Island Bays, Rivers and Watersheds Coordination Team”

This chapter establishes a team of seven state agencies to enhance coordination and collaboration with respect to protection, restoration and management of Rhode Island’s bays, rivers and watersheds and water-dependent economy. The statute requires a systems-level plan be developed to guide agency programs and activities. The law specifically directs the plan to address aquatic nuisance species. The Coordination Team meets monthly and initiated work toward developing a systems-level plan, tentatively expected to be completed in 2008. It is expected that the AIS plan will be integrated into or referenced in the larger systems level plan.

This statute, as well as RIGL 46-23.2, also authorizes the RI Environmental Monitoring Collaborative (RIEMC) that was established in 2004. It is comprised of ten voting members representing state agencies and URI along with a larger number of participating members representing federal partners, non-profit entities, etc. The RIEMC is charged with developing and coordinating a comprehensive environmental monitoring strategy, including a data management component, to support the needs of state resource managers. In addition to a number of other parameters, the law specifies that the comprehensive monitoring strategy address nuisance aquatic species. The RIEMC advises and reports to the Coordination Team. Its initial work has focused on water quality monitoring strategies, but it has recently begun discussion of proposed strategies for freshwater wetlands, marine fisheries and coastal erosion. It is expected the monitoring strategies outlined in this plan will be reviewed by the RIEMC as part of the on-going process to development the comprehensive monitoring strategy.

b. RIGL § 46-17.3 “Ballast Water”

This statute required RIDEM to investigate and evaluate issues related to ballast water and report to the General Assembly in 2002 on the recommended options for establishing a ballast water management program in RI. Among the report’s recommendations was to pass state legislation to directly manage ballast water in Rhode Island. No further legislative action has been forthcoming and given changes in regulation at the federal level, the recommendations merit re-evaluation.

c. RIGL § 20-10-1.1 Creation of the Biosecurity Board

This statute establishes a Biosecurity Board within the CRMC composed of seven (7) members including representatives from CRMC, RIDEM Fish and Wildlife, the state veterinarian or an individual certified in veterinary medicine, with a specialty in aquatic diseases, or by the American Fisheries Society, a certified medical doctor or a person with a Ph.D. in public health, the RI Marine Fisheries Council, the aquaculture industry and a faculty member of the University of Rhode Island, Department of Fisheries,

Animals and Veterinary Science. Duties of the board include assisting and advising the CRMC in carrying out the provisions of this chapter. In performing this duty, the Biosecurity Board shall cooperate with appropriate state and federal agencies, including but not limited to the RI Department of Health, and shall recommend inspections as necessary to ensure compliance with public health standards. The Biosecurity board shall from time to time review federal agency regulations pertaining to aquaculture disease and the importation of non-indigenous and genetically altered species and shall otherwise maintain a current understanding of aquatic diseases and management practices necessary to preserving the aquaculture industry and wild stock.

A number of other state laws provide authorities or create programs that are supportive of AIS management. A table of related state laws that provide authority is included below.

Table 2. – RI Statutes Relevant to Aquatic Invasive Species

<u>Title</u>	<u>Chapter</u>	<u>Section</u>	
2			
Agriculture and Forestry			
2-1	1-19		<u>Public policy on swamps, marshes, and fresh water wetlands</u>
			<ul style="list-style-type: none"> • Establishes policy of the state to preserve the purity and integrity of the swamps, marshes, and other fresh water wetlands of this state • Places state restrictions on the uses of wetlands and, in the exercise of the police power regulates those wetlands
2-16	16.1		<u>Rhode Island General Plant Pest Act</u>
			<ul style="list-style-type: none"> • Interstate pest control compact serves to remedy funding constraints and bridge jurisdictional gaps that exist among state and federal governments • Establishes pest control insurance fund to provide financial assistance to address pest outbreaks of economic significance or of concern to other states, plant infestations outside the control or means of a single jurisdiction, and infestations of a size that results can be achieved
4			
Animals and Animal Husbandry			
4-18	18-1		<u>Permit required to import wild animals</u>
			<ul style="list-style-type: none"> • Authorizes RIDEM to regulate the receiving, possessing or importation into this state without first obtaining a permit from the department, animals of the following orders, families, and genera: primates, carnivores, amphibia, reptilia, canidae, and insecta (RIDEM Director may designate additional orders, families, genera, or species).

20		Fish and Wildlife
20-1	1.2	<p><u>Authority over fish and wildlife</u></p> <ul style="list-style-type: none"> • Authorizes RIDEM the responsibility over the fish and wildlife of the state and over fish, lobsters, shellfish and other biological resources in marine waters of RI.
20-1	1-8	<p><u>Enforcement powers of director and conservation officers</u></p> <ul style="list-style-type: none"> • Empowers RIDEM director and conservation officers to enforce laws, rules and regulations to include those pertaining to fish, wildlife, plants, areas and activities under CRMC jurisdiction, agriculture, farmland and pest control, shipment of all fish, shellfish, crustaceans, marine mammals, amphibians, reptiles, birds and mammals
20-2	1-9	<p><u>Powers and duties of the director</u></p> <ul style="list-style-type: none"> • Authorizes RIDEM director to file emergency rules to protect an unexpectedly imperiled fishery resource, to provide access to a fisheries resource that is unexpectedly more abundant, and to protect the public health and safety from an unexpected hazard or risk
20-8	8.1	<p><u>Atlantic States Marine Fisheries Compact</u></p> <ul style="list-style-type: none"> • Executes compact to promote the better utilization of the fisheries, marine, shell and anadromous, of the Atlantic seaboard by the development of a joint program for the promotion and protection of such fisheries, and by the prevention of the physical waste of the fisheries from any cause • Establishes shellfish program at RIDEM
20-10	10	<p><u>Creation of the Biosecurity Board</u></p> <ul style="list-style-type: none"> • Biosecurity Board will assist and advise CRMC; recommend inspections as necessary to ensure compliance with public health standards • Reviews federal agency regulations pertaining to aquaculture disease, importation of non-indigenous and genetically altered species • Maintains current understanding of aquatic diseases and management practices necessary to preserve aquaculture industry and wild stock; may file emergency regulations • Reviews and comments on proposed aquaculture operations that include non-indigenous species and the protocols to prevent their releases into RI waters
20-11	11-10	<p><u>Injurious substances</u></p>

- Prohibits placement, deposition or explosion of any substance (to include aquatic herbicides) injurious to the health or life of fish in any freshwaters except if permitted by the director of RIDEM
- 20-11 11-5 Sale of Freshwater Fish
- Prohibits sale of finfish taken from any freshwaters within the state except those artificially cultured in private ponds
- 20-11 11-6 Stocking of Streams and Ponds
- Prohibits stocking, placing or liberating any fish in any fresh waters of Rhode Island without a permit from RIDEM
- 20-11 11-7 License required for selling freshwater minnows
- Prohibits the sale or barter or engagement in the business of taking or catching for the purpose of selling or bartering fresh water live minnows for bait without a permit from RIDEM

42 State Affairs and Government

- 42-17.1 1-2 Department of Environmental Management (RIDEM)
- Establishes DEM to supervise and control the protection, development, planning, and utilization of the natural resources of the state, such resources, including but not limited to, water, plants, trees, soil, clay, sand, gravel, rocks and other minerals, air, mammals, birds, reptiles, amphibians, fish, shellfish, and other forms of aquatic, insect, and animal life
- 42-17.1 1-4 Divisions within RIDEM
- Establishes divisions of parks and recreation; fish and wildlife, agriculture, coastal resources, planning and development, enforcement, forest environment and boating safety

46 Waters and Navigation

- 46-12 12-1 Water Pollution Act
- Authorizes RIDEM to classify waters of the state and promulgate water quality standards (including references to aesthetic conditions that relate to aquatic nuisance species)
 - Authorizes RIDEM to regulate the discharge of pollutants (defined broadly to include biological materials) into state waters

- 46-15 15-1 Water Resources Board
- Regulates the proper development, protection, conservation and use of the water resources of the state
- 46-15 15.7 Authority to enter upon lands and waters for purpose of survey
- Grants the right of the water resources board, its assistants, consultants, employees, subordinates, engineers, surveyors, or other agents or servants, to enter in, over, and onto any lands or waters in the state along with the equipment and devices as may be necessary and appurtenant for the conducting of examinations, investigations, appraisals, surveys, or other studies without being liable for trespass upon giving due notice of intent and purpose, and with the consent of the landowner.
- 46-17 17.3 Ballast Water
- Calls RIDEM to coordinate development of a ballast water management program
 - DEM provided report to general assembly 2003 (Appendix)
- 46-23 23-2 Coastal Resources Management Council (CRMC)
- Establishes Council to manage the state's coastal resources
 - Sets state policy to preserve, protect, develop, and, where possible, restore the coastal resources of the state
 - Implements the Coastal Zone Management Act (1978)
- 46-23 23.1 The Rhode Island Coastal and Estuary Habitat Restoration Program and Trust Fund
- Facilitates the design, planning, construction and monitoring of coastal and estuarine restoration projects by providing grants and technical assistance
- 46-23 23.2-1 The Comprehensive Watershed and Marine Monitoring Act of 2004
- Establishes RI Environmental Monitoring Collaborative (EMC)
 - Charges EMC with development of a comprehensive monitoring program
- 46-28 28-1 Rhode Island Rivers Council
- Authorized, created, and established RI Rivers Council with the purpose of coordinating, overseeing, and reviewing efforts to improve and preserve the quality of rivers and to develop plans to increase the utilization of river areas throughout the state, and to support and strengthen grassroots watershed organizations as local

implementers of the plans

46-31 31-1 RI Bays, Rivers, Watersheds Coordination Team

- establishes Coordination Team of seven state agencies to coordinate protection, restoration and management of RI bays, rivers, watersheds and water-dependent economy
 - authorizes RI Environmental Monitoring Collaborative (EMC; 2004) to develop and coordinate a comprehensive environmental monitoring strategy which must address aquatic nuisance species
-

IV. Regulatory Agencies and Non-Regulatory Programs

1. Federal Regulatory and Non-Regulatory Programs

Multiple federal agencies implement invasive species related programs and activities pursuant to their specific missions and responsibilities (GAO, 2003). Several federal government agencies have recognized the severity of the invasive species problem, and have adopted the management and control of invasive species as priority programs areas. Both the National Invasive Species Council and the Aquatic Nuisance Species Task Force have been established to facilitate coordination of federal activities.

a. National Invasive Species Council (NISC)

As noted earlier, the National Invasive Species Council (NISC) was created by executive order to coordinate the multi-agency federal effort to combat invasive species, both terrestrial and aquatic. The NISC is composed of 13 federal departments and agencies and was responsible for developing the National Management Plan regarding invasive species, which was issued in 2001. The NISC is co-chaired by the Departments of Agriculture, Commerce, and Interior, with the remaining council members representing the Department of Defense, the EPA, Homeland Security, Health and Human Services, NASA, the Office of the US Trade Representative, the State Department, the Department of Transportation, the Treasury Department, and USAID.

b. Aquatic Nuisance Species Task Force (ANS Task Force)

The ANS Task Force, consisting of 10 Federal agency representatives and 12 Ex-officio members, is charged with coordinating federal *aquatic* nuisance species management efforts with the efforts of the private sector and other North American interests. The Task Force is co-chaired by the U.S. Fish and Wildlife Service and National Oceanic and Atmospheric Administration. The ANS Task Force is responsible for initiating research programs, planning initiatives, and policy direction for the prevention, detection and monitoring, and control of aquatic nuisance species, and operates through regional panels as well as issue-specific working groups that address particularly problematic invaders.

Of particular significance to Rhode Island is the series of Species Control Plans published by the ANS Task Force. Given the priority species identified in the RIAIS Plan, the following ANS Task Force Species Control Plans will be primary sources to guide the state in developing and implementing AIS prevention and control measures:

- Bighead, Black, Grass, and Silver Carps Management and Control Plan
- *Caulerpa* Control Plan
- European Green Crab Management Plan
- Giant Salvinia Control Plan, Draft 2002
- Mitten Crabs Management Plan
- Purple Loosestrife Management Plan
- Water Chestnut Management Plan

The ANS Task Force has published other Species Control Plans that will be used as primary sources as conditions require. For more information on the ANS Task Force, its activities and numerous publications, please go to: <http://www.anstaskforce.gov/default.php>.

c. The U.S. Fish and Wildlife Service (USFWS)

The USFWS has traditionally played a leading role in dealing with invasive species at the federal level and is co-chair of the federal ANS Task Force. The agency headquarters includes a Branch of Invasive Species. In addition to programs targeting AIS on federal properties, the USFWS provides technical assistance to states in developing invasive species control plans and other guidance on AIS issues. In addition to these activities, the USFWS administers grants that can be used for invasive species management through the Wildlife Restoration Program. More detail is available at: <http://www.fws.gov/contaminants/ANS/ANSSpecies.cfm> and <http://www.fws.gov/contaminants/branches/ANS.cfm>

d. The U.S. Environmental Protection Agency (EPA)

In general, the EPA Office of Wetlands, Oceans and Watersheds (OWOW) has developed a strategic action plan to improve its effectiveness at countering invasive species, both aquatic and terrestrial, that impact the nation's aquatic systems. Under this office the EPA activities include providing guidance, conducting research, and certain regulatory duties.

However, at the time of this writing, a significant action regarding the EPA role in regulating the discharge of ballast water is unfolding. The EPA currently exempts ballast water as a regulated discharge under the Clean Water Act. Under a lawsuit filed by Northwest Environmental Advocates in the U.S. District Court for the Northern District of California challenging this position, the court granted summary judgment to plaintiffs, and issued an order granting injunctive relief on September 18, 2006. While the EPA has filed an appeal to this decision in the U.S. Court of Appeals for the Ninth Circuit, it is nonetheless initiating the process of developing a vessel discharge permit program. Notice of this action was published in the Federal Register on June 21, 2007 (Volume 72, Number 119). Under this notice, the EPA is "seeking to make the public aware of this matter and obtain their input, in the form of public comment or relevant information, to further help the Agency in the timely development of an NPDES permitting framework, which has not existed to date for discharges incidental to the normal operation of vessels." The U.S. District Court has issued a final order revoking the EPA exemption for ballast water discharges, that mandates regulation "for discharges incidental to the normal operation of vessels effective September 30, 2008." Previously exempt vessels, including approximately 143,000 commercial vessels and more than 13 million state-registered recreational boats will require a permit beginning on this date. However, regulated discharges would include more than just ballast water; discharges may include ballast water, bilge water, deck runoff, and gray water.

e. The National Oceanic and Atmospheric Administration (NOAA)

NOAA has identified the problem of aquatic invasive species as a National Priority Area under the National Sea Grant Program. Sea Grant scientists hosted the first zebra mussel

research conference and led the way in the development of research, education and outreach strategies to address all invasions. The initial zebra mussel research conferences have expanded into International Conferences on Marine Bioinvasions. In addition, the NOAA Deputy Assistant Secretary for Oceans serves as Co-chair of the federal Aquatic Nuisance Species Task Force, providing leadership under the National Aquatic Nuisance and Prevention Act.

f. The U.S. Coast Guard

The U.S. Coast Guard administers navigation regulations that include provisions adopted in 2004 that implement a national mandatory ballast water management program for all vessels equipped with ballast water tanks that enter or operate within U.S. waters with certain exceptions. These regulations, Title 33: Navigation and Navigable Waters, Part 151—Vessels Carrying Oil, Noxious Liquid Substances, Garbage, Municipal or Commercial Waste, and Ballast Water, specifically address ballast water under Subpart D, “Ballast Water Management for Control of Nonindigenous Species in Waters of the United States.”

The ballast water management (BWM) program applies to all vessels equipped with ballast water tanks that operate in U.S. waters and are bound for ports or places in the U.S. Highlights of the program are: (1) requires mandatory ballast water management practices for all vessels that operate in U.S. waters; (2) additional practices for vessels entering U.S. waters after operating beyond the EEZ; and (3) requires reporting and record-keeping of ballasting operations by all vessels with no declarable ballast on board (NOBOBs) and vessels engaged in coastwise trade are exempt from mandatory ballast water management. Information on the BWM program can be found in 33 CFR Part 151 subparts C and D and at <http://www.uscg.mil/hq/gm/mso/bwm.htm>

In addition to its regulatory role, the Coast Guard has also issued voluntary guidelines in 2001 that target recreational users of aquatic resources (divers, boaters, anglers, hunters) regarding the intentional or unintentional introduction of plant and animal aquatic nuisance species, especially the zebra mussel, purple loosestrife, sea lamprey, water hyacinth, Chinese carp, hydrilla, Eurasian water milfoil, and the Asian swamp eel. It identifies boats, boat anchors, diving equipment, seaplanes, and live bait as introduction vectors. It also advises on the proper precautionary techniques for safe removal of aquatic nuisance species from equipment to prevent translocation.

g. The U.S. Geological Survey (USGS)

The USGS has acknowledged its role in nonindigenous species management in a White Paper on Invasive Species, in which the goal of developing new strategies for the prevention, early detection, and prompt eradication of new invaders is identified. The USGS further identifies information management and documentation of invasions as a priority for the agency. In keeping with this objective, the USGS has developed and maintains an extensive, spatially referenced database of nonindigenous species, which is accessible via the Internet <http://nas.er.usgs.gov/>

h. The U.S. Department of Agriculture (USDA) / Natural Resource Conservation Service (NRCS)

The USDA has significant involvement in AIS issues. The National Agricultural Library established the National Invasive Species Information Center (NISIC) in 2005 to assist in meeting the information needs of users including the National Invasive Species Council (NISC). NISIC created and manages the website www.invasivespeciesinfo.gov. The website serves as a reference gateway to information and services about invasive species. The USDA is further involved with AIS through its Animal and Plant Health Inspection Service (APHIS) and the Natural Resource Conservation Service. The APHIS is a multi-faceted Agency with a broad mission area that includes protecting and promoting U.S. agricultural health, and regulating genetically engineered organisms among other duties. To protect agricultural health, APHIS works to defend America's animal and plant resources from agricultural pests and diseases. In the event that a pest or disease of concern is detected, APHIS implements emergency protocols and partners with affected States to quickly manage or eradicate the outbreak. This aggressive approach has enabled APHIS to successfully prevent and respond to potential pest and disease threats to U.S. agriculture.

Through the APHIS Cooperative Agricultural Pest Survey (CAPS), the USDA works with state agricultural agencies to monitor for agricultural pests and noxious weeds. Individual state monitoring programs are directed by a state survey committee, which is made up of representatives from state agencies and scientific institutions. Each year, the state survey committee reviews an APHIS recommended list of potential pests for survey (the Noxious Weed List), and chooses one or more for annual surveillance efforts. Target species may include weeds, plant diseases, insects, and other invertebrates. APHIS also cooperates with the U.S. Customs Service to limit the import of specified plant pests and their hosts into the country. The NRCS office in Rhode Island has been very active in administering two USDA grant programs, the Wildlife Habitat Incentives Program (WHIP) and the Wetlands Preserve Program (WRP) that often include aquatic invasive species eradication or control elements in the projects they fund.

2. Regional Programs

Preventing the spread of aquatic invasive species requires that Rhode Island collaborate with neighboring states and other entities working on regional AIS initiatives. Several of these are described below.

a. The Northeast Regional Aquatic Nuisance Species Panel (NEANS Panel) of the Federal Aquatic Nuisance Species Task Force

Recognizing the need for interstate and international cooperation on AIS issues in the Northeast, the RI Coastal Resources Management Council, the Massachusetts Office of Coastal Zone Management, MIT Sea Grant, and others formed the Northeast Regional Aquatic Nuisance Species Panel (NEANS Panel). The NEANS Panel includes state, federal and regional government representatives, as well as non-government

organizations from the states of New York, Connecticut, Rhode Island, Massachusetts, Vermont, New Hampshire, and Maine, and the Canadian provinces of Nova Scotia, New Brunswick, and Quebec. The NEANS Panel was recognized by the federal ANS Task Force in July of 2001; the fourth regional panel to be established. Once formally recognized by the federal ANS Task Force, each regional panel becomes eligible for limited funding for implementation. The NEANS Panel website can be reached via the following link: <http://www.northeastans.org/>

The NEANS Panel's mission is to protect the marine and freshwater resources of the Northeast from invasive aquatic nuisance species through commitment and cohesive coordinated action. The NEANS Panel addresses issues and concerns relative to the freshwater and marine resources of its member states. The panel's members represent state, federal, and provincial governments, academia, commercial and recreational fishing interests, recreational boaters, commercial shipping, power and water utilities, environmental organizations, aquaculture, nursery and aquarium trades, tribal concerns, lake associations, and the bait industry, among others. The panel has four working committees: Shipping; Communications, Education, and Outreach; Policy and Legislation; and Science and Technology.

b. MIT Sea Grant (mitIS database)

The Marine Invader Tracking Information System (MITIS) is a service of the MIT Sea Grant College Program's Center for Coastal Resources. MITIS is a collection point for information on marine invasive species in the northeast United States and beyond. There are online forms for various scientist and citizen scientist groups to submit their sighting data. MIT is developing a searchable database of species sightings and fact sheets, maps of species sightings and population trends, as well as links to national and international databases. For more information go to the following website: <http://chartis.mit.edu/mitis/>

c. The New England Invasive Plant Group (NIPGro)

In keeping with its aquatic invasive plant management priorities, the Silvio O. Conte Refuge has taken the lead in the establishment and administration of the New England Invasive Plant Group (NIPGro). NIPGro is a networking link among the organizations and agencies involved with terrestrial and freshwater aquatic invasive plant issues in the region. Priorities of the group include:

- Minimizing new introductions to the region by instituting an early warning and response system;
- Using the NIPGro network to exchange information, share educational materials, identify research needs, and establish links with researchers;
- Developing standardized criteria for creating priority species lists; and,
- Coordinating control efforts.

d. Invasive Plant Atlas of New England

A U.S. Department of Agriculture grant supports the development of an Invasive Plant Atlas of New England (IPANE), which is the foundation of an early warning and response system for the region. The University of Connecticut oversees the Atlas work, assisted by the New England Wild Flower Society. The grant also provided the salary for the NIPGro coordinator from 2002–2005. Rhode Island and the Northeast Regional Panel will work closely with NIPGro on various AIS management issues, and, in particular, on the sharing and organization of invasive species distribution information. Leslie J. Mehrhoff, Ph.D., Director, Invasive Plant Atlas of New England, University of Connecticut, Box U-43, 75 North Eagleville Road, Storrs, CT 06269-3043; Office phone (860) 486-5708; FAX (860) 486-6364; les.mehrhoff@uconn.edu

3. RI State Government Programs

Within Rhode Island state government, the RI Coastal Resources Management Council and RI Department of Environmental Management undertake a number of activities related to AIS. Similar to the federal government, the activities reflect the missions and responsibilities of the agencies. CRMC is focused primarily on issues with marine AIS and aquaculture. RIDEM has a broad role in the protection and management of aquatic habitats statewide. The agency activities are summarized below.

a. Coastal Resources Management Council (CRMC)

The CRMC, the state coastal zone management agency, has been involved with aquatic invasive species through its various regulations and policy initiatives:

- **Northeast Aquatic Nuisance Species Panel (NEANS Panel):** The CRMC has been involved with NEANS since its inception, and currently provides staff to serve as a Co-chair of the NEANS Panel. The CRMC also currently Co-Chairs the NEANS Panel Shipping Committee, and formerly Co-chaired its Policy Committee.
- **The Narragansett Bay Rapid Assessment Survey (2000):** was the first attempt to conduct a bay-wide survey of aquatic invasive species in the Bay. The CRMC led this collaborative project, which was closely linked to a similar survey of Massachusetts coastal waters led by MIT Sea Grant and the Massachusetts Office of Coastal Zone Management. The other project partners were the Narragansett Bay Estuary Program, RI Sea Grant, the Narragansett Bay Estuarine Research Reserve, and the RI Natural History Survey. Dr. James T. Carlton of Williams College, the widely acknowledged leading expert on marine aquatic invasion science in the world, was recruited to lead a team of top taxonomic experts in surveying 13 sample sites from the northern reach of the Bay in the Seekonk River to its mouth at Newport. The survey identified 21 non-indigenous species and 17 cryptogenic species. The 2000 (RIRAS) led to a follow-up survey of a broader section of northeastern US coastal waters in 2002 that was led by the Narragansett Bay Estuary Program, the Massachusetts Bay Estuary Program, and MIT Sea Grant.

- **The Biosecurity Board:** RIGL Section 20-10-1.1 created a Biosecurity Board within CRMC. The purpose of this body is to advise the CRMC on issues relating to aquaculture, including aquaculture diseases and importation of non-indigenous and genetically modified organisms. Furthermore the board is charged with maintaining a current understanding of aquatic diseases and management practices necessary to maintaining the aquaculture industry and wild stocks. The board comprised of 7 individuals including representatives from the Coastal Resources Management Council, RIDEM Division of Fish & Wildlife, The RI Marine Fisheries Council, the aquaculture industry, and a representative of the Department of Health. Other members are the state veterinarian and, a faculty member of the University of Rhode Island, Department of Fisheries. The Biosecurity Board reviews and comments on proposed aquaculture operations that include non-indigenous species, and the concurrent protocols designed to prevent their release into the waters of the state.
- **Permitting of Aquaculture Operations:** The CRMC is the lead agency for promoting sustainable development of aquaculture. CRMC issues permits for aquaculture operations and its applicable regulations (Section 300.11 of the ‘Red Book’) includes authority regarding the importation of shellfish and fin fish into the state for culture. Current regulations prohibit introduction of any non-indigenous species without the prior approval of the CRMC Biosecurity Board. The RI CRMC is also responsible for approving all shellfish seed importations into Rhode Island. The CRMC Biosecurity Board has recommended a process for approving shellfish seed importation which is currently in use. The CRMC prohibits the introduction of non-indigenous species for aquacultural purposes unless protocols are in place to ensure that no accidental releases into the state’s waters can occur.
- **Permitting of Construction and other Activities:** CRMC regulations governing new construction and other activities in the coastal zone include sections that provide the CRMC with mechanisms to address aquatic invasive species through individual permits. These include requirements for maintenance or re-establishment of native vegetation in buffer zones associated with land development projects (Section 150 of the “Red Book”) and CRMC Rules and relevant portions of the Regulations Governing the Protection and Management of Freshwater Wetlands in the Vicinity of the Coast. See Appendix F for further details on the CRMC’s AIS regulatory programs.
- **The Coastal and Estuary Habitat Restoration Program and Trust Fund** was created by the Rhode Island General Assembly to facilitate the design, planning, construction and monitoring of coastal and estuarine restoration projects by providing grants and technical assistance. The CRMC administers the Trust Fund and chairs the RI Habitat Restoration Team. Many of the current projects have included the eradication of non-native aquatic invasive plant species as part of the restoration of coastal habitats to their native conditions.

b. Rhode Island Department of Environmental Management (RIDEM)

The Rhode Island Department of Environmental Management has broad responsibilities for environmental protection and resource management within Rhode Island. As the lead state agency for fish and wildlife management, agriculture and water pollution control, boating regulation and enforcement, RIDEM implements a number of programs that pertain to AIS. These include both regulatory and non-regulatory activities. In addition, RIDEM manages numerous conservation lands, including the Big River Management Area in cooperation with the RI Water Resources Board. The RIDEM is authorized under RIGL 46-17.1-2 to supervise and control the protection, development, planning, and utilization of the natural resources of the state, such resources, including but not limited to, water, plants, trees, soil, clay, sand, gravel, rocks and other minerals, air, mammals, birds, reptiles, amphibians, fish, shellfish, and other forms of aquatic, insect, and animal life. Among its many divisions, the following have various responsibilities related to aquatic invasive species.

RIDEM Division of Fish and Wildlife (RIDEM-FW)

The RIDEM Division of Fish and Wildlife, through both its marine and freshwater fisheries programs, plays a central role in the identification, monitoring and management in AIS. It administers a number of regulations that are designed, in part, to prevent the establishment of nonindigenous species.

- **Regulations for Marine Fisheries:** Under the Rules and Regulations Governing the Management of Marine Fisheries, Section 6.3 “Emergencies” the director of RIDEM may promulgate marine fisheries management rules with less than sixty (60) days notice to the RI Marine Fisheries Council (RIMFC) if and to the extent necessary to comply with federal or regional requirements or to respond to sudden and/or imminent peril or unanticipated developments where delay would likely cause immediate harm to fishery resources or fishers pursuant to RIGL 42-35-3(b).²

An example of an emergency regulation with implications for aquatic invasive species is the case of the “Black Salty” baitfish. The RIDEM after consultation with the CRMC Biosecurity Board filed an emergency regulation on May 20,

² RIGL 42-35-3 (b): If an agency finds that an imminent peril to the public health, safety, or welfare requires adoption of a rule upon less than thirty (30) days' notice, and states in writing its reasons for that finding, it may proceed without prior notice or hearing or upon any abbreviated notice and hearing that it finds practicable, to adopt an emergency rule. The rule so adopted may be effective for a period of not longer than one hundred twenty (120) days renewable once for a period not exceeding ninety (90) days, but the adoption of an identical rule under subsections (a)(1) and (a)(2) is not precluded. Emergency regulations may also be promulgated by DEM under RIGL 20-2.1-9 (1) (vi): Emergency rules, as provided for in chapter 35 of title 42, to protect an unexpectedly imperiled fishery resource, to provide access to a fisheries resource that is unexpectedly more abundant, and to protect the public health and safety from an unexpected hazard or risk. The marine fisheries council shall be notified of all emergency rules on or before their effective date, and no emergency rule shall become a final rule unless it is promulgated as provided for in subdivision (3) of this section.

2006 prohibiting the use as bait, any variety of goldfish in the freshwaters of the state. The emergency regulation also prohibited the importation, sale, or possession of any variety of goldfish for use as bait in the state's fresh waters, including the variety being marketed as the "Black Salty" baitfish. The news release announcing the promulgation of the emergency regulation stated that the entire species of goldfish are invasive, exotic fish that are not native to the United States.

- **Regulation of Freshwater Fisheries:** Another area of concern for the RIDEM-FW is the importation of live bait. As noted above, live bait may be a vector for the importation of AIS and as such it may be prudent to establish monitoring protocols for the importation and handling of live bait in Rhode Island.

In addition, the import or translocation of certain aquatic native or exotic species such as frogs and fish can cause negative impacts to certain ecosystems. Examples would be the importation or translocation of bullfrogs onto Jamestown, Aquidneck or other Narragansett Bay islands. They currently do not exist there, not having reached there before the islands were isolated from the mainland and may be in part the reason that leopard frogs only still occur in some of these areas. Block Island is another example where the introduction of certain species native to the mainland would be detrimental. The introduction of finfish of any kind into permanent, fishless ponds also deserves mention here. There are only a handful of such ponds that still exist in RI and they support some of the most robust and sometimes diverse populations of aquatic insects, including odonates and are also important breeding sites for amphibians.

- **Permitting of AIS Chemical Control Projects:** The RIDEM-FW jointly administers the permitting of chemical control projects with the Division of Agriculture.
- **Fisheries Surveys:** There is potential for AIS monitoring under existing RIDEM-FW monitoring programs, many of which are conducted annually throughout RI waters. In freshwaters, electro shocking methods are used to collect data on fish communities in lakes and rivers. Another example of how such surveys may be applicable to AIS monitoring is shown in the prevalence of Lizard Fish recorded in the marine trawl survey conducted during 2006. This survey can provide a useful database for AIS as it is conducted monthly on a year-round basis and produces data on fish and invertebrate species in coastal waters. Other surveys using different gear types can also be monitored for AIS.
- **Public Boat Ramps and Fishing Facilities:** The RIDEM-FW is responsible for maintenance of over 200 boat ramps and fishing facilities that provide public access to both marine and freshwater recreational opportunities throughout the state.

- **Fish Hatchery Operations:** Regarding finfish culture, RIDEM-FW hatcheries are regularly inspected and regulations require that all fish, eggs and fry that enter state hatcheries or are imported to the state for the purpose of release are certified disease-free. Additionally the best management practice (BMP) for the state hatcheries requires that raceways and any other flow through system are cleaned of any accumulated solids and the discharge be tested regularly. Disease is also a concern for finfish in the state and every measure possible is taken to ensure that diseases are not carried over the border. This is a concern however if fish are being released or escaping into the wild without our knowledge and consent.

The RIDEM-FW also works collaboratively with other agencies and has representatives on many committees within these agencies. Two that the marine section is involved with are the Atlantic States Marine Fisheries Council (a compact amongst the Atlantic Coast states that addresses migratory fish species) and the RI Marine Fisheries Council (local advisory council comprised of scientific, recreational, and commercial fishing representatives that addresses all marine fisheries issues). Collaboration with these groups will be essential in the AIS discussions and Fish and Wildlife can be used as an avenue for this.

DEM Division of Agriculture (RIDEM-AG)

The Division of Agriculture is involved in invasive species in a number of ways, including the exercise of regulatory functions. Activities related to AIS include:

- **Rules and regulations governing wild animal importation and possession:** Under section 1.1 the Rules and Regulations Governing Importation and Possession of Native Wildlife: “No person shall import, receive, or possess in this state a native animal, exotic animal, a member of a target species, or a hybrid, unless in possession of a current permit issued by the director pursuant to these regulations.” Under the definitions of this Rule, “exotic animals” are defined as those “animals not occurring naturally, either presently or historically, within the boundaries of the State of RI including but not limited to: mute swans, monk parakeets, mudpuppies, and red-eared sliders.” Procedures for applying for permits, quarantines, etc. are specified in the regulations. In short, it is very difficult for anyone other than a scientific entity i.e. university, accredited zoo to meet the necessary criteria to import and possess native and non-native animals.
- **Regulation of Pesticides:** The Division of Agriculture regulates pesticides and herbicides that may be used to eradicate AIS. The Division also licenses the persons who apply certain pesticides on a commercial basis under various rules:
 - **Rule A restricted use and state limited use pesticides**
 1. Restricted Use Pesticides - Any Pesticide which is classified for restricted use by EPA, as published in the Federal Register, is a restricted use pesticide under the Rhode Island Pesticide Control Act. A listing of such restricted uses shall be maintained with the Division of Agriculture.

2. State Limited Use Pesticides

a. The registration of Products containing Chlordane shall be classified for State Limited Use effective January 31, 1984. The conditions of sale & use shall be included in the State Limited Use Registration.

- **Pesticide relief fund regulations**

Rules and Regulations of the Pesticide Relief Fund of the State of Rhode Island Adopted Pursuant to Chapter 42-35 and 23-25.2 of the General Laws of Rhode Island.

- **Pest control rules and regulations (Rule C)**

Category 5 - Aquatic Pest Control

This category includes commercial applicators using or supervising the use of restricted use or state limited use pesticides purposefully applied to standing or running water, excluding applicators engaged in public health related activities included in Category 8.

Category 8 - Public Health Pest Control

This category includes State, Federal or other governmental employees using or supervising the use of restricted use or state limited use pesticides in public health programs for the management and control of pests having medical and public health importance.

Category 9 - Regulatory Pest Control

This category includes State, Federal or other governmental employees who use or supervise the use of restricted use or state limited use pesticides in the control of regulated pests.

- **Noxious Seed Regulations:** The Division of Agriculture also implements regulations that address the methods of sampling, inspecting, analyzing, testing and examining agricultural and vegetable seeds and tolerances to be followed in the administration of the law. The terms used in seed testing and the methods of sampling, inspecting, analyzing, testing and examining agricultural and vegetable seeds and the tolerances to be followed in the administration of this law shall be those adopted effective July 1, 1955 and as subsequent amended by the Association of Official Seed Analysts.

The Division of Agriculture also licenses aquarium and pet shops and regulates the release of spawn or live fish.

DEM Office of Water Resources (RIDEM-OWR)

The DEM Office of Water Resources (RIDEM-OWR) is responsible for implementation of federal Clean Water Act requirements including monitoring and assessing water quality, promulgation of water quality standards and various

water pollution control permitting functions among others. RIDEM-OWR also implements the state freshwater wetlands act for a majority of the state, excluding those coastal areas under CRMC wetlands jurisdiction. Other office functions that relate to AIS include water quality restoration planning via Total Daily Mass Load (TMDL), non-point source pollution abatement, lake management planning and habitat restoration and buffer protection.

- **Water Quality Standards and Assessment:** RIDEM-OWR administers the state water quality regulations that create a framework to classify all surface waterbodies (marine and freshwater), designate uses for these waters and specify standards and criteria to protect the designated uses. All waters are designated to support aquatic life use (suitable aquatic habitat). The criteria include consideration of the aesthetic condition of a waterbody and specify that all waters shall be free from pollutants in concentrations or combinations that cause changes in conditions that interfere with existing designated uses of the waterbody or that create a nuisance. Accordingly, the specific criteria for nutrients in freshwater includes a narrative standard that specifies that the concentration of nutrients should not “cause undesirable or nuisance aquatic species associated with cultural eutrophication.”

The RIDEM-OWR periodically compiles ambient water quality information and makes determinations as to whether a specific water body is impaired (not meeting water quality standards.) In this process, information on nuisance aquatic weeds or other alterations to biological communities is considered when available. The assessment process leads to a list of impaired water, known as the 303(d) list. There are currently 20 lakes or ponds and 2 river segments listed with noxious weed or excess algae problems. (2006 –303(d)).

- **Water Quality Monitoring:** The RIDEM-OWR is the lead state agency with respect to implementing ambient water quality monitoring programs. DEM-OWR has limited internal capacity to conduct monitoring and is continuing to rely on contracts and partnerships to implement the ambient monitoring programs. The programs cover all water resource types including freshwater lakes, ponds, rivers and streams, freshwater wetlands, and estuarine waters. Those program pertinent to AIS include:
 - **Lakes and Ponds:** RIDEM-OWR provides financial support to the URI-Watershed Watch Program (URI-WW), which coordinates volunteer-based monitoring and is the primary source of data on the water chemistry lakes and ponds in RI. In 1994, DEM provided EPA funds to URI-WW to develop a training module on aquatic plants for volunteers monitoring lakes. Twelve surveys were conducted in 1994. In 2007, URI-WW in collaboration with the RINHS trained volunteers from 10 lakes to identify AIS.
 - **Rivers and Streams:** In 2004, the RIDEM-OWR adopted a rotating basin approach to river and stream sampling that provides data to support a more thorough assessment of water quality conditions throughout a watershed. This

program is in third cycle and plans to begin sampling in a new basin in the late summer of 2007. The program combines physical, chemical and biological monitoring (macroinvertebrates.) During field reconnaissance and habitat assessments that are part of the biological monitoring program, DEM-OWR is identifying the presence of AIS in rivers.

- Freshwater Wetlands: In 2006, RIDEM-OWR completed a strategy for monitoring freshwater wetlands reflecting guidance from EPA. One stated goal of this plan is to provide data on AIS to support the development and implementation of management programs. In the fall of 2006, DEM-OWR, with contractor support, completed field inspections at 27 wetlands on 18 sites wetlands using Rapid Assessment Methods (RAMs). Data collected categorized the presence of invasive species as follows: absent – 6 wetlands, nearly absent (<5%) – 13 wetlands, sparse (5-25%) – 6 wetlands, and moderate (25-75%) – 2 wetlands. RIDEM-OWR is planning on continuing this work via a partnership with the RI Natural History Survey with additional assessments conducted during 2007.
- **Water Quality Restoration Plans (TMDLs):** RIDEM-OWR is responsible for developing water quality restoration plans for the impaired waters identified in Rhode Island. The schedule for developing the plans, also known as TMDLs, currently extends to 2016. The plans are relevant for helping abate or mitigate problems with nuisance aquatic plants. For example, a plan for a lake with excessive weed growth, an example being Yawgoo Pond, may include recommendations for reducing nutrient pollutant loadings to that lake as well as other lake management techniques.
- **RIDPES Permitting:** Where a point source discharge presents the possibility of spreading an invasive or other species of concern, the RIDPES program can prevent the release through appropriate regulation of the discharge. Reviews of proposed discharges from aquaculture operations are coordinated with RIDEM-FW as appropriate to ensure the discharge will not harm the biological community in the receiving waters.
- **Freshwater Wetlands Permitting:** RIDEM-OWR regulates activities that occur in and in the vicinity of freshwater wetlands for a majority (90%) of the state. (A portion of the state in the coastal zone is regulated by CRMC for purposes of freshwater wetland protection.) Certain activities, such as mechanical or physical removal of aquatic weeds, undertaken to control or manage AIS require permits under the wetland program. To encourage both habitat restoration, including the removal of AIS, and water quality improvement projects, the RIDEM-OWR established a Water Quality and Wetland Restoration Team that can offer technical guidance on such projects. The team includes representatives from all relevant programs in the office. In recent revisions to the regulations, RIDEM-OWR has streamlined the permitting process projects to control AIS in lakes.

With certain limitations, a general exemption for mechanical or physical AIS control projects will allow “cutting for invasive species control, including removal of invasive trees, shrubs, or emergent vegetation, where necessary to facilitate the growth of native plants, provided that the project plans and details are submitted to the Department’s Water Quality and Restoration Team for review, and the project is deemed to contain the necessary controls, expertise and follow-up monitoring to ensure success of the invasive control project.”

- **Habitat Restoration and Buffer Protection**

The RIDEM-OWR also encourages freshwater habitat restoration and improvement by providing funds, when available, from federal or state sources in the form of matching grants to implement such projects. In recent years, habitat restoration projects involving the removal of AIS have been supported by DEM via grants using federal EPA non-point source and wetlands funds as well as state bond funds. Many of them focused on removal of phragmites.

- **Lake Management**

RIDEM-OWR currently does not have an active lake management program comparable to those established in the other New England states. RIDEM-OWR has retained an aquatic biologist who, as time allows, has provided limited assistance in the form of technical guidance to lake associations interested in abating aquatic nuisance plant problems. RIDEM-OWR is currently developing guidance for release via its web-site on the development of lake management plans. RIDEM-OWR has provided for a reduced wetland permit fee for AIS control projects that are proposed as part of a lake management plan.

c. Narragansett Bay National Estuarine Research Reserve

The Narragansett Bay National Estuarine Research Reserve (NBNERR) is managed by RIDEM-OWR and is a partnership between NOAA and DEM. The NBNERR has identified terrestrial invasive species as a top research and management priority and is currently discussing aquatic invasive species as a priority issue as part of its management plan which is being updated at the time of this writing. The CRMC and NBNERR have been discussing the need to increasingly collaborate on AIS management efforts under their relationship through the CZMA. This is consistent with the significant contributions the NBNERR made in supporting the Narragansett Bay Rapid Assessment Survey of 2000 led by the CRMC.

d. Narragansett Bay Estuary Program (NBEP)

The NBEP has identified natural resource protection and management, including protecting Narragansett Bay from the impacts of AIS, as important action items in its Comprehensive Conservation and Management Plan (CCMP). As a major contributor to the 2000 Narragansett Bay Rapid Assessment Survey for AIS, and its coordination of the

2003 northeast regional RAS with MIT Sea Grant and the Mass Bays Program, the NBEP is an important part of AIS management in Rhode Island. The NBEP is part of the National Estuary Program (NEP), a national network of 28 programs working for collaborative solutions for estuaries designated by Congress as having critical importance. Created in 1987 under the Clean Water Act, the NEPs are charged with protecting and restoring U.S. estuaries by engaging state and federal agencies, nongovernmental organizations and local communities in planning and management decisions and actions. The U.S. Environmental Protection Agency provides base funding and federal oversight for each of the NEPs, but program management is typically the responsibility of an estuary stakeholder-based management committee. In 1993, the Governor of Rhode Island and the Administrator of the Environmental Protection Agency affixed their signatures to the Narragansett Bay CCMP, committing both entities, with other partners who developed the plan's recommendations, to implementation of the Bay plan. Concurrently, the CCMP was accepted as part of the R.I. State Guide Plan, requiring that State agency and municipal plans are consistent with the CCMP.

4. Rhode Island Non-Governmental Programs

a. Rhode Island Natural History Survey (RINHS)

The RINHS is funded by several different sources to provide invasive species training to volunteer groups, data to agencies, and to organize outreach and research efforts on certain key areas. RINHS is also authorized in legislation to provide data and advice on the biota and natural communities of Rhode Island to state agencies. RINHS is also engaged in regular data exchanges with key regional partners including the New England Wildflower Society (NEWFS), IPANE, and others. RINHS is the exclusive NatureServe data partner for the jurisdiction.

b. Rhode Island Invasive Species Council (RIISC)

The Rhode Island Invasive Species Council was established in 2000, to serve as a clearinghouse for invasive species information in Rhode Island. Its mission is to protect native biodiversity in Rhode Island. The RIISC gathers and conveys information on the presence, distribution, ecological and economic impacts, and management of invasive species; promote uses of native species and non-invasive alternatives throughout Rhode Island; and 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 addresses both terrestrial and AIS issues and is comprised of representatives from federal agencies (e.g., US Fish & Wildlife Service), state agencies (e.g., CRMC, divisions within the RI Department of Environmental Management), municipal agencies (e.g., planning offices, land trusts), academic institutions (e.g., URI, Roger Williams University), NGOs (e.g., The Nature Conservancy, Save The Bay, Audubon Society of RI), and industry groups (e.g., the nursery and landscape trade, pet and aquarium trade). The Rhode Island Invasive Species Council has also developed the RI Invasive Species Portal which can be reached through the following link: <http://odonata.edc.uri.edu/cgi-bin/page.cgi/>

The Rhode Island Invasive Species Portal is a comprehensive internet resource designed to provide a resource for scientists, naturalists, and all individuals interested in better understanding invasive species in Rhode Island. The Rhode Island Invasive Species Council is an outreach program of the Rhode Island Natural History Survey, The Rhode Island Agricultural Experiment Station, and The University of Rhode Island Cooperative Extension

c. Rhode Island Sea Grant College Program

The National Sea Grant College Program was established in 1966 to foster research, outreach, and education for the promotion of sustainable development of coastal regions. The Program has played an active role in research on invasive species issues in the United States through projects such as the National Aquatic Nuisance Species Clearinghouse, the Zebra Mussel Training Initiative, and a competitive grant program for invasive species research and outreach projects. URI Sea Grant recognized the need to promote scientific knowledge on the status of marine aquatic invasive species when it provided major funding for the first Rapid Assessment Survey of Aquatic Invasive Species in Narragansett Bay in 2000. Roger Williams University is also contributing to AIS research, by partnering with the CRMC in providing a senior law school student develop a regional ballast water management plan for the northeastern U.S. under the auspices of the NEANS Panel.

d. University of Rhode Island Watershed Watch Program (URI-WW)

URI-WW works with volunteers to monitor marine and freshwater water resources, including identification and mapping of aquatic plants. An expanded AIS monitoring effort is planned for the summer of 2007 in cooperation with the RINHS. For more information on the URIWW contact Linda Green lgreen@uri.edu or Elizabeth Herron emh@uri.edu, or visit the website at <http://www.uri.edu/ce/wq/ww/>

e. Rhode Island Wild Plant Society

The RI Wild Plant Society has members who conduct field investigations to locate, identify, and develop inventories of both terrestrial and aquatic invasive plants.

f. The Nature Conservancy

The Nature Conservancy has developed an Invasive Species Initiative and leads Conservation Learning Networks on invasive species assessment, prevention, management and monitoring. The Initiative partners with various groups on science-based strategies, public policy, and communications to prevent and abate invasive species threats to biological diversity. A dataset for global assessment of marine invasive species, their impacts, and degree of risk is in development. Current areas of interest include: 1) Assessing Problems and Setting Priorities; 2) Public Policy; 3) Strategies and Tools; 4) Working with Industry & Professionals; and, 5) Training and Networking. For further information please see: <http://tncweeds.ucdavis.edu/>

5. *International Agreements*

While international organizations have limited authority in the United States and countries worldwide, organizations such as the International Maritime Organization (below) have taken a lead role in developing policies and guidelines relating to international trade and commerce. Clearly, invasive species management is an international issue, and limiting uncontrolled global transport of AIS will require some reliance on these agencies to shape and implement management strategies.

a. The International Maritime Organization (IMO)

The IMO was established in 1948 to address safety and pollution mitigation measures for the international shipping industry. The United States plays a leadership role on the Marine Environment Protection Committee (MEPC), which is comprised of all 161 Member States, 37 Intergovernmental Organizations, and 61 Non-Governmental Organizations. The MEPC is empowered to consider any matter within the scope of the IMO concerned with prevention and control of pollution from ships, including ballast water management and the transport of AIS. IMO Assembly Resolution A.868(2) was adopted in 1993 and establishes international guidelines for the control of ballast water, which have served as a model for ballast water management in many countries.

The IMO Guidelines for the control and management of ships' ballast water to minimize the transfer of harmful aquatic organisms and pathogens address the following:

- Recognition of ballast water as the "most prominent" media of transferring invasive species
- Every ship that carries ballast water should be provided with a ballast water management plan to assist in the minimization of transfer of harmful aquatic organisms and pathogens
- Port States should inform local agents and/or the ship of areas and situations where the uptake of ballast water should be minimized, such as: areas with outbreaks, infestations or know populations of harmful organisms and pathogens
- When loading ballast, every effort should be made to avoid the uptake of potentially harmful aquatic organisms, pathogens and sediment that may contain such organisms.

b. International Plant Protection Convention (1952)

This convention applies primarily to quarantine pests in international trade. It creates an international regime to prevent the spread and introduction of plant and plant product pests through the exchange of phytosanitary certificates between importing and exporting countries' national plant protection offices. Parties have national plant protection organizations established according to the Convention with authority in relation to quarantine control, risk analysis and other measures required to prevent the establishment and spread of invasive alien species that, directly or indirectly, are pests of plants. Parties to the convention agree to cooperate on information exchange and on the development of International Standards for Phytosanitary Measures.

c. Alien Species: Guiding Principles for the Prevention, Introduction and Mitigation of Impacts (February, 2000)

This Code of Conduct includes 15 Guiding Principles pertaining to invasive species that address the practices of national governments on the intentional and unintentional introduction of non-indigenous animals and plants

d. FAO Code of Conduct for Responsible Fisheries (October 31, 1995)

This Code of Conduct addresses national governments; fishing entities; sub-regional, regional and global organizations; and "all persons concerned with the conservation of fishery resources." Article 9.2.3 states that: "States should consult with their neighboring States, as appropriate, before introducing non-indigenous species into transboundary aquatic ecosystems;" and, Article 9.3.1 states: "Efforts should be undertaken to minimize the harmful effects of introducing non-native species or genetically altered stocks... into waters, especially where there is a significant potential for the spread of such non-native species or genetically altered stocks into waters under the jurisdiction of other States as well as waters under the jurisdiction of the State of origin. States should, whenever possible, promote steps to minimize adverse genetic, disease and other effects of escaped farmed fish on wild stocks."

V. Management Objectives and Tasks

The following objectives and tasks outline a five-year plan for AIS management in RI in order to achieve the following overarching goal:

By 2013, fully implement a coordinated approach to preventing the introduction and minimizing the ecological and socio-economic impacts of aquatic invasive species in the marine and freshwater environments of Rhode Island.

Objectives and tasks were developed by the AIS Working Group to address priority species and transport vector management concerns, and to expand the general capabilities of Rhode Island agencies and organizations to address AIS issues. Current management priorities include developing an early detection - rapid response strategy and network, ballast water management and preventing the release of live non-native species into RI waters.

Resources currently dedicated to each objective have been identified within task descriptions along with estimates of additional resource requirements for the completion of each task. Rhode Island does not expect to receive all of the necessary funds to fully implement this plan from the federal ANS Task Force. In conjunction with the NEANS Panel, the AIS Working Group has begun to seek additional resources through avenues such as state and federal grants and will use the following objectives and tasks to direct future state and federal appropriations.

A detailed annual work plan will be developed following the submission of this plan and prior to each subsequent year of implementation. Work plans will be developed based on foreseeable resources available for implementation during each year and incorporate additional management needs as they are recognized.

Objective 1: COORDINATION and COMMUNICATION

- **Task 1A: Coordinate with Federal and International Agencies and Organizations with AIS Issues**

Current Status: Under the federal National Invasive Species Act, the establishment of regional panels is recommended as the mechanism by which states coordinate with federal agencies regarding AIS management problems. The NEANS Panel, of which RI is a charter member, is an associate member of the federal ANS Task Force, and as such, makes recommendations to the Task Force as a part of its responsibility to coordinate with federal authorities to develop regional priorities and management strategies to address the problem of AIS. The NEANS Panel shall continue to serve as a conduit for coordination between the State of Rhode Island and federal agencies. It is important to note that better coordination on AIS issues with agencies such as USDA NRCS, which has partnered with RI state agencies on various environmental initiatives, could result in policy recommendations the distribution of funds to strategically tackle AIS problems in a prioritized manner. For example, various RIDEM divisions coordinate with federal agencies on AIS issues pertaining to fisheries, agriculture and nuisance aquatic plants

(EPA, USDA, USFW, NOAA); as well as site specific permitting concerns; e.g. Army Corps of Engineers.

Existing Expenditures: The CRMC has supported a 0.05 FTE to participate in the NEANS Panel since its inception in 2001 and will continue to do so. This includes the participation of CRMC staff in meetings of the federal ANS Task Force. The CRMC has dedicated approximately \$500/year for travel expenses in support of this activity. Additionally, RIDEM contributes limited staff time as needed. As a NOAA program, NBNERR serves as a communication node and conduit for information being disseminated through the National Estuarine Research Reserve (NERR) system regarding aquatic invasive species issues. NBNERR also serves as a partner in the development and implementation of methods and strategies that have national significance for AIS issues. These tasks are estimated at 0.1 FTE. . The NBEP currently contributes a 0.025 FTE to this task, through its attendance at national and international meetings with other National Estuary Programs.

Additional Expenditures Needed: CRMC needs to ensure stable funding to continue to execute this task at the levels described above; as such a 0.05 FTE is required. Similarly, the RIDEM will continue to contribute staff time as needed. RINHS performs coordination functions at the international level as the sole NatureServe member program for the jurisdiction of Rhode Island. The RINHS estimates that a 0.1 FTE is needed toward this continued task. The NBEP estimates that a 0.05 FTE is needed to fund its continued participation in this task and NBNERR estimates an additional 0.1 FTE is needed to further its current tasks as noted above.

- **Task 1B: Coordinate with Neighboring States and Nations on AIS Issues of Mutual Interest**

Current Status: The Northeast Aquatic Nuisance Species Panel (NEANS Panel) was established for this purpose when it was approved by the federal ANS Task Force in 2001. The NEANS Panel mission statement “*Protect the marine and freshwater resources of the Northeast from AIS through commitment and cohesive coordinated action*” identifies coordination as a top priority. As Co-Chair of the RIAIS Working Group and the NEANS Panel, the CRMC is in a unique position to ensure that the implementation of the RIAIS Management Plan is coordinated wherever possible with initiatives of the states and Canadian Provinces represented on the NEANS Panel. In addition, various RIDEM divisions coordinate with their counterparts in MA and CT on AIS management issues pertaining to fisheries, agriculture and nuisance aquatic plants.

Existing Expenditures: As mentioned under Task 1A above, the CRMC has supported a 0.05 FTE to participate in the NEANS Panel since its inception and will continue to do so. The CRMC will coordinate AIS activities between Rhode Island and the region by attending the bi-annual NEANS Panel meetings to report AIS activities in RI and report AIS activities throughout the northeast region back to the RIAIS Working Group. The CRMC has provided on average, \$500/year for travel expenses in support of its participation and leadership of the NEANS Panel. The CRMC will also conduct regional

coordination by participating in the regular conference calls conducted by the NEANS Panel Steering Committee throughout the year. RIDEM- OWR dedicates a small portion of a contract employee's time to coordination of AIS issues in lakes and ponds. The NBEP currently contributes a 0.025 FTE to this task through its ongoing participation in the NEANS Panel.

Additional Expenditures Needed: In addition to the CRMC's continued 0.05 FTE toward continuing its participation on the NEANS Panel, the RIAIS Working Group will seek to coordinate with other New England states through informational exchanges including educational materials related to freshwater AIS plant management and biennial information sharing conferences sponsored by the NIPGro, an ongoing exchange of educational materials. To better address AIS in freshwater lakes and ponds, DEM-OWR estimates additional staff time at 0.1 FTE is needed. In addition, the NBEP and NBNERR will continue to coordinate with other National Estuary Programs and National Estuarine Research Reserves on marine and estuarine AIS issues. The RINHS also performs coordination functions at the regional level through its participation in regular data exchanges and collaborative programs with the natural heritage programs of the six New England states and the state of New York, the New England Wild Flower Society, Invasive Plant Atlas of New England, the NEANS Panel, and the New England Regional Office of The Nature Conservancy. RINHS estimates an additional 0.2 FTE is needed toward this task. The NBEP estimates that an additional 0.05 FTE is needed to properly conduct this task.

- **Task 1C: Coordinate RI AIS Management Activities**

Current status: Current AIS management activities in Rhode Island have not been fully coordinated across state agencies and other organizations with an interest in AIS. To address this, the RIAIS Working Group has been created to provide a continuing forum for appropriate agencies and organizations to coordinate and implement tasks to address AIS issues in the state. As the lead state agencies for environmental management in the state, the CRMC and RIDEM will Co-chair the RIAIS Working Group. It is important to note however, that the members of the NEANS Panel have agreed to contribute funding from approved state AIS Plans to support and coordinate on tasks that address AIS threats of regional significance in the northeast. As the CRMC Co-chairs the NEANS Panel and is responsible for ensuring the implementation of such tasks, the CRMC shall administer the annual federal grant to the state upon approval of the RIAIS Plan by the ANS Task Force. The Working Group will conduct an annual meeting to determine priority state tasks, with consideration for tasks of regional significance as identified by the NEANS Panel.

Existing Expenditures: CRMC will support a 0.10 FTE to administer the federal grant allocated to the State of Rhode Island and to coordinate overall AIS activities in Rhode Island through the RIAIS Management Plan. NBNERR coordinates with local NGOs, Universities, State and local governments for the collection and evaluation of AIS data at an estimated expenditure of 0.1 FTE. These agencies and organizations are represented on the RIAIS Working Group Steering Committee and as such are key leads for the

implementation of the RIAIS Management Plan. To track the progress of ongoing tasks and to keep abreast of AIS issues in the state, the CRMC will organize quarterly meetings of the AIS Working Group Steering Committee. The Steering Committee will present annual progress reports to the Working Group at its annual general meeting.

It is important to note that the CRMC and RIDEM respond throughout the year to AIS issues as they arise by using existing personnel; DEM-OWR has dedicated a portion of a contract employee's time as well as seasonal worker to AIS, at approximately 0.25 FTE. For the, RINHS programs such as the Biota of Rhode Island publication series and database, the annual Ecology of Rhode Island conference, and online projects such as the Biodiversity Center Online, and the Rhode Island Natural History Directory provide important and unique connections between diverse AIS stakeholder groups, particularly the academic and grassroots stakeholders, within Rhode Island. An estimated 0.5 FTE is currently expended on these tasks.

Additional Expenditures Needed: The CRMC is seeking funding to create a 1.0 FTE to coordinate marine, estuarine, and other coastal related AIS activities in Rhode Island. Similarly, RIDEM recognizes that an expansion of effort is needed to properly coordinate and respond to AIS issues in freshwater ecosystems; a 1.0 FTE is required to properly coordinate an expansion of program activities. The RINHS estimates that an additional 0.1 FTE is needed to further support the above stated tasks. The NBNERR estimates an additional 0.05 FTE is needed to further its future contribution to this task.

- **Task 1D: Develop Criteria to Evaluate and Prioritize the Risk of AIS Introductions**

Current Status: Rhode Island faces the risk of introduction from a number of species that have proven to be damaging in other regions (see Section II: Problems and Concerns). Development of criteria to evaluate the risk of introduction of these species will be necessary to identify and implement species-specific preventative measures. The RIAIS Working Group should consider developing a strategy to identify and rank potential AIS introductions to Rhode Island. Further, an evaluation and ranking of these species based on their potential to colonize and spread throughout various habitats and ecosystems is needed. Additionally, as public funds are expended for the purposes of AIS eradication and control, there is a need to prioritize and ensure investments are effective.

The Rhode Island Invasive Species Council (RIISC) is a joint program of RINHS and URI College of the Environment and Life Sciences/Rhode Island Agricultural Experiment Station (URI-CELS/RIAES). In 2001-02, with funding from the Rhode Island Agricultural Experiment Station, the Rhode Island Invasive Species Council convened a committee to develop criteria for invasiveness and to evaluate the vascular flora using those criteria. Participation included representatives of regulatory authorities, the nursery and agricultural trades, academic, and community interest groups. With appropriate funding to support staff convening and coordinating functions, RIISC could convene expert panels to develop criteria and/or evaluate groups of organisms.

With respect to importations, there is one body currently overseeing the importation of aquatic organisms for the aquaculture industry, the CRMC Biosecurity Board. The board has advised the RIDEM Division of Fish and Wildlife on issues when requested, and would be willing to advise other entity's who requested its advice. This board could have its purview expanded to include all aquatic organism importation for restorations, enhancement, aquatic plants, etc. The board is currently legislatively mandated to advise the CRMC on aquaculture issues, it would be necessary to legislatively expand the board's purview to obtain authority to review all aquatic importations, and the board would have to expand its membership to include experts in other areas, such as aquatic plants.

Existing Expenditures: As mentioned under Tasks 1A and 1B above, the CRMC has supported a 0.05 FTE to participate in the NEANS Panel since its inception and will continue to do so. Specifically, the CRMC expenditures on the topic of criteria to evaluate and prioritize AIS introduction risks have come through the agency's continued participation in meetings and workshops conducted by the NENAS Panel where this has been a topic of discussion. RIDEM would expect existing staff to participate in this task through the Working Group.

Additional Expenditures Needed: The RIAIS Working Group will develop a strategy to evaluate the risk of the introduction and spread of AIS priority species. An estimated \$5,000 will be needed to contract with a graduate student to complete this task. With funding to support staff convening and coordinating functions, RIISC could convene expert panels to develop criteria for AIS. The estimated additional expenditures needed are 0.3 FTE plus direct costs (printing, refreshments, communications & travel) which are estimated at \$7,500/year. If support for this task were ongoing, then every year CRMC or other coordinating body would direct the RIISC to evaluate priority AIS, over time all areas would be covered. Alternatively, this could be stated as a one-time estimated expense of \$30K/year for 3 years, after which time only ad hoc review of new organisms would be necessary.

- **Task 1E: Maintain Outreach & Communication with Stakeholders**

Current Status: Outreach efforts and educational materials targeted to specific stakeholders that represent AIS vectors or may be impacted by the introduction of AIS have not been fully developed or widely distributed in Rhode Island. The 2007 Chinese mitten crab alert issued by the CRMC and RINHS represents the current ad hoc approach of responding to potentially imminent AIS introductions and their impacts. specific potential threats when they appear imminent. There is a need to develop and maintain broad-based educational outreach and communications with the various stakeholders in Rhode Island. Stakeholders should include maritime transportation, aquaculture operations, nursery and water garden businesses, commercial and recreational fishers, the aquarium/pet shop trade, and others. There are a number of ways in which RIDEM contributes to education about AIS. RIDEM-Office of Water Resources is currently developing additional content for its website concerning AIS in lakes and ponds and RIDEM-DFW executes outreach associated with boating in freshwaters. In association

with its regulatory responsibilities, RIDEM-AG provides information to certain groups of businesses that may be vectors for AIS; e.g. nurseries, pet shops, etc. AIS outreach and training is in the planning stages, but remains a high national priority within NOAA and the national NERR. (This status applies to the other tasks listed below). The NBNERR Coastal Training Program (CTP) can coordinate a subgroup of the RIAIS Working Group that would be tasked with the investigation of existing AIS outreach and communications materials and methods to avoid any duplication of effort, as well as, where needed, develop and distribute new materials and communication strategies targeting marine and estuarine-related stakeholders.

Existing Expenditures: The CRMC developed, printed, and distributed a poster advertising a Chinese mitten crab alert for Rhode Island in coordination with the Smithsonian Environmental Research Center/Marine Invasions Research Lab; these tasks are estimated at a 0.025 FTE. This task was also networked with the NBEP and the RINHS, both of which added the poster to their respective websites. The poster includes information on how to identify the Chinese mitten crab, how to collect and store specimens, and who to contact in the case of a sighting. DEM-OWR has dedicated 0.1 FTE to developing guidance materials on AIS in lakes. As part of its mission, RINHS maintains a network of scientists, agencies, non-profits, and knowledgeable avocational naturalists broadly representative of AIS stakeholder groups, especially academics and community grassroots stakeholders, in Rhode Island. RINHS maintains and communicates with this network through programs such as an annual conference, public lectures, biodiversity field days, technical training events, and opportunities for volunteer land stewardship activities, as well as paper and web-based publications and other products. It is estimated that these activities are funded at 0.5 FTE. NBNERR estimates its current expenditure toward this task at 0.025 FTE.

Additional Expenditures Needed: The RIAIS Working Group will investigate existing educational/outreach materials to avoid duplication where applicable resources are currently available for distribution to stakeholders. Information and materials are available from Habitattitude™ a national initiative developed by the ANS Task Force and its partner organizations, The Pet Industry Joint Advisory Council (PJAC), the US Fish and Wildlife Service, and the NOAA National Sea Grant College Program. Where such materials are not available, they will be developed and distributed. The CRMC, at 0.025 FTE, will produce and distribute materials targeting marine and estuarine related stakeholders. RIDEM and RINHS will do the same for freshwater related stakeholders. DEM estimates it needs \$10,000-\$20,000 to reproduce materials that can be posted (signs) or distributed. The RINHS estimates an additional 0.1 FTE is needed to further their efforts noted above. NBNERR estimates an additional 0.075 FTE is needed for future participation in this task.

- **Task 1F: Coordinate AIS Data Collection, Storage, and Access**

Current Status: The RIAIS Working Group should develop a plan for data management taking advantage of existing AIS related databases. At the local level, the RIDEM and URI Watershed Watch generate and manage data via ambient monitoring programs. The state needs to improve the systematic reporting of AIS occurrences to capture and organize more of the available data. At present, data are contributed to the RINHS portal described below on a voluntary basis.

The NEANS Panel currently takes advantage of existing data bases to manage information on AIS. The NEANS Panel collaborates with several databases including the Marine Invader Tracking Information System (MITIS), a service of the MIT Sea Grant College Program's Center for Coastal Resources. MITIS is a collection point for information on marine invasive species in the northeast United States and beyond. There are online forms for various scientist and citizen scientist groups to submit their sighting data. MITIS is developing a searchable database of species sightings and fact sheets, maps of species sightings and population trends, as well as links to national and international databases. The five following organizations or programs contribute data to MITIS, each through a set of online data entry forms:

- AISRN - Aquatic Invasive Species Reporting Network (NEW sightings)
- HitchHikers - Hitchhiker Guide Volunteers
- Divers - New England Diver Volunteers
- MIMIC - Marine Invader Monitoring and Information Collaborative (a collaboration with the MA Office of Coastal Zone Management - CZM)
- RAS - Rapid Assessment Surveys

Rhode Island marine AIS data has been contributed to MITIS through HitchHikers, Divers, and RAS. Other AIS databases that link to the NEANS Panel website are the Nonindigenous Aquatic Species (NAS) information resource of the United States Geological Survey, and the Smithsonian National Research Center's National Exotic Marine and Estuarine Species Information System (NEMESIS).

The NEANS Panel also utilizes NISbase, a distributed database of the Smithsonian Environmental Research Lab, which provides information concerning nonindigenous species. Through this site, users can access information on taxonomy, life history, native and introduced ranges, photos, maps, and impacts of aquatic species introduced around the world. While not exactly a database, NISbase is a portal developed at the SERC Marine Invasions Research Lab in collaboration with the USGS Center for Aquatic Studies through which a user can query multiple invasive species databases at one time with the convenience of a single search form. Results are returned separately from each database but presented together as a single table. As NISbase continues to grow it actively seeks new partner databases and developing innovative ways to share our combined invasive species information. The following are the participating database(s) that may be included in a search:

- NAS Database (Nonindigenous Aquatic Species Database)
- Chesapeake Bay Exotic Marine and Estuarine Species Information System
- Nonindigenous Species in the Gulf of Mexico Ecosystem
- NIMPIS (National Introduced Marine Pest Information System)
- Introduced Marine Species of Hawaii Guidebook
- CIESM Atlas of Exotic Species in the Mediterranean Sea
- Guide to the Exotic Species of San Francisco Bay
- Marine Invader Tracking Information System

Locally, the RINHS operates the Biota of Rhode Island Information System (BORIIS), the most comprehensive database on Rhode Island's animals, plants, and natural communities. RINHS has invested over \$300,000 developing BORIIS in a customized MS Access format and integrating all known, available data sources, including terrestrial and aquatic. BORIIS provides information on the location and status of over 10,000 animal and plant species and 101 natural community types using almost 150,000 evidentiary records, including field observations, specimens, and bibliographic citations. BORIIS includes data on all species - terrestrial, marine and freshwater aquatic, native, invasive, and cryptogenic--that are known to, or based on data from neighboring jurisdictions, that have a potential to occur in Rhode Island. When available locational data on species observations are available in BORIIS they can be accessed and manipulated using GIS tools because BORIIS is fully integrated with RIGIS and other available GIS data sources through RINHS's partnership with URI's Environmental Data Center. The resources of BORIIS are currently used for local and statewide planning, land stewardship, and invasive species monitoring, control, and research.

RINHS also developed and operates three online resources uniquely valuable for invasive species data management: the Rhode Island Invasive Species Web Portal (www.rinhs.org/invasives), the online natural history directory that catalogs people, companies, and organizations working in the natural history field, and the Biodiversity Center forum where stakeholders can participate in discussions, ask questions, and report findings in real time from any networked computer.

NBNERR and Save the Bay will be also synthesizing and disseminating the results of various invasive species monitoring programs via a variety of media to provide access to data by academia, managers, NGOs etc.

Existing Expenditures: The NEANS Panel website is maintained by its professional contract employee, and is available free of charge, as are all the linked databases mentioned above. The RIDEM expends minimal existing staff time to the data base task mentioned above, and the RINHS existing effort on the BORIIS database is 0.0 FTE, but a 1.0 FTE is expended on its Invasive Species Web Portal, the online natural history directory, and the Biodiversity Center forum. The NBNERR currently expends a 0.10 FTE on this task

Additional Expenditures Needed: The NEANS Panel will continue to support its website and provide links to the several databases mentioned above at no cost to the State

of Rhode Island. For the RIDEM, additional expenditures to maintain the above mentioned database it manages with URI Watershed Watch are currently undetermined, but it is estimated that between \$50K- \$100K will be needed for annual maintenance. The RINHS estimates additional effort at 1.0 FTE will be necessary to fully operate the BORIIS database on an annual basis. This database is currently available on a strictly subscription basis due to a lack of outside funding to support it. The NBNERR estimates an additional 0.10 FTE is needed to properly conduct this task.

- **Task 1G: Develop Early Detection/Rapid Response Strategy for New AIS**

Current Status: RI needs to develop a protocol for early detection reporting and rapid response. The CRMC, Narragansett Bay Estuary Program, and Rhode Island Natural History Survey issued a Chinese mitten crab alert during the summer of 2007 in collaboration with the Smithsonian Environmental Research Center/Marine Invasions Research Lab. Media follow-up included a television interview with the CRMC and NBEP contacts for the Chinese mitten crab alert. The RIAIS Working Group should identify agencies responsible for eradicating or controlling specific types of introductions (i.e., aquatic plants, fouling organisms, marine species, and freshwater species). Based on the National Incident Command System, the RIAIS Working Group should develop and implement an appropriate response protocol for the eradication of newly detected priority invaders. This protocol will include specification of appropriate biological, chemical, and physical controls where necessary, and will address priority species. Other tasks should include:

- developing a list of pesticides currently not registered for use that may be necessary for the control of pioneering AIS
- encouraging state and federal agencies and NGOs to develop a MOU that recognizes and facilitates implementation of early response protocols

The CRMC, RIDEM Division of Agriculture, and RIDEM Division of Fish and Wildlife will develop an expedited permitting process and/or emergency herbicide application regulations. The decision to authorize expedited control technologies will be based on guidelines that consider both the effect on targeted AIS and secondary impacts.

Existing Expenditures: Approximately 40 hours of CRMC staff time was dedicated to the Chinese mitten crab alert. The associated task included the preparation and distribution of a poster to SCUBA shops in Rhode Island and nearby Connecticut and Massachusetts, preparation of a web-based alert (CRMC website), and preparation for and the execution of the follow-up television news story.

Additional Expenditures Needed: The CRMC estimates its additional needs to assist in this task at 0.25 FTE, the RINHS estimates 1.0 FTE is needed for its contribution, and the NBEP estimates it needs at 0.05 FTE to properly contribute to this task.

Objective 2: MONITORING

- **Task 2A: Monitor the Introduction and Spread of AIS in Coastal Ecosystems**

Current Status: The first survey of AIS in Rhode Island's coastal waters occurred in 2000 when the CRMC led a Rapid Assessment Survey (RAS) that sampled thirteen sites throughout Narragansett Bay. Twenty-one AIS were identified by the survey's research team, which was led by Dr. Jim Carlton, Williams College/Mystic Seaport Maritime Studies Program. MIT Sea Grant and the Mass Bays Program coordinated a follow-up RAS in 2003 that covered coastal waters from Maine to New York. Dr. Carlton again led the research team, in which twenty-nine taxa were identified as introduced species. The RIAIS Working Group should develop a long-term monitoring program for Rhode Island's marine and estuarine waters and coastal wetlands that includes RAS and volunteer monitoring programs utilizing SCUBA divers, aquaculturists, "beachcombers" and others to ensure comprehensive coverage of the state's coastal habitats. In coordination with the RI Environmental Monitoring Collaborative, the RIAIS Working Group should develop an AIS monitoring strategy addressing marine and estuarine ecosystems.

Existing Expenditures: NBNERR and Save the Bay are currently working to implement a volunteer dock monitoring program for epiphytic marine organisms throughout Narragansett Bay. NBNERR is also currently implementing a program to evaluate the distribution of various invasive crab species within the NBNERR and eventually throughout Narragansett Bay. This monitoring protocol is based upon a nationally approved NERRS methodology. NBNERR estimates its current expenditure on these tasks at 0.2 FTE.

Additional Expenditures Needed: The CRMC invested approximately 0.25 FTE toward the development and management of the 2000 RAS, direct project costs totaled approximately \$13,500, and a state match of \$4,500 was also included in the total cost of the project. It is estimated that at least \$40,000 in current US dollars would be needed to replicate the Narragansett Bay RAS conducted in 2000. Based on cost estimates to develop a "beachcombers" volunteer monitoring program in Massachusetts, it is estimated that at least \$10,000 is needed to support development, printing, and training workshop costs. Similarly, it is estimated that at least \$10,000 will be needed to train SCUBA divers and support related project costs to develop an underwater volunteer monitoring project. Establishing permanent sentinel stations and training and equipping volunteers to monitor them on a long-term basis will require at least \$10,000. NBNERR estimates an additional 0.10 FTE is required to continue its current tasks mentioned above.

- **Task 2B: Monitor the Introduction and Spread of AIS in Freshwater Ecosystems**

Current Status: Effective management of freshwater AIS will require the expansion of monitoring efforts that have been limited by lack of staff time and funding. With respect

to freshwaters, surveys of aquatic plants were completed in 12 lakes during 1994 by URI-WW with financial support from RIDEM (Clean Lakes funding). No further systematic monitoring of AIS in freshwater systems was undertaken until 2007 when the DEM-OWR inspected 33 lakes and URI-WW, with RINHS, trained volunteers to conduct plant surveys. In addition, RIDEM-FW has responded to reports of AIS in freshwaters in order to collect samples and document occurrences and RIDEM-OWR has begun documenting AIS in rivers in its ambient water quality monitoring program. Data obtained from these recent efforts suggest invasive plants are established in lakes across the state.

The RIAIS Working Group should also consider developing an AIS monitoring strategy for freshwater rivers, lakes, and ponds in coordination with the RI Environmental Monitoring Collaborative. In addition, the CRMC has the mandate to regulate all aquaculture, including freshwater, and as such, should also be involved in freshwater body monitoring initiatives.

Existing Expenditures: RIDEM-OWR and RIDEM-FW expenditures on monitoring lakes and freshwater rivers are 0.25 FTE.

Additional Expenditures Needed: RIDEM needs for continued freshwater body AIS monitoring is estimated at 0.5 FTE; an additional RIDEM expenditure, in support of expanding the URI-Watershed Watch volunteer-based monitoring program is estimated at 0.3 FTE, for total RIDEM expenditure needs of 0.8 FTE.

- **Task 2C: Monitor Known AIS Vectors**

Current Status: There are numerous known vectors for the introduction of AIS in Rhode Island. On the marine side, Narragansett Bay is home to several ports for international shipping and cruising, which makes ballast water and hull fouling causes for concern. Aquaculture and university based marine research laboratories and vessels also present opportunities for introductions. The state's freshwater habitats are threatened by vectors such as the nursery and water garden trade. Vectors that potentially impact both marine and freshwater ecosystems include recreational fishers/boaters and the aquarium/pet industry. Dietary preferences also present potential impacts, as growing immigrant communities include the Chinese mitten crab and other species among their culinary delights. Perhaps the most difficult of vector to control is the internet trade in aquatic plants and animals. CRMC currently monitors possible vectors for AIS in the aquaculture industry through the CRMC Biosecurity Board. RIDEM which has regulatory authority over a number of other businesses identified as potential vectors should review their inspection procedures and evaluate whether modifications can be accommodated to improve the oversight of AIS vectors. Cross-training of staff may be necessary to accomplish the integration of AIS into other inspection programs.

Existing Expenditures: The USDA/NRCS provides grant monies through its EQIP Program that currently funds an ongoing project in which at least 40% of all RI aquaculturists monitor marine biofouling communities on their shellfish grow-out gear for AIS and other species of concern. A very small portion of the \$290,000 in financial

assistance allocated through this program is spent on AIS specific monitoring, rather, it occurs opportunistically in concert with a suite of other physical and biological data monitoring activities.

Additional Expenditures Needed: The NBEP estimates that an additional 0.05 FTE is needed to properly conduct its contribution to this task. However, the RIAIS Working Group should take a broader look at this issue and develop estimated expenditures needed to monitor all known AIS vectors.

Objective 3: EDUCATION, OUTREACH, TRAINING

- **Task 3A: Build/Maintain Understanding of AIS Plan in Pet/Nursery/Aquaculture Trades**

Current Status: Because legal and other standards that could prevent introduction and spread of ANS through these trades in Rhode Island are incomplete, there is an opportunity to improve the situation through education and voluntary measures. Representatives of these industries participate in some programs with the potential to address this issue, including the RIISC, NBEP, and the ANS Task Force, nonetheless, the overall connections between this community and agencies involved in AIS management need to be strengthened.

Existing Expenditures: The CRMC is responsible for the regulation of all aquaculture activities in Rhode Island, and an important part of its responsibilities is to educate the industry on the impacts of AIS on aquaculture operations. As such, the CRMC coordinates AIS monitoring activities with industry and university representatives in the state, and through this activity is currently conducting AIS education and outreach. An estimated 0.10 FTE is expended on these activities. The NBEP currently dedicates an estimated 0.025 to the task of educating the public on the dangers associated with releasing non-native species into Rhode Island's aquatic ecosystems.

Additional Expenditures Needed: The CRMC will continue to conduct the education and outreach activities described above at a 0.10 FTE. Similarly, the NBEP will continue its education and outreach activities regarding not releasing AIS into the aquatic ecosystems of the state at a 0.025 FTE.

- **Task 3B: Initial and Refresher Training on ID of AIS for Monitors**

Current Status: AIS monitoring is currently done on an ad hoc basis by academic researchers and agency personnel, assisted by taxonomic experts from various programs. As has been generally noted, the decline in taxonomy in academics and the trend among agencies toward outsourcing specialized skills is leaving a substantial gap in practical skills that will be hard to fill. The Cooperative Extension program at URI used to fund an invasive species coordinator with Federal Agricultural Experiment Station funds in order to train Extension and other volunteers in invasive ID and to provide 2nd tier support for

hotlines and other public contacts but this funding has been discontinued. Larger non-profits have stewardship capacity including stewards skilled in invasive control and restoration. These personnel are usually heavily overburdened and have little ability to assist with projects that do not directly affect their organization's properties.

Existing Expenditures: There are some relevant expenditures among non-profits and universities but they would be hard to quantify.

Additional Expenditures Needed: At a minimum, the URI Cooperative Extension invasive coordinator should be restored at 0.5 FTE

- **Task 3C: Educate Public on Dangers of Releasing Non-Natives into Local Waters**

Current Status: There is ample evidence that non-native aquatic species have been released into Rhode Island water bodies. The common carp is regularly found in rivers and lakes at various locations throughout the state. However, while there are presently no resources specifically dedicated to the task of educating the public on the dangers of releasing non-native species into the state's water bodies, the recent coordination of a Chinese Mitten Crab alert indicates an interest in establishing a network for this purpose.

Existing Expenditures: The NBEP currently contributes a 0.025 FTE to the task of educating the public on the dangers of releasing non-native species through occasional articles in its publication *The Narragansett Bay Journal*.

Additional Expenditures Needed: The NBEP estimates that an additional 0.05 FTE is needed to properly conduct this task.

- **Task 3D: Ensure Availability of Training/Training Materials in Best Management Practices for Control/Restoration/Mitigation**

Current Status: The NBNERR CTP can coordinate a subgroup of the RIAIS working group that would be tasked with the investigation of existing trainings and related materials on BMPs for the control/restoration/mitigation of AIS to avoid any duplication of effort, as well as, where needed, develop and deliver new trainings and related materials targeted toward various decision-makers audiences.

Existing Expenditures: The NBNERR currently expends a 0.025 FTE on this task.

Additional Expenditures Needed: The NBNERR estimates an additional 0.125 is needed to properly conduct this task.

- **Task 3E: Train Community Groups, Land Trusts, and Conservation Commissions in Best Management Practices for Restoration/Mitigation**

Current Status: The CRMC engages in three distinct activities related to training local government and community groups in BMPs for the restoration and mitigation of aquatic habitats: 1) via CRMC Coastal and Estuarine Habitat Restoration Trust Fund public workshops; 2) meeting with coastal homeowner groups during the summer months; and, 3) public presentations on the habitat restoration elements of its various Special Area Management Plans. The NBNERR also has an active public education and outreach function with respect to habitat restoration and mitigation BMPS implemented within the research reserve. The audience for AIS publication is significant in Rhode Island; there are numerous community-based non-profits and municipal boards and commissions that are involved with land and water conservation and stewardship that are becoming increasingly aware of the problem of AIS. Within this group, coordination and provision of information on restoration and mitigation BMPs relative to AIS impact tends to be ad hoc and a coordinated effort to consistently provide training as new technologies and methodologies emerge is needed.

Existing Expenditures: The CRMC expends a 0.025 FTE on the activities described above, and the NBNERR currently expends a 0.025 FTE. Other existing efforts that are difficult to quantify are led by such organizations as the Rhode Island Land Trust Council, Narragansett Bay Estuary Program, RINHS, The Nature Conservancy, New England Wildflower Society, the U.S. Fish and Wildlife Service, and NRCS, among others.

Additional Expenditures Needed: The CRMC will continue to invest at a 0.025 FTE level on the tasks described above. The NBNERR CTP can coordinate a subgroup of the RIAIS Working Group that would be tasked with the development of a strategy and implementation plan for the delivery of trainings and products to land trusts and conservation commissions based on the goals and objectives of the RIAIS Plan. The NBNERR estimates a 0.075 FTE is needed to properly conduct this task. It may also be useful to consider establishing a statewide AIS coordinator to keep invasive preparedness on the agenda of non-profits and town boards and commissions, disseminate important news, and distribute information on restoration and mitigation BMPs. While undetermined at present where such a position would reside, it is estimated that 0.25 FTE would be needed to properly fulfill these outreach and education tasks.

- **Task 3F: Certify Green Professionals in Restoration/Mitigation/Maintenance**

Current Status: The CRMC is in the process of developing a certification program for “Green Professionals” to train workers in the nursery trade on the proper methods for controlling AIS in vegetated buffer zones adjacent to coastal and other waterbodies in the state. It is planned that only certified workers will be legally permitted to participate in AIS control activities under CRMC permits.

Existing Expenditures: There are no existing expenditures for this task.

Additional Expenditures Needed: The projected value of expenditures required to complete this task are currently unclear, but it is expected that a contract will be awarded to an appropriate expert and existing staff time will be invested in coordinating the task.

Objective 4: RESEARCH and DEVELOPMENT

- **Task 4A: Statewide Surveys to Map Distribution of AIS**

Current Status: There are often many unknown parameters about the biology of AIS in Rhode Island or their effects on the state's ecosystems. AIS distribution may be a result of ecological or historical variables such as location, means, and timing of introduction and means of spread. Statewide surveys of specific species or specific habitats are one way to tease apart the different factors contributing to an AIS's distribution. Mapping distribution of AIS against environmental variables or vectors will also be an important tool for control and mitigation.

In marine waters, the CRMC led the first rapid assessment survey (RAS) of AIS in Narragansett Bay in 2000, and the NBEP coordinated with the Mass Bays Program and MIT Sea Grant to conduct a follow-up RAS in 2003. The results of these surveys provide the baseline data for marine AIS in Rhode Island. There are no follow-up RAS planned for Rhode Island's coastal waters during the upcoming FY, but it is recommended that they be conducted at a minimum, on a continuous five-year cycle. There is however, to expand AIS surveys to cover all of the state's aquatic ecosystems. In freshwaters, statewide or targeted surveys may also be appropriate to address data gaps on the occurrence of certain species of concern.

Existing Expenditures: While the 2000 RAS was primarily funded by a grant from RI Sea Grant and significant outlays of existing staff time and in-kind contributions from numerous state agencies, including NBEP, CRMC, NERR, there are currently no existing expenditures dedicated toward conducting a RAS in the immediate future.

Additional Expenditures Needed: Based on the cost of the original RAS, it is estimated that at a minimum, a 0.10 FTE, \$25K, and generous in-kind contributions (i.e. NBNERR or other lab and housing facilities) are needed to conduct a future RAS.

- **Task 4B: Develop Improved Shipping/Boating Hygiene Technologies**

Current Status: The CRMC dedicates existing staff to the task of Co-chairing the NEANS Panel Shipping Committee. The Shipping Committee's current funded task is the development of a regional blast water management strategy for the northeast; the CRMC Co-chair developed the RFP for this task and is supervising the research assistant hired to complete it. A final report is expected in November 2007. In addition, the CRMC developed the RI Clean Marina Program during 2006 and administers this program for the state. Developing and implementing BMPs to remove hull fouling organisms in an environmentally safe manner is included in this Program.

Existing Expenditures: The CRMC dedicates existing staff to the task of Co-chairing the NEANS Panel Shipping Committee. The Shipping Committee's current funded task is the development of a regional ballast water management strategy for the northeast; the CRMC Co-chair developed the RFP for this task and is supervising the research assistant hired to complete it. A final report is expected in November 2007. An estimated 0.125 FTE is currently devoted to the NEANS Panel Shipping Committee task of developing a regional ballast water strategy. While the development of the RI Clean Marina Program represents a past expenditure, the CRMC expends an approximate 0.125 FTE towards its continued administration, which includes working to improve marine recreational boat cleaning BMPs. RIDEM-OWR also expends a small amount of staff time by participating in the inspections of marinas in the Clean Marina Program.

Additional Expenditures Needed: This task addresses both marine and freshwater boating and shipping interests, and the CRMC estimates that an additional 0.10 FTE is needed toward the task of supporting the development of technologies that improve shipping/boating hygiene.

- **Task 4C: Support the Development of Best Practices for Control/Restoration**

Current Status: The CRMC currently co-chairs the RI Coastal Habitat Restoration Team. The primary AIS control/restoration functions of this program are aimed at restoring salt marshes impacted by *Phragmites australis*. Other efforts are ad hoc and limited to permit stipulations. For example, in recently granting a permit for the removal and offshore disposal of a demolished bridge in Narragansett Bay, the CRMC stipulated control measures for the tunicate *Didemnum sp.* But beyond the RI Coastal Habitat Restoration Team and ad hoc efforts such as permit stipulations, there is little current effort expended toward the task of developing BMPs for AIS control/restoration in general. In addition, NBNERR and Save the Bay are currently evaluating the results of various monitoring protocols that have been developed regionally and nationally for application within Narragansett Bay. These include the results of invasive crab monitoring and dockside surveys. The RIDEM-OWR also distributes grants from state and federal sources that have been used to implement wetland and riparian buffer restoration projects.

Existing Expenditures: Through its activities on the RI Coastal Habitat Restoration Team, the CRMC expends approximately a 0.025 FTE in support of research and development to improve AIS restoration technologies. With respect to monitoring, the NEER currently contributes a 0.05 FTE to this task. RIDEM devotes a portion of an FTE to grant management tasks.

Additional Expenditures Needed: The CRMC will continue to expend a 0.025 FTE toward this effort. The NEER estimates that an additional 0.10 FTE is needed to continue this task, and the NBEP estimates that it needs a 0.05 FTE to begin contributing to this task.

- **Task 4D: Evaluate and Synthesize Scientific Literature on Control of AIS, Assessing Control Technique Applicability to RI Waters and Invasive Ecology for Priority Species**

Current Status: The NEANS Panel Science and Technology Committee has developed a list of currently used AIS control methods, including mechanical, chemical, and biological, for nineteen AIS selected for their regional importance in the northeast. Marine alga and animals, freshwater aquatic plants, and wetland plant species are all represented on this list, which is available at <http://www.northeastans.org/controls.htm>. This list provides a good starting point to further expand the number of AIS and control technologies specific to Rhode Island.

Existing Expenditures: There are currently no dedicated expenditures on this task.

Additional Expenditures Needed: Using the NEANS Panel list as a basis to further evaluate and synthesize scientific literature on AIS controls applicable to RI ecosystems, an estimated 0.10 FTE is needed to update and expand information specific to the state.

- **Task 4E: Research Ecosystem Effects of AIS**

Current Status: The RI Coastal Habitat Restoration Team was formed in part, in response to research that demonstrated the ecosystem impacts of AIS; the primary example in Rhode Island is the loss of native salt marshes to *Phragmites australis*. Beyond this ubiquitous species, research on ecosystem effects of AIS in general is minimal in the state. However, given the recent NOAA RFP “National Sea Grant College Program Aquatic Invasive Species Research and Outreach” (OAR-SG-2008-2001200) and its recognition the Northeast region is concerned about the spread of *Didemnum sp*, it is likely that research into the ecosystem effects of an increasing number of AIS species may be likely.

The NOAA RFP states :(*Didemnum sp*).”has not been identified to species and therefore its region of origin, its ecology, and tolerances are largely unknown. It further identifies the following research needs:

- (i) identify the species using molecular probes,
- (ii) identify its life cycle and relationship to competitors and predators,
- (iii) identify ways to prevent its further spread and to manage and control the species in nearshore and deeper water ecosystems,.

And finally, the RFP states “the greatest challenge is to limit its spread and manage the species in Georges Bank where it may interfere with the scallop and groundfish productivity and cause even greater economic hardship to the fishing industry.”

Existing Expenditures: There are currently no expenditures on this task.

Additional Expenditures Needed: Given the broad range of potential AIS, Rhode Island’s relative abundance of marine and freshwater ecosystems, and the numerous potential vectors for the introduction of AIS, the task of conducting comprehensive

research on the ecosystem effects of AIS in RI is significant. This task would likely be conducted at the university level or by RFP to a contractor. If conducted by existing staff at the state government level, it will likely require at least a 0.75 FTE.

Objective 5: PLANNING AND ASSESSMENTS

- **Task 5A: Convene a Panel of Experts to Develop a Prioritized AIS Threat List**

Current Status: The RI Habitat Restoration Team and NRCS evaluate proposals and fund projects designed to eradicate or otherwise control AIS species such as *Phragmites australis*. The RI Habitat Restoration Team includes biologists and other experts that collectively prioritize coastal habitats for restoration, based in part on the threat posed by AIS. The CRMC Biosecurity Board serves a similar function relative to preventing the introduction of disease organisms via aquaculture operations in Rhode Island. Additionally, this plan proposes that the CRMC Biosecurity Board be expanded to include an individual with expertise in AIS and that its functions be similarly expanded to create a permanent body in state government that to oversee all potential biological threats to Rhode Island's ecosystems, economic interests, and the public health. The RIAIS Working Group should consider working with all of these existing groups to develop a prioritized list of AIS threats to the state. As part of this process, the RIAIS Working Group should consider developing risk assessment protocols for additions and deletions to both marine and freshwater AIS priority lists.

Existing Expenditures: The CRMC currently supports 0.025 FTE to Chair the RI Coastal Habitat Restoration Team, which evaluates and funds proposals that often include AIS management as a critical part of habitat restoration projects. The CRMC also expends a 0.025 FTE to Chair the CRMC Biosecurity Board and participate in all of its functions.

Additional Expenditures Needed: In addition to the above mentioned groups, the NBEP is considering a possible role in this task and estimates that a 0.025 FTE would have to be dedicated to it.

- **Task 5B: Assess Effects of Control/Restoration Efforts**

Current Status: The Coastal and Estuary Habitat Restoration Program and Trust Fund (CEHRTF) is established within the CRMC which also chairs the RI Coastal Habitat Restoration Team, which provides funding for projects that propose to restore coastal and estuarine habitats including seagrass beds, salt marshes and river systems. Many of the projects funded to date include tasks to control or eradicate AIS. Proposals are evaluated and ranked according to numerous factors, including a monitoring plan to ensure that short-term and long-term restoration goals are met.

Additionally, the RIDEM-OWR distributes state and federal grants funds for habitat and riparian buffer restoration projects that support broader water quality restoration goals, and the NBNERR also conducts habitat restoration within the research reserve. Because

the NBNERR was established as a platform for long-term preservation, research and education, the NBNERR serves as an important control or sentinel site for much of Rhode Islands Coastal habitat. Significant effort has been invested to quantify the distribution and extent of various coastal habitats such as salt marsh, and seagrass beds not only within the NBNERR but throughout Narragansett Bay. NBNERR works not only with the NOAA to document and measure habitat changes according to standard protocols, but NBNERR works with local NGOs and Universities to collect data, measure trends, and provide data to managers. Examples include measurement of the distribution of SAV, as well as functionality of restored salt marsh habitat.

CRMC and RIDEM should review approvals for future grants and where needed consider strengthening requirements for monitoring and reporting on the success of AIS eradication projects.

Existing Expenditures: The RI Coastal Habitat Restoration Team seeks to include monitoring of restored sites, however, no portion of the funds awarded to restoration projects is allocated to this task. In some cases, limited federal funding from the USDA/NRCS, or in-kind contributions from NGOs such as Save The Bay may be allocated to monitoring. For restoration projects managed by NBNERR an estimated 0.40 FTE is expended on monitoring.

Additional Expenditures Needed: Because the RI Coastal Habitat Restoration Team allocates a large portion of CEHRTF funds to project design and construction, there is a need for a reliable and consistent source of pre and post-construction vegetation monitoring funding. It is estimated that approximately \$15,000 is required to adequately monitor restoration projects, which are currently funded at \$157,755. The NBNERR estimates an additional 0.25 FTE should be expended on this task for projects conducted within the Research Reserve boundaries.

- **Task 5C: Periodic Review of Monitoring Network Performance**

Current Status: As there is currently no AIS monitoring network in place, it follows that there is no current task to review a monitoring network's performance. However, the development and implementation of an Early Detection Rapid Response strategy is a high priority for Rhode Island, and as such, developing protocols to monitor its performance will occur early in the process of implementing the RIAIS Plan.

Existing Expenditures: There are currently no expenditures for this task.

Additional Expenditures Needed: There is a need for the RIAIS Working Group to identify agencies, organizations and resources to address this task. At a minimum, the CRMC, RINHS, and NBEP should collaborate on this task, as they are identified as participating in the development of an EDRR strategy (see Task 1G).

- **Task 5D: Develop System to Rapidly Collect Vouchers and Preserve Evidence of Regulatory Non-Compliance**

Current Status: As there is no regular coordinated collection of AIS voucher specimens, there is a need to plan a system to do so early in the process of implementing the RIAIS Plan. This task is related to the development of an Early Detection Rapid Response strategy and network.

Existing Expenditures: There are currently no expenditures for this task.

Additional Expenditures Needed: There is a need for the RIAIS Working Group to identify agencies, organizations and resources to address this task. At a minimum, the CRMC, RINHS, and NBEP should collaborate on this task, as they are identified as participating in the development of an EDRR strategy (see Task 1G).

Objective 6: PREVENTION AND CONTROL

- **Task 6A: Assess Introduction Risks and Prioritize Vectors for Management**

Current Status: Although studies have identified numerous potential vectors for the introduction of AIS there is currently limited knowledge regarding the confirmed pathways by which specific AIS are introduced to Rhode Island’s marine, estuarine, and freshwater ecosystems. In 2000 the Narragansett Bay Rapid Assessment Survey identified twenty-one non-native species and assumptions regarding their transport vectors were extrapolated from similar research conducted in other parts of the United States. Based on these results, the RI General Assembly passed the RIGL § 46-17.3 “Ballast Water,” a statute that authorized an investigation into the potential role of ballast water as a vector for the introduction of AIS into Narragansett Bay. The resultant report authored by the Narragansett Bay Estuary Program addresses ecological effects, economic impacts and human health concerns; it further addresses species risk assessments and provides an overall risk assessment for Narragansett Bay. However, there are no other such analyses of AIS vectors in Rhode Island. There is clearly a need to assess introduction risks and prioritize their associated vectors for management activities designed to prevent, control, or minimize AIS impacts to Rhode Island’s aquatic ecosystems.

Existing Expenditures: There are no current expenditures for this task. However, in response to RIGL § 46-17.3 “Ballast Water” the Narragansett Bay Estuary Program led the research, writing, and production of a report to the RI General Assembly that identifies ballast water as an AIS vector. The report includes information on ecological effects, economic impacts and human health concerns; it further addresses species risk assessments and provides an overall risk assessment for Narragansett Bay.

Additional Expenditures Needed: There is a need to identify all potential vectors for the introduction of AIS in Rhode Island aquatic ecosystems. The RIAIS Working Group

will develop a research proposal to accomplish this task; in support of this task the CRMC will make office space, access to computers, and other types of support available as required. It is estimated that \$5,000 will be needed to hire one graduate student intern to conduct the necessary research and produce a report. The NBEP estimates that an additional 0.025 FTE is needed to properly conduct this task.

- **Task 6B: Minimize the Risk of AIS Introduction from Ballast Water and Hull Fouling**

Current Status: While it is commonly recognized that commercial shipping, the recreational cruising industry, and similar activities may be responsible for AIS introductions worldwide, there is significant progress yet to be made regarding minimizing the risks posed by ballast water and hull fouling. As a first step toward addressing to this goal, the RIAIS Working Group will consider the recommendations of a study commissioned by the NEANS Panel's Shipping Committee to develop a regional ballast water management strategy. This study's report is expected in November 2007. Based upon its findings, the RIAIS Working Group will develop a set of priority tasks and seek funding for their implementation.

Existing Expenditures: The CRMC dedicated 0.20 FTE to the task of Co-chairing the NEANS Panel Shipping Committee; the RFP that was drafted for the above mentioned study was one of several tasks that executed under the direction of the CRMC staff person chairing the Shipping Committee.

Additional Expenditures Needed: The RIAIS Working Group will seek to partner with the USCG Station Providence to compile ballast water reporting information for RI coastal waters. Based on the results of this proposed task, the RIAIS Working Group's next task will be to develop and distribute education/outreach materials to commercial shipping interests, recreational cruise line companies, and others that represent potential ballast water or hull fouling vectors in the state.

- **Task 6C: Minimize AIS Introductions from Recreational Fishing and Boating**

Current Status: The control of AIS in freshwater habitats in Rhode Island is typically limited to ad hoc efforts to eradicate freshwater plant species in privately-owned lakes and ponds. These activities tend to be privately funded and are targeted at restoring aesthetic and recreational values. It is generally accepted however that publicly owned lakes and ponds are at risk for the introduction of AIS by recreational fishing and boating activities. The need to post signage on the risk of transporting AIS at public boat launching ramps is evident; no such signage is currently posted in the state. The same is true for public boat launching ramps and other types of public access at estuarine and marine water bodies. In order to address these conditions, the RIDEM should assess the costs associated with funding the construction of boat cleaning stations (including trailers) at freshwater bodies known to be infested by AIS.

Existing Expenditures: The CRMC has dedicated 0.10 FTE and provided materials for the production of large scale posters for display at AIS seminars and other venues in Rhode Island and throughout the northeast region. The CRMC has also taken the opportunity to distribute educational materials produced by the NEANS Panel (i.e. boaters floating key chains, *Hydrilla Watch* cards) at these venues. DEM F&W and OWW will cooperate and produce signs for posting at state boat ramp. As resources allow, educational materials will be updated and distributed to target audiences such as freshwater lake property owners, boaters, etc. Existing expenditures are associated with minimal staff-level pre-planning activities.

Additional Expenditures Needed: The CRMC will continue to distribute NEANS Panel outreach material as noted above, and will continue to produce other educational materials (as above) as needed. The NBEP estimates that an additional 0.025 FTE is needed to properly conduct this task. RIDEM estimated that a 0.1 FTE is needed to support the cooperative educational activities described above. While the following tasks have not all been evaluated in terms of expenditure values, it is important to note the following discussion regarding RIDEMs anticipated activities to minimize AIS introductions from recreational fishing and boating. The RIDEM estimates it needs 0.5 FTE to develop and coordinate a permanent Lakes and Ponds Program to manage AIS in Rhode Island's freshwater bodies. As part of this initiative RIDEM will:

- investigate the feasibility of installing a public boat wash station at a RIDEM boat ramp. RIDEM anticipates a cost of \$40,000 for installation of the station and is seeking an additional \$2,000/year to support general maintenance costs. CRMC and RIDEM will assess the utility of installing additional boat-wash stations at both freshwater and coastal locations based on the results of this pilot effort;
- work with CRMC, URI Watershed Watch and others to evaluate the potential development of a permanent AIS inspection program for recreational boats. RIDEM will seek funding to support 0.2 FTE for two years to scope and develop a boat inspection program in Massachusetts, and a feasibility study of program implementation.
- design, produce, and install signage at all boat ramps managed by the agency. The signage will describe the threat of AIS transport between freshwater bodies by boats, trailers, and recreational fishers;
- develop and distribute AIS educational materials to lake and pond associations;
- develop a pamphlet describing the risk of AIS transport via boats, trailers, and recreational fishers. This pamphlet will be distributed along with boat registration applications and/or commercial fishing licenses.

Similarly, the CRMC will post appropriate AIS signage at its designated public rights-of-way to the shore through partnerships developed with various groups via its Adopt-An-Access Program. As applicable, the CRMC will also post signage at public access sites associated with the Urban Coastal Greenway which is currently in development under the Metro Bay Special Area Management Plan. Additionally, the CRMC will require the posting of such signage where applicable, through the public access plans required as

mitigation for certain types of coastal development under Section 335 of the RI Coastal Resources Management Program.

- **Task 6D: Minimize the Risk of AIS Introductions from the Commercial Seafood and Freshwater Fish Industries**

Current Status: There are currently no criteria in place that specifically address minimizing the potential for introduction of AIS via the capture, handling, transport, and fate of the various live finfish and shellfish species taken in state or federal waters, or imported to Rhode Island. The same is true for the non-live seafood and freshwater fish markets. There are however, studies that report on numerous issues of concern to AIS management, such as the introduction of fish viruses in frozen shrimp. Such information provides a starting point toward understanding AIS risks associate with the commercial seafood and freshwater fish industries. This topic is also of particular concern given the apparent growing market for live fisheries products. The first record for the invasive Chinese Mitten Crab on the United States east coast occurred in 2007, and subsequent verified sightings indicate that it is moving northward toward Rhode Island. The Chinese Mitten Crab is considered a delicacy in some ethnic cuisines, and it is speculated that specimens are intentionally released in the hopes of establishing a supply for the live market.

Existing Expenditures: As stated above at Task 1G, the CRMC dedicated approximately 40 hours of staff time in response to the Smithsonian Environmental Research Center Chinese mitten crab alert. *For accounting purposes it is important to note that the CRMC costs at Task 1G are not also being applied to this task; for planning purposes it is important to note that the tasks performed under Task 1G are also applicable to the objective of Task 6D.*

In addition, the USDA Natural Resources Conservation Service (NRCS) assists agricultural producers through its Environmental Quality Improvement Program (EQIP) who voluntarily apply to the program to help them improve environmental quality in concert with agricultural production on their farms. In 2006, the Rhode Island NRCS office opened its EQIP Program for the first time to aquaculturists in the state. RI-NRCS's 2006 EQIP Shellfish Management program builds upon the highly successful Massachusetts EQIP pilot project on Cape Cod; which made cost-share assistance available to shellfish farms in 2005. NRCS in partnership with Roger Williams University and the University of Rhode Island adapted the Massachusetts program to fit the unique resource conditions and industry technology in Rhode Island waters. In 2006 NRCS funded 40% of all Rhode Island shellfish farms for a total of \$290,000 in financial assistance. Funding is provided to assist growers to achieve higher levels of environmental stewardship. This is done by providing cost incentives to a) protect water quality by controlling oil and gasoline emissions from outboard motors and biofouling residue discharges from cage culture wash operations; b) protect endangered species through gear management, and c) improve the health of wild and farmed shellfish populations through record keeping and disease monitoring.

Additional Expenditures Needed: The CRMC Biosecurity Board was established pursuant to RIGL Section 20-10-1.1 and charged with assisting and advising the CRMC in carrying out the provisions of RIGL Chapter 20-10 “Aquaculture.” The CRMC Biosecurity Board reviews and comments on proposed aquaculture operations that include non-indigenous species and the concurrent protocols designed to prevent their release into the waters of the state. It is proposed to review the feasibility of expanding the CRMC Biosecurity Board to have jurisdiction over other importations, including possibly plants; an AIS expert should be added to the CRMC Biosecurity Board to evaluate permits for transport and importation introduction risks. Henceforth, the CRMC Biosecurity Board’s recommendations should address all activities that could pose a risk for AIS introductions to Rhode Island.

Another task of the AIS Working Group will be the evaluation of current nonindigenous game fish stocking practices in Rhode Island and recommendations for preventing AIS introductions via this vector. Expenditure values for this task have not yet been determined, and will be done so through the RIAIS Working Group.

Finally, the CRMC will seek \$5,000 to fund a graduate student research assistant to update and expand existing lists of seafood and freshwater fisheries species that are imported or exported within Rhode Island.

- **Task 6E: Minimize the Risk of Prevent AIS Introductions to Freshwater and Marine Systems via the Bait Industry**

Current Status: The import of baitfish and invertebrate species along with their packing materials may pose a significant threat of AIS introductions to Rhode Island. Comprehensive information that identifies and prioritizes risks associated with known (and potential) bait species and packing materials should be developed. It is also critical that recommendations be developed and regulations be promulgated as required to prevent or minimize the potential for AIS introductions through this vector.

Existing Expenditures: RIDEM currently utilizes its statutory authority to implement emergency regulations as required to prevent AIS introductions via the bait industry and other potential vectors. The RIDEM dedicates minimal staff time to this task on an ad hoc basis.

Additional Expenditures Needed: RIDEM will develop guidance for the disposal of unused bait species for distribution with commercially sold bait or for printing directly on bait packing materials. RIDEM will seek \$5,000 for printing and distribution costs.

- **Task 6F: Minimize AIS Introductions by the Aquarium and Pet Trade, Nurseries and Water Garden Suppliers, and Other Wetland Vegetation Growers**

Current Status: Species distributed for use in aquaria and water gardens are often selected due to their ability to survive and grow with minimal care under a range of environmental

conditions. Intentional or unintentional release of these organisms is common, and several harmful introductions have been documented through these pathways worldwide. Locally, there have been recent verified reports of lionfish in Rhode Island's coastal waters; these specimens are likely following the Gulf Stream northward after being intentionally or unintentionally released via public aquaria or a home aquarist.

Existing Expenditures: The NEANS Panel has endorsed Habitattitude™ a national initiative developed by the ANS Task Force and its partner organizations. While the U.S. Fish and Wildlife Service is the lead federal agency for this program, there are distinct differences between Habitattitude™ and previous ANS Task Force initiatives. Habitattitude™ is endorsed by the Pet Industry Joint Advisory Council (PJAC) and the nursery and landscape industry. In addition to this industry involvement, the National Sea Grant College Program and state fish and wildlife agencies have also joined in. These agencies serve as important partners due to their regulatory authorities, which ultimately serve to protect fish and wildlife resources from potential AIS introductions and other harmful impacts. The CRMC has dedicated 0.20 FTE in support of the NEANS Panel.

Additional Expenditures Needed: There is a need to develop a comprehensive strategic plan with guidelines to minimize AIS introductions through the aquarium and water garden trade. The RIAIS Working Group will coordinate with the RIDEM-FW and RIDEM-AG to determine the resources required for and available for this task. Elements of this task should include measures to address:

Import and sale of potentially invasive invertebrate species;
Import and sale of potentially invasive plant species and organisms that may be transported with these species;
Proper labeling of plant and animal species sold by pet stores and water garden suppliers;
Inspections of pet stores and water garden suppliers for priority AIS;
Best management practices for the disposal of diseased or unwanted organisms

- **Task 6G: Minimize the Risk of AIS Introductions by Universities, Public Aquaria, and Other Research Facilities**

Current Status: Universities, public aquaria and other research facilities often hold nonindigenous organisms for experimental and display purposes. Maintenance of these live species often requires the exchange of water with the natural environment, providing the opportunity for the release of these species, which often have microscopic life history stages. It is believed that such practices are the likely vector for the initial introduction of *Caulerpa taxifolia*. Furthermore, experimentation with live nonindigenous organisms may be conducted in laboratories or natural environments, requiring careful controls to prevent their release or escape.

Existing Expenditures: There are no existing expenditures for this task.

Additional Expenditures Needed: The State of Rhode Island should consider promulgating legislation to prevent the introduction of nonindigenous aquatic organisms

via universities, public aquaria, and other research facilities. The state should also work with the various institutional review boards (the committees that review whether animals are being treated humanely by researchers at a particular institution) to develop appropriate procedures for the use and disposal of nonindigenous aquatic organisms. The development of a list of prohibited organisms or those that require special permits should also be considered. The CRMC will seek \$5,000 to fund a graduate student research assistant to conduct these tasks.

- **Task 6H: Minimize the Risk of AIS Introductions by the Aquatic Organism Supply Industry**

Current Status: The sale of live aquatic organisms typically occurs through mail order and Internet sales. The companies that supply these organisms tend to develop affiliations with both marine and freshwater research facilities, and ship directly to them and other recipients on a worldwide scale. There also tend to be few or no controls regarding the ultimate fate of the organisms once received by the purchaser.

Existing Expenditures: There are no current expenditures toward this task.

Additional Expenditures Needed: The RIAIS Working Group should consider developing recommendations to the federal ANS Task Force to minimize AIS introductions to Rhode Island through the Internet, mail order businesses, and other means by which the shipment of live aquatic organisms is accomplished. As part of this task, the RIAIS Working Group should identify and educate key industry representatives on the potential threats posed by AIS introductions through their shipping activities. The RIAIS Working group should pursue the following activities:

- Contract a graduate student research assistant to identify companies that supply or potentially supply aquatic organisms to RI based institutions
- Identify the legal authorities required to address the potential for AIS introductions through the Internet, mail order businesses, and other shipping agents
- Based on the proper legal authorities identified in the task above, develop and distribute guidelines on measures that can be taken by the aquatic organism supply industry to minimize AIS introductions to those companies identified through this task.

The CRMC will seek \$5,000 to fund a graduate research assistant to conduct this task.

- **Task 6I: Programs to Restore Habitats Impacted by AIS**

Current Status: Aquatic invasive species management plans are funded by the CRMC through its Coastal and Estuarine Habitat Restoration Trust Fund (CEHRTF). Typically, AIS management occurs as part of a larger salt marsh restoration project, in which *Phragmites australis* is controlled through hydrological modifications such as the removal of tidal restrictions, herbicide treatment, and/or mechanical removal and mulching.

Existing Expenditures: The CEHRTF is annually funded at \$250,000, of which a total of \$157,755 was awarded towards AIS management. This investment in the restoration of habitats impacted by AIS represents 63% of the total Rhode Island expenditure on coastal habitat restoration. Direct CRMC expenditures related to AIS management include administering the CEHRTF, coordinating the technical advisory committee and proposal review. Direct involvement in a limited number of restoration projects also occurs, with estimated expenditures of staff time on these tasks at 0.05 FTE.

Additional Expenditures Needed: It is difficult to estimate expenditures needed to address restoration of impacted habitats as the scope of potential impacts and effected habitats is very broad. As a first step, the RIAIS Working Group should determine the potential for and severity of (economic, environmental, public health) as many AIS impacts as practicable. The next step should be to develop a priority list of habitats targeted for restoration should they be impacted by AIS.

Objective 7: LEGISLATION and REGULATION

Current Status: As invasive species management evolves in Rhode Island, additional legislative needs may become apparent. The Working Group should consider developing a presentation relating state and regional AIS management issues to the RI General Assembly and help prepare legislation for these needs. The Working Group should consider conducting an annual evaluation of legislative and regulatory needs based on the results of implementation efforts outlined in the AIS Management Plan.

- **Task 7A: Evaluate Rhode Island's Authority to Restrict the Introduction and Order the Removal of AIS**

Current Status: Rhode Island's authority to restrict the introduction of AIS identified as threats to the state's environment or economy is not well understood. Basic elements such as lists of marine and freshwater plants and animals that are banned from importation into the state are incomplete or lacking. The state's ability to restrict interstate trade associated with known vectors for AIS identified as threats is also not well understood. While current statutes authorize access to private property by public officials under certain conditions, there are no current laws that specifically address the state's authority to access private freshwater bodies and require the removal of AIS species. The RIAIS Working Group should recommend a study to determine whether Rhode Island currently has the authority to restrict the introduction of AIS identified as threats and order their removal under all conditions. Any resultant report should include legally defensible recommendations for developing the legal mechanisms required to protect the state from AIS.

Existing Expenditures: There are currently no dedicated expenditures for this task. Nonetheless,, it is important to note that the RI General Assembly addressed the issue of potentially restricting the introduction of marine AIS under a ballast water management

strategy (RIGL § 46-17.3). However, this statute does not include enforceable policies regarding restrictions to ballast water management in Rhode Island’s coastal waters.

Additional Expenditures Needed: An estimated 0.25 FTE is needed to conduct a legal investigation that expands on the issue of ballast water to include the state’s authority to restrict the introduction of all known AIS identified as threats.

- **Task 7B: Identify Statutory and Regulatory Gaps in the Rhode Island Legal Framework to Prevent, Control, and Minimize AIS Impacts**

Current Status: While RIGL § 46-17.3 authorizes commencing the process of developing a ballast water management program, the state lacks a comprehensive legal framework to address the problem of AIS across all species, vectors, and ecosystems. The RIAIS Working Group should prioritize an exhaustive review of the state’s legal framework to identify gaps related to the prevention, control, and minimization of AIS impacts. Further, a report should be produced that among other things, makes recommendations regarding the need for statutes, regulations, and other means to address problems associated with such gaps.

Existing Expenditures: The CRMC dedicated a 0.20 FTE toward the task of researching and writing this RIAIS Management Plan, a portion of which involved compiling a list of state statutes, regulations, and programs related to AIS.

Additional Expenditures Needed: An estimated 0.5 FTE will be needed to conduct an exhaustive legal analysis of the statutes, regulations, and programs listed in the RIAIS Management Plan, in order to identify gaps and make recommendations to address them. The CRMC and DEM will be responsible for the execution of this task.

- **Task 7C: Streamline Permitting for Rapid Response Control Methods**

Current Status: Some legal mechanisms potentially adaptable to a streamlined permitting process to control AIS are already in place. RIGL §42-35-3(5) (b) of the RI Administrative Procedures Act authorizes agencies to adopt emergency rules when a determination is made that an imminent peril to the public health, safety, or welfare exists. DEM has used emergency rules to prohibit the possession of certain nonindigenous baitfish and commonly uses them to implement fisheries management regulations.

Existing Expenditures: At present, the CRMC and RIDEM should dedicate staff time to draft emergency regulations as required.

Additional Expenditures Needed: The RIAIS Working Group should consider this task to be among its highest priorities as its successful completion will provide the impetus required to develop and implement a legally sound Early Detection/Rapid Response protocol for AIS in Rhode Island. The CRMC and RIDEM should dedicate staff resources equally toward a 0.250 FTE for this task.

Table 3. Implementation Table and Budget Summary				Entity (Current Budget / Estimated Increase Required)*	
Rhode Island Aquatic Invasive Species Management Plan					
Goals:	Objectives:	Tasks:	Task Short Summary (see Section IV for detailed descriptions)	Addresses Goal(s):	
I	prevention				
II	control				
III	minimize or abate harm				
	1	coordination/communication			
		A	coordinate with federal and international agencies and organizations with AIS interests	I	crmc (0.05 / 0.05) nerr (0.1 / 0.1) rinhs (0 / 0.1) nbep (0.025 / 0.05) owr (min. / ***)
		B	coordinate with neighboring states and nations on AIS issues of mutual interest	I	crmc (0.05 / 0.05) rinhs (0 / 0.2) nbep (0.025 / 0.05) owr (min. / 0.1)
		C	coordinate RI AIS activities	I	crmc (0.1 / 1.0) nerr (0.1 / 0.5) rinhs (0.5 / 0.1) owr (0.25 / 1.0)
		D	develop criteria to evaluate and prioritize the risk of AIS introductions	I	rinhs (0 / 0.3+) owr (min. / ***)
		E	maintain outreach/communication with stakeholder groups via seminars, list serve, web sites, and other means	I,II,III	crmc (0.025 / 0.25) rinhs (0.5 / 0.1) owr (0.1 / \$10K-\$20K) nerr (0.025 / 0.75)
		F	coordinate AIS data collection, storage, and access	I,II,III	nerr (0.025 / 0.075) rinhs (0 / 1.0) owr (see note / \$50K-\$100K)
		G	develop early detection/rapid response strategy to control or abate new AIS	II	crmc (0 / 0.25) rinhs (0 / 1.0) nbep 0 / 0.05)
	2	monitoring			
		A	monitor the introduction and spread of AIS in coastal ecosystems	I,II	crmc (***/ \$70K) nerr (0.2 / 0.1)
		B	monitor the introduction and spread of AIS in freshwater ecosystems	I, II	owr (0.25 / 0.8)
		C	monitor known AIS vectors	II,III	nrcs (***/ ***) nbep (0 / 0.05) riais (***/ ***)
	3	education/outreach/training			
		A	build/maintain understanding of AIS plan in pet/nursery/aquaculture trade	I,II	crmc (0.1 / 0.1) nerr (0.02 / 0.25)
		B	initial and refresher training on ID of AIS for monitors	I,II	uri (***/ 0.5)

1) Unless otherwise indicated all values are full-time equivalent percentages (i.e. 0.1 = one-tenth FTE). (\$) = dollars; (min.) = minimal dollar or staff investment; (***) = see corresponding task discussion in "Management Objectives and Tasks"

2) see footnote at end of table for titles of entities shown as acronyms in this column

	C	educate public on dangers of releasing non-natives into local waters	I,II	nbep (0.025 / 0.05)
	D	ensure availability of training/training materials in best practices for control/restoration/mitigation	I,II,III	nerr (0.025 / 0.125)
	E	train community groups in best practices for restoration/mitigation	II,III	crmc (0.025 / 0.025) nerr (0.125 / 0.025)
	F	certify green professionals to do restoration/mitigation/maintenance	III	crmc (** / **)
	4	research and development		
	A	statewide surveys to map distribution of AIS	II	crmc (0 / 0.1) nbep (0 / **) nerr (0 / **)
	B	develop improved boat cleaning technologies	I,II	crmc (0.25 / 0.1)
	C	support the development of best practices for control/restoration/monitoring	II,III	crmc (0.025 / 0.025) nerr (0.05 / 0.1) nbep 0 / 0.05)
	D	evaluate and synthesize scientific literature on control of AIS, assessing control technique applicability to RI waters and invasive ecology for priority species	I	neans (** / **)
	E	research ecosystem effects of AIS	III	riais working group (** / **)
	5	planning/assessments		
	A	convene a panel of experts to develop a prioritized AIS threat list	I,II	crmc (0.05 / **) nbep (0 / 0/025)
	B	assess effects of control/restoration efforts	I,II	crmc (0 / \$15K) nbep (0.4 / 0.25)
	C	periodic review of monitoring network performance	I,II	riais (** / **)
	D	plan system to rapidly identify vouchers and preserve/control evidence of crimes/regulatory non-compliance	I,II	riais (** / **)
	6	prevention/control/restoration		
	A	assess introduction risks and prioritize vectors for management	I,II	crmc (** / \$5K) nbep (** / 0.025)
	B	prevent/minimize the risk of AIS introductions from ballast water and hull fouling	I,II,III	crmc (0.2 / **) riais (** / **)
	C	prevent/minimize the risk of AIS introductions from recreational fishing and boating	I,II,III	crmc (0.1 / **) nbep (0 / **) owr (0 / **)
	D	prevent/minimize the risk of AIS introductions from commercial seafood and freshwater fish industries	I,II,III	riais (** / **) crmc (** / \$5K)
	E	prevent/minimize the risk of AIS introductions via the bait industry	I,II,III	dem (** / \$5K)

		F	prevent/minimize the risk of AIS introductions by the aquarium/pet trade, nursery/water garden trade, and other wetland vegetation growers	I,II,III	crmc (0.2 / ***) riais (** / ***)
		G	prevent/minimize the risk of AIS introductions by universities, public aquaria, and other research facilities	I,II,III	crmc (** / \$5K) riais (** / ***)
		H	prevent/minimize the risk of AIS introductions from the aquatic organism supply industry	I,II,III	crmc (** / \$5K) riais (** / ***)
		I	programs to restore habitats impacted by AIS	III	crmc (\$157,755 & 0.05 / ***)
	7	legislation/regulation			
		A	evaluate rhode island's authority to restrict the introduction and order the removal of AIS	I	crmc (** / ***) dem (** / 0.025)
		B	identify statutory and regulatory gaps in the rhode island legal framework to prevent, control, and minimize AIS impacts	I	crmc (0.2 / ***) dem (** / 0.5)
		C	streamline permitting for rapid response control methods	II,III	crmc (** / 0) dem (** / 0)

crmc: Coastal Resources Management Council
 dem: RI Department of Environmental Management
 nbep: Narragansett Bay Estuary Program
 neans: Northeast Aquatic Nuisance Species Panel
 nerr: Narragansett Bay National Estuarine Research Reserve
 nrsc: Natural Resources Conservation Service (USDA)
 owr: RIDEM Division of Water Resources
 riais: RI Aquatic Invasive Species Working Group
 rinhs: Rhode Island Natural History Survey
 uri: University of Rhode Island

VI. Program Monitoring and Evaluation

Following submission of this management plan to the federal ANS Task Force, the RIAIS Working Group will produce its first annual work plan based on the tasks shown in Chapter V. The RIAIS Working Group will conduct an annual evaluation of how well the RIAIS Plan is being implemented; its assessment of the progress made toward meeting the goals and objectives of the RIAIS Plan will be based on whether the previous year's tasks have been implemented. As it is anticipated that it will be difficult to assign quantitative measures of progress toward achieving goals and objectives, this type of evaluation provides something of a direct measure regarding the success of the RIAIS Plan on an ongoing basis. The RIAIS Plan's Implementation Table provides the guidance and focus needed to continually evaluate and make consensus-based decisions toward annually prioritizing tasks for implementation. Results of the evaluation will be summarized in an annual report that will include:

- A qualitative description of progress towards each of the three goals – *prevention, control, minimize or abate harm* - listed on the Implementation Table;
- A comprehensive list of tasks identified in the previous year's work plan, a proposed budget for each task, including resources procured and expended;
- Implementation status (i.e. implemented, partially implemented, or not implemented) for each priority task listed in the previous year's work plan and a brief explanation of how the implementation status was determined; and,
- A description of the resources needed to successfully complete the implementation of partially or not implemented tasks.

Evaluation of annual work plans will play a major role in directing activities for the following years, as well as restructuring tasks identified in the original plan. Work plans for upcoming years will be produced concurrently with each annual program evaluation document. Public meetings similar to those described in Section I will be held to solicit comments on the draft annual report and work plan prior to the distribution of a final document to relevant state and federal agencies, municipalities, academics, industry representatives, and the general public.

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Appendix B

Public Scoping Meetings: Notice and Comments

The following notice was posted on the websites of the Coastal Resources Management Council and the Rhode Island Natural History Survey:

10/3/07, WAKEFIELD – The Northeast Aquatic Nuisance Species (NEANS) Panel is hosting a series of public forums from October 10-12 to gather comments on the draft Rhode Island Aquatic Invasive Species (RIAIS) Management Plan that was recently completed by the RIAIS Working Group, chaired by the Coastal Resources Management Council.

The public comment meetings will be held from 6-8 p.m. each of the three days, with a meeting schedule as follows: October 10 at Stedman Government Center, Room 232, 4808 Tower Hill Road, Wakefield, RI; October 11 at Narragansett Bay Commission, One Service Road, Providence, RI; and October 12 at Roger Williams University School of Law, Room 286, 10 Metacom Avenue, Bristol, RI. The general public is encouraged to attend.

Aquatic invasive species (AIS) are non-native animals, plants, or microorganisms that may harm aquatic environments, economic resources, or the public health. The most notorious AIS in the United States is the zebra mussel which has caused billions of dollars in damage while spreading throughout the nation's freshwater systems since its accidental introduction to the Great Lakes in 1988. The RIAIS Plan will become a significant part of the NEANS Panel's efforts to address the threat of AIS in Rhode Island and the northeast once it is approved by the Federal Aquatic Nuisance Species Task Force. The CRMC is a charter member and serves as co-chair of the NEANS Panel, which was established in 2001 under the Federal Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990. This law seeks to prevent the introduction and spread of aquatic invasive species into U.S. waters and to control or eradicate them if necessary. The NEANS Panel includes the six New England states, the State of New York, and the Canadian Provinces of New Brunswick, Nova Scotia, and Quebec. It represents state, provincial, and federal governments; academia; commercial and recreational fishing interests; recreational boaters; commercial shipping; power and water utilities; environmental organizations; aquaculture; nursery and aquarium trades; tribal concerns; lake associations; and the bait industry. The RIAIS Plan's goals to prevent, control, and abate the impacts of AIS in the state will be implemented on a continual basis upon receiving federal approval.

RI Aquatic Invasive Species Management Plan (Draft) (PDF)

Outcome: A PowerPoint® presentation on the RIAIS Plan was shown at the public scoping meetings and comments were taken from attendees. The meeting audiences typically included state agency officials. The predominant comments focused on the need to develop an interagency AIS early detection-rapid response network in Rhode Island and the need to establish a freshwater lakes AIS management program at the state agency level.

Selected Federal Authorities and Programs

General Statutes

Agreement on the Application of Sanitary and Phytosanitary Measures (1995)

(SPS Agreement 1995). A supplementary agreement to the World Trade Organization Agreement. Provides a uniform interpretation of the measures governing safety and plant and animal health regulations. Applicable to all sanitary and Phytosanitary measures directly or indirectly affecting international trade. Sanitary and Phytosanitary measures are defined as any measure applied a) to protect animal or plant life or health within (a Members' Territory) from entry, establishment or spread of pests, diseases, disease carrying organisms; e) to prevent or limit other damage within the (Members Territory) from the entry, establishment or spread of pests (annex A).

Water Resources Development Act of 1990

The Water Resources Development Act of 1990 (33 U.S.C. 2201-2324 (Supp. 1991) states that the goal of the U.S. Army Corps of Engineers' resources development program is "no overall net loss" of wetlands. The act also requires the Corps to develop an action plan to achieve this goal. The action plan must be prepared in consultation with the U.S. Environmental Protection Agency and the U.S. Fish and Wildlife Service.

The Endangered Species Act of 1973 (and amendments)

The Endangered Species Act can be used to authorize the eradication or control of AIS in the case that a listed species is threatened by the invader's presence or spread.

Federal Water Pollution Control Act of 1972 (The Clean Water Act)

The primary goal of this statute, which is more commonly known as the Clean Water Act (CWA) (33 U.S.C. 1251 et seq.) and has since been amended, is to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters," and to apply the best available and economically achievable technology in order to obtain water quality at a level adequate to protect fish, shellfish, wildlife and human recreational activities. A broad framework of planning, research, financial assistance, and permits systems was outlined with the purpose of furthering national goals for the elimination of both direct and indirect discharge of pollutants into the navigable waters of the United States.

National Environmental Policy Act (1970)

With respect to aquatic invasive species, NEPA addresses non-native species that pose harm to the environment, including those via intentional introductions related to major federal actions. NEPA requires federal government agencies to consider the environmental effects of their actions through preparation of environmental impact statements. Any harmful effects to the environment related to non-native species must be included in an EIS.

Rivers and Harbors Act of 1899

The Rivers and Harbors Act of 1899 (33 U.S.C. 401 et seq.) was originally established to protect interstate commerce in navigable waters. It is the basic act for controlling works or activities in navigable waters of the United States, overseen by the Department of the Army through a public interest review. This provision calls for the review of such factors as economics, aesthetics, general environmental concerns, historical values, water quality, and fish and wildlife impact before approval of the project is granted.

Agriculture and Forestry

§6006 of the Safe, Accountable, Flexible, Efficient Transportation Equity Act

A Legacy for Users (SAFETEA-LU) (2005) Includes a provision that makes activities for the control of noxious weeds and the establishment of native species eligible for Federal-aid funds under the National Highway System (NHS) and the Surface Transportation System (STP). The control of terrestrial noxious weeds and aquatic weeds is commonly done by maintenance districts or contracted crews of each State department of transportation. Historically, maintenance activities have been the responsibility of the State and therefore have not been eligible for Federal-aid dollars.

Noxious Weed Control and Eradication Act (2004)

- (a) In General.--The Secretary shall establish a program to provide financial and technical assistance to control or eradicate noxious weeds.
- (b) Grants.--Subject to the availability of appropriations under section 457(a), the Secretary shall make grants under section 454 to weed management entities for the control or eradication of noxious weeds.
- (c) Agreements.--Subject to the availability of appropriations under section 457(b), the Secretary shall enter into agreements under section 455 with weed management entities to provide financial and technical assistance for the control or eradication of noxious weeds

Federal Plant Pest Act (1957; amended in 1994)

Under this Act, a plant pest is defined as any living stage of insects, mites, nematodes, slugs, snails, protozoa, or other invertebrate animals, bacteria, fungi, other parasitic plants or reproductive parts, viruses, or organisms similar to or allied with any of these, or infectious substances which can directly or indirectly injure or cause disease or damage in plants or parts, or processed, manufactured or other products of plants. The Act prohibits persons from importing or entering plant pests into the U.S., or moving plant pests interstate, or accepting delivery of plant pests moving into the U.S. or interstate, except in accordance with regulations enacted by the Secretary to prevent the dissemination of plant pests. These regulations may require that a plant pest be accompanied by a permit issued by the Secretary prior to its movement or a certificate of inspection by appropriate officials of the country or state from which the plant pest is to be moved. No letter or package containing a plant pest may be mailed unless the mailing complies with the Secretary's regulations. §§ 150bb-150cc.

National Invasive Species Council. National Invasive Species Act of 1996

P.L. 104-332

Section 1: This act reauthorizes and amends the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (P.L. 101-646).

Section 1002: Findings and Purposes. Nonindigenous invasive species have become established throughout the waters of the U.S. and are causing economic and ecological degradation to the affected near shore regions. Zebra mussels are present in the Great Lakes and inland waters including the Mississippi drainage, Arkansas River, Hudson River, and Lake Champlain. Other exotic species infestations, such as the mitten crab, brown mussel, ruffe, Eurasian watermilfoil, and hydrilla, occur throughout waters of the U.S. If preventive measures are not taken nationwide, introduction and spread of aquatic nuisance species will continue in marine and fresh waters of the U.S.

Section 1101: Aquatic Nuisance Species in the Waters of the United States. The Act reauthorizes the Great Lakes ballast management program and expands applicability to vessels with ballast tanks (as opposed to vessels which carry ballast water). The Secretary of Transportation shall develop national guidelines to prevent the introduction and spread of nonindigenous species into U.S. waters via ballast water of commercial vessels. The primary means of prevention is exchange of ballast water on the high seas. The guidelines apply to vessels equipped with ballast water tanks and directs vessels that enter U.S. waters after operating beyond the exclusive economic zone to undertake ballast exchange in the high seas. The Secretary shall establish record keeping and reporting procedures and sampling techniques, based upon the best science available, to monitor compliance. A vessel is not required to conduct a ballast water exchange if the master decides that the exchange threatens the safety or stability of the vessel, its crew, or its passengers.

National Ballast Water Management Information

The Task Force and the Secretary of Transportation shall conduct ecological and ballast discharge surveys in waters highly susceptible to invasion or requiring further study. Ecological surveys (Department of Interior authorized \$1 million/year for 6 years) will examine attributes and patterns of nonindigenous species invasions and the effectiveness of ballast management and the guidelines used in abating the invasions. The rate of ballast discharge, types of ballast practices, and effectiveness of the guidelines developed under this section also will be examined in these waters in a ballast discharge survey (Department of Transportation authorized \$1 million/year for 6 years).

Compliance with and effectiveness of the guidelines will be reviewed periodically by the Secretary of Transportation. The Secretary shall submit a report on its findings to Congress within 30 months of issuing the guidelines. If the review reveals compliance or reporting inadequacies, the Secretary may promulgate region-specific regulations to enforce the voluntary guidelines 6 months after issuing the report to Congress. The Secretary shall revise the regulations in order to be consistent with any international measure agreed to by the United States. The Secretary shall ensure that U.S. and foreign flag vessels receive equal treatment under the Act.

In developing guidelines, the Secretary of Transportation should consult and negotiate with foreign governments, such as Canada and Mexico. Further, other agencies, such as APHIS, should be utilized to streamline reporting to the extent practicable.

The Secretary of Transportation in consultation with the Under Secretary of Commerce for Oceans and Atmosphere, affected shore side ballast water facility operators, affected crude oil tanker operators, and interested parties shall study the effectiveness of the shore side ballast water facility in Alaska in preventing the introduction of nonindigenous aquatic species. In addition, the cost and feasibility of modifying the facility to improve its effectiveness will be studied.

Section 1102: National Ballast Water Management Information

The Task Force and the Secretary of Transportation shall conduct ecological and ballast discharge surveys in waters highly susceptible to invasion or requiring further study. Ecological surveys (Department of Interior authorized \$1 million/year for 6 years) will examine attributes and patterns of nonindigenous species invasions and the effectiveness of ballast management and the guidelines used in abating the invasions. The rate of ballast discharge, types of ballast practices, and effectiveness of the guidelines developed under this section also will be examined in these waters in a ballast discharge survey (Department of Transportation authorized \$1 million/year for 6 years). Regional research grants may be made available by the Under Secretary of Commerce to fund research on aquatic nuisance species prevention and control in the Chesapeake Bay, Gulf of Mexico, Pacific Coast, Atlantic Coast, and the San Francisco Bay-Delta Estuary (Fish and Wildlife is authorized \$3 million/year for 6 years).

The Secretary of Transportation, in consultation and cooperation with the Task Force and the Smithsonian Institution, shall develop and maintain a clearinghouse of national data on ballasting practices, compliance with the national ballast management guidelines, and other information. A report synthesizing and analyzing the data collected shall be prepared by the Secretary and submitted to the Task Force and Congress on a biannual basis. The Department of Transportation is authorized \$0.5 million/year for 6 years for the clearinghouse.

Section 1103: Armed Services Ballast Water Program. The Secretary of Defense shall implement a ballast water management program for seagoing vessels of the Department of Defense. The Secretary of Transportation shall implement a ballast water management program for seagoing vessels of the Coast Guard.

Section 1104: Ballast Water Management Demonstration Program

The Secretary of the Interior and the Secretary of Commerce, with the concurrence of and in cooperation with the Secretary of Transportation, are instructed to undertake a demonstration of technologies and practices which may prevent introduction and spread of nonindigenous species through ballast discharge. The demonstration program is authorized at \$2.5 million over 3 years. Installation and construction of technologies will occur in the U.S. Currently active vessels with ballast systems in common usage documented under U.S. law are eligible to participate in demonstrations. Priority in

selecting technologies and practices to demonstrate shall be given to those identified as promising in a NRC Marine Board study. The results of the demonstration project shall be presented to Congress within 3 years.

Section 1201: Establishment of Task Force. The Chesapeake Bay Program and the San Francisco Bay-Delta Estuary Program shall have official designees on the Aquatic Nuisance Species Task Force.

Section 1202: Aquatic Nuisance Species Program. The Secretary of Transportation shall issue guidelines developed by the Task Force to control the spread of zebra mussels and other aquatic nuisance species via recreational activities, such as boating and fishing, within 1 year. The EPA is authorized \$500,000 over 6 years for research grants to identify methods for controlling the dispersal and spread of invading species. The Department of the Army is authorized to receive \$750,000 over 6 years to identify methods for preventing and reducing the dispersal of nonindigenous species through the Chicago Shipping and Sanitary Canal into the Mississippi River drainage.

Section 1203: Regional Coordination. Regional panels are encouraged to form and participate in activities to control introduction of aquatic nuisance species. A Western Regional Panel will identify priorities and make recommendations on an education, monitoring, prevention and control program to prevent the spread of aquatic nuisance species to the Western region. The Department of the Interior is authorized to receive \$0.3 million/year for 6 years to fund regional panels.

Section 1204: State or Interstate Invasive Species Management Plans. Invasive species management plans may be prepared by state, interstate, or Indian tribal governments for technical, enforcement, or financial assistance to reduce the risk of nonindigenous species invasions. The Department of Interior is authorized to receive \$4 million/year for 6 years for state management plans.

The Plant Protection Act of 2000 (amending the Noxious Weed Act of 1974)

The Plant Protection Act gives the U.S. Department of Agriculture (USDA) Animal and Plant Health Inspection Service (APHIS) the authority to prohibit the import and interstate transport of species included on the Noxious Weed List developed by the USDA. In cooperation with state agricultural departments, APHIS annually designates priority agricultural pest species for annual intensive monitoring efforts.

Organic Act (1944)

Gives APHIS the authority to conduct pest eradication programs.

The Federal Seed Act of 1939 (and amendments)

This act prohibits the importation of seeds of unknown type and origin by ensuring the purity and proper labeling of seed imports.

The Lacey Act of 1900 (and amendments)

The Lacey Act establishes a permitting process administered by the U.S. Fish and Wildlife Service regulating the importation and transport of vertebrates, mollusks, and crustacea that are "injurious to human beings, to the interests of agriculture, horticulture, forestry, or to wildlife or the wildlife resources of the United States." The Secretary of the Interior maintains the Injurious Species List.

Estuary, Coastal, and Marine Zones

This order establishes the National Invasive Species Council (NISC), a federal interagency organization charged with the biennial development of a National Invasive Species Management Plan. The first National Management Plan was issued in 2001 and followed by progress reports on the implementation of the plan in 2003 and 2005. The National Invasive Species Council is responsible for providing national leadership regarding both terrestrial and aquatic invasive species. The order is included in Appendix C.

Fish and Wildlife

Most of the following statutes were not promulgated primarily to address aquatic invasive species, rather they contain provisions that authorize actions to prevent their introduction, or to control or eradicate them if possible. Many of these laws pre-date NANPCA and tend to address the interstate and international transport of known pest plants and animals to protect horticultural, aquacultural, or endangered species. Others primarily address habitat restoration, but contain provisions to manage aquatic invasive species. Still others are intended to address broader topics such as natural resource protection.

North American Wetlands Conservation Act of 1989

Signed by President Bush, the North American Wetlands Conservation Act of 1989 (16 U.S.C. 4401-4413 (Supp. 1991)) encouraged partnerships among federal agencies and others to protect, restore, enhance, and manage wetlands, and other habitats for migratory birds, fish and wildlife. The act obligates annual appropriations for the implementation of the North American Waterfowl Management Plan, which was signed by the United States and Canada (and endorsed by Mexico) to provide a broad framework for waterfowl conservation and management in North America.

Federal Aid in Wildlife Restoration Act of 1937

The Federal Aid in Wildlife Restoration Act of 1937 (16 U.S.C. 669 et seq. (1985 and Supp. 1991)), which is also known as the Pittman-Robertson Act), provides federal aid to states for wildlife restoration work. Funds from an excise tax on sporting arms and ammunition are provided to States on a matching basis for land acquisition, development, and management projects.

Fish and Wildlife Coordination Act of 1985

The Fish and Wildlife Coordination Act of 1985 (16 U.S.C. 661-668 (Supp.1991)) established guidelines for consultation between the U.S. Fish and Wildlife Service and the U.S. Army Corps of Engineers. Mitigation measures are also identified to prevent the loss of, or damage to, wildlife resources from permitted activity. The purpose of this act is to provide fish and wildlife resources "equal consideration" with other features of water resource development programs.

Anadromous Fish Conservation Act of 1965

The Anadromous Fish Conservation Act of 1965 (16 U.S.C. 757a et seq. (Supp. 1965)) authorizes the Secretary of the Interior to cooperate with the states in conserving, developing, and enhancing the Nation's anadromous fisheries resources. The act

authorizes research, construction, and maintenance of hatcheries and of structures to improve feeding and spawning conditions, and to facilitate the free migration of fish.

Federal Aid In Sport Fish Restoration Act of 1950

The Federal Aid in Sport Fish Restoration Act of 1950 (16 U.S.C. 777a-77771 (1985 and Supp. 1991)) provides federal aid to states in sport fishing restoration work. Also known as the Dingell-Johnson Act, this legislation is funded by excise taxes on fishing equipment, import duties on fishing tackle and pleasure boats, and a portion of a tax on motorboat fuels.

Estuaries and Clean Water Act of 2000

President Clinton signed this legislation to protect estuaries. It establishes an Estuary Habitat Restoration Council that is responsible for developing a National Habitat Restoration Strategy within one year and for reviewing and establishing funding priorities among restoration projects. The goal is to promote a comprehensive approach to the selection and prioritization of estuary habitat restoration projects and the coordination of federal and non-federal restoration activities. The legislation also reauthorizes the National Estuary Program and other federal estuary programs. President George W. Bush is now responsible for appropriations and implementation of the Act.

Magnuson-Stevenson Fisheries Management and Conservation Act of 1996

Originally introduced in 1956, this legislation (16 U.S.C. 1801 et seq.) has been amended multiple times and was most recently reauthorized in 2000. The Magnuson-Stevenson Act governs fishing in all United States waters throughout the U.S. Exclusive Economic Zone (to 200 miles). The purpose of the Act is to promote conservation and sound management of commercial and recreational fishing resources. It covers all species of marine animals and plants, including anadromous fish, except for marine mammals, birds, and highly migratory species, all of which are covered under other laws or treaties.

Coastal Wetlands Planning Protection and Restoration Act of 1990

The Coastal Wetlands Planning Protection and Restoration Act of 1990 (16 U.S.C. 3951-3956 (Supp. 1991)) authorizes the U.S. Fish and Wildlife Service to make matching National Coastal Wetlands Conservation grants to coastal states for acquiring, managing, restoring, or enhancing wetlands. Priority is given to projects that are consistent with the National Wetlands Priority Conservation Plan and that are in states with dedicated funding programs for the acquisition of coastal wetlands, natural areas, and open spaces.

Coastal Zone Management Act of 1972

The Coastal Zone Management Act (CZMA) of 1972 (16 U.S.C. 1451-1464), and subsequent amendments (1985 and Supp. 1991), makes federal funds available to encourage states to develop coastal zone management plans which would provide for conservation and environmentally sound development of coastal resources. The purpose of the CZMA is to "preserve, protect, develop, and where possible, to restore or enhance the resources of the Nation's coastal zone for this and succeeding generations."

Estuary Protection Act of 1968

The Estuary (Estuarine) Protection Act of 1968 (PL 90-454, as amended et seq. 16 U.S.C. 1221 et seq.) established congressional policy on values of estuaries and the need to conserve their natural resources. The purpose of the act is to provide a means to protect, conserve, and restore estuaries in a manner that "adequately and reasonably" maintains a balance between the national need for protecting and conserving natural resources and natural beauty and the need to develop estuaries to further the growth and development of the nation.

Park System Resources Protection Act

The Park System Resources Protection Act (16 U.S.C. 19jj) requires the Secretary of the Interior to assess and monitor injuries to park system resources. The act specifically allows the Secretary to recover response costs and damages from the responsible party causing the destruction, loss of or injury to park system resources. It provides that any monies recovered by the National Park Service may be used to reimburse the costs of response and damage assessment and to restore, replace, or acquire the equivalent of the injured resources.

Title 33: Navigation and Navigable Waters, Part 151

Vessels Carrying Oil, Noxious Liquid Substances, Garbage, Municipal or Commercial Waste, and Ballast Water, specifically address ballast water under Subpart D, "Ballast Water Management for Control of Nonindigenous Species in Waters of the United States." The regulations (1) require vessels to maintain a ballast water management plan that is specific for that vessel; (2) require vessels to submit ballast water reporting forms; and (3) assigns responsibility to the master or appropriate official to understand and execute the ballast water management strategy for that vessel. This applies to vessels that carry ballast water that was taken on in areas less than 200 nautical miles from any shore into the waters of the U.S. after operating beyond the exclusive economic zone. Ballast water management strategies are: complete ballast water exchange in an area no less than 200 nm from any shore, retaining ballast on board the vessel, or using an environmentally sound method of ballast water management that has been approved by the U.S. Coast Guard. Vessels with no declarable ballast on board (NOBOB) and vessels engaged in coastwise trade are exempt from mandatory ballast water management

Agreement on the Application of Sanitary and Phytosanitary Measures

(SPS Agreement 1995). This is a supplementary agreement to the World Trade Organization Agreement. The agreement provides a uniform interpretation of the measures governing safety and plant and animal health regulations. Applicable to all sanitary and Phytosanitary measures directly or indirectly affecting international trade. Sanitary and Phytosanitary measures are defined as any measure applied a) to protect animal or plant life or health within (a Members' Territory) from entry, establishment or spread of pests, diseases, disease carrying organisms; e) to prevent or limit other damage within the (Members Territory) from the entry, establishment or spread of pests (annex A).

Rhode Island Regulatory Programs – Further Detail

CRMC regulations related to AIS

Biosecurity Board recommendations for shellfish seed regulations in RI

The following are recommendations that the CRMC Bio Security Board are suggesting to govern the importation of shellfish seed into the State of Rhode Island. Public law 353 was enacted

The Bio Security Board has communicated via e-mail, and met to finalize these recommendations at a meeting at the CRMC offices on June 9th, 2003.

The recommendations are:

- 1) The US shall be divided into three regions for the purposes of defining levels of stringency for importation. The regions will be defined as: Region 1, to include the states from Maine to Virginia, inclusive. Region 2 shall be defined as the region including the Atlantic coast of Florida, from Key West, to the northern border of North Carolina. Region 3 shall be all remaining parts of the US including Hawaii and Alaska. International importation shall be governed by the guidelines contained in the “International Aquatic Animal health Code (OIE-World organization for Animal Health)” and each international importation of shellfish seed into the State of Rhode Island shall be considered on a case-by-case basis by the CRMC Bio Security Board.
- 2) Importation from Region 1 (the area from Maine to Virginia) shall meet the following requirements:
 - a) A pathology report from a recognized aquatic health pathologist shall be required.
 - b) The pathology report shall follow generally accepted protocols for disease diagnosis.
 - c) The report shall investigate the presence of pathogens that are defined by the CRMC Bio Security Board.
- 3) Importation from Region 2 shall meet the following requirements:
 - a) All of the requirements listed for Region 1.
 - b) Permission from the CRMC Bio Security Board is required for each individual importation.
- 4) Importation from Region 3 shall meet the following requirements:
 - a) All of the requirements listed for Region 2.
 - b) All seed lots shall be treated in the following manner:
 - 1) Place on a screen and rinse (hose) with fresh tap water
 - 2) Slosh up and down for several minutes in a bleach solution

3) Place seed clams in seawater with food (so they will pump and clear their guts and mantle cavities - could be running seawater or artificial food). Then treat effluent - or dump on land.

4) Repeat 2)

5) Repeat 1).

c) Shellfish seed from any one particular hatchery will be required to perform testing for a single 3 year period beginning when seed from that hatchery is first imported into the state. The testing shall follow the following protocol:

1) Twice yearly (spring and fall) a pathology test shall be conducted on the year class seed. The CRMC Bio Security Board shall define pathogens of interest and protocols to be used.

2) The testing shall be paid for by the hatchery or the grower as part of the requirements for importation.

3) The CRMC Bio Security Board will determine sites to be tested and if there will be a limited introduction from any particular hatchery until the 3 year testing period has passed.

d) The CRMC Bio Security Board shall set any other specific requirements for importation based on specifics of any specific importation request (for example, but not limited to, hatcheries utilizing polyculture, any specific disease endemic to a area the hatchery is located in, etc.).

Regulations to prevent the introduction of AIS via aquaculture operations include:

300.11.C Prerequisites

10. Applicants who propose to introduce non-indigenous species into an aquaculture setting are required to design a protocol that will be reviewed by the Bio-Security Board prior to issuance of an assent. This review can occur concurrently with the aquaculture application process.

300.11.E Prohibitions

4. Introduction of non-indigenous species is prohibited unless protocols are in place to ensure that no accidental releases into the state's waters can occur. These protocols will be reviewed by the CRMC Bio-Security Board before any permit is issued. Any proposed modifications to the permitted operation will be reviewed by the Bio-Security Board before an assent modification can be issued. The issuance of a permit under these stipulations can be revoked if a release of non-indigenous species takes place during the term of the assent.

Regarding construction activities, under its rules for insignificant alterations in Appendix 1 of its freshwater wetlands regulations, the CRMC addresses aquatic invasive species at Section C (4) (d) as follows:

4) Minor excavated pond construction (less than one-quarter (1/4) acre for new ponds and re-excavation for existing ponds) only where:

(a) The pond is located mostly adjacent to, or only partially in, any swamp, marsh, or other emergent, shrub or forested wetland;

(b) All spoils from excavation are removed to an upland location away from all wetland, area(s) of land within fifty (50) feet, riverbank, and flood plains;

(c) The construction or re-excavation does not result in the diversion, damming, or diking of any type of watercourse other than surface seepage from groundwater discharges;

(d) Re-excavation of an area less than 2,500 square feet of existing pond is accomplished for maintenance purposes to remove accumulated inorganic sediments or concentrated areas of problem emergents or aquatic weeds such as tall reed (*Phragmites australis*) or purple loosestrife (*Lythrum salicaria*). The excavation must be limited to concentrated problem areas and must incorporate all proper controls to protect the adjacent wetland, area(s) of land within fifty (50) feet, riverbank, and flood plain environment; and

(e) The activity does not result in the loss of the only natural vegetated area adjacent to a swamp, marsh, or other emergent, shrub or forested wetland. Such projects must either incorporate the use of a well-designed buffer zone to minimize impacts to wildlife, or be sufficiently away from human activity so as to minimize interaction between humans and wildlife.

Appendix E

Grant Programs Applicable to Aquatic Invasive Species

NATIONAL PROGRAMS

Partners for Fish and Wildlife Program

Sponsor Agency: United States Fish and Wildlife Service

Contact: Steve Hill 413-253-8614 <http://grants.fws.gov>

Eligibility: Private land owners

Overview: Offers technical and financial assistance for the voluntary restoration of wetlands and other fish and wildlife habitats on private land. Enhances reestablishment of native vegetation and ecological communities for benefit of fish and wildlife in concert with the needs and desires of private landowners.

Range of Funding: N/A

Cost Sharing: Yes, 50/50 local sharing

Deadline: N/A

Partnership for Wildlife

Sponsor Agency: United States Fish and Wildlife Service

Contact: Gary Reinitz Gary_reinitz@fws.gov

Eligibility: State Agencies

Overview: To provide grants to state projects that benefit a variety of fish and wildlife species and/or encourage non-consumption fish and wildlife recreation opportunities.

Range of Funding: FY00 \$768,000 available

Cost Sharing: none

Deadline: N/A

Regional Geographic Initiative

Sponsor Agency: US Environmental Protection Agency

Contact: Deb Harsted 617-918-1085 www.epa.gov/regional/rgi.htm

Eligibility: Contact Deb Harsted

Overview: Provides up to four years of “seed money” for projects that address a high human health or ecosystem risk (such as those associated with aquatic invasive species) and have significant potential for risk reduction. These projects will focus on a place rather than a pollutant.

Range of Funding: N/A

Cost Sharing: none

Deadline: All stages of the process normally take place between October and January.

USDA NRCS Farm Bill Programs

The Grassland Reserve Program (GSO) helps landowners restore and protect grassland, rangeland, pastureland, shrubland and certain other lands and provides assistance for rehabilitating grasslands.

Wetlands Reserve Program

Sponsor Agency: U.S. Dept. of Agriculture, Natural Resource Conservation Service

Contact: Joseph Bachand

Eligibility: State, private, association, any legal entity that has owned the land for at least one year.

Overview: This is a voluntary program to provide financial incentives to restore and protect wetlands in exchange for retiring marginal agricultural land. Landowners may sell a conservation easement or enter into a cost-share restoration agreement. Landowners voluntarily limit future use of the land, but retain private ownership. Landowners and the NRCS develop a plan for the restoration and maintenance of the wetland. This restoration may include the control and prevention of invasive species.

Funding: Based on acreage, not funding levels;

Cost Sharing: USDA will provide 75% unless owner opts for permanent easement, in which case the USDA purchases the land

Deadline: Continuous sign-up

The Wildlife Habitat Incentives Program (WHIP) provides financial incentives to develop habitat for fish and wildlife on private lands. The objective of Rhode Island's WHIP program is to enhance and restore native wildlife habitats that have been degraded, altered, or eliminated as a result of agriculture, urban & residential development, and changes in land use. The focus of this program is to restore habitat types that have been identified by existing local, state, and federal restoration planning initiatives and NRCS partnerships. These habitats include:

Coastal Habitats (Anadromous/Catadromous Fish Runs, Coastal marshes, and Eelgrass meadows)

Freshwater Wetlands, Vernal Pools & Riparian Habitats (including urban rivers and floodplain buffers)

Upland Habitats of State significance-Early successional habitats- (such as warm season grasslands, early successional forest and shrub-scrub habitat) and Oak/pitch pine barrens, and unfragmented interior forest

The Environmental Quality Incentives Program (EQIP) addresses locally identified problems with natural resources. EQIP offers agricultural producers incentive payments and cost sharing for conservation practices, such as manure management systems, pest management, erosion control, and other practices to improve and maintain the health of natural resources.

The Conservation Security Program (CSP) provides financial and technical assistance to promote the conservation and improvement of soil, water, air, energy, plant and animal life, and other conservation purposes on Tribal and private working lands

Conservation Innovation Grants: Conservation Innovation Grants (CIG) is a voluntary program intended to stimulate the development and adoption of innovative conservation approaches and technologies while leveraging Federal investment in environmental enhancement and protection, in conjunction with agricultural production. Under CIG, Environmental Quality Incentives Program funds are used to award competitive grants to

non-Federal governmental or non-governmental organizations, Tribes, or individuals. CIG enables NRCS to work with other public and private entities to accelerate technology transfer and adoption of promising technologies and approaches to address some of the Nation's most pressing natural resource concerns. Conservation Innovation Grants will benefit agricultural producers by providing more options for environmental enhancement and compliance with Federal, State, and local regulations. The Natural Resource Conservation Service administers CIG. For further information please go to <http://www.nrcs.usda.gov/programs/cig/>.

North American Wetlands Conservation Grants

Sponsor Agency: U.S. Fish and Wildlife Services

Contact: Regional: Andrew Milliken, andrew_milliken@fws.gov

National: Bettina Sparrowe, Bettina_sparrowe@fws.gov (Standard Grants)

Keith Morehouse, keith_morehouse@fws.gov (Small Grants)

Eligibility: Any individual or group

Overview: Provides assistance for long-term conservation efforts directed toward wetlands through habitat protection, restoration, or enhancement. The purpose of the grant is to encourage voluntary, public-private partnerships to conserve wetland ecosystems. Originally established to help support the North American Waterfowl Management Plan so many of the approved projects involved bird habitat preservation. Applicants working with invasive species may want to highlight the importance of native species in habitat restoration.

Range of Funding: Standard: up to one million

Small Grants: Up to \$50,000.00

Cost Sharing: 50/50 split, cost sharing

Coastal Wetlands Planning, Protection, and Restoration Act Program

Sponsor Agency: U.S. Fish and Wildlife Services

Contact: Sue Essig, 413-253-8611 sue_essig@fws.gov

300 Westgate Center Dr.

Hadley, MA 01035-9589

Eligibility: Coastal states including the lake region, Guam, US Virgin Islands, Puerto Rico, Commonwealth of the Northern Mariana Islands, the Trust Territories of the Pacific Islands, and America Samoa

Overview: Provides funds to assist in pursuing coastal wetland conservation projects. Funds can be used for acquisition of lands or waters and for restoration, enhancement or management of coastal wetland ecosystem. Programs will provide for long-term conservation of such lands and their hydrology, water quality and fish and wildlife.

Funding: FY00 \$11.8 million

Cost Sharing: Grant will provide between 50-75%

Aquatic Resource Education

Sponsor Agency: United States Fish and Wildlife Service

Contact: Gary_reinitz@fws.gov

Eligibility: State agencies

Overview: Through the Sport Fishing Restoration Act, states are reimbursed for aquatic resource education programs with budgets that do not exceed 15% of the total state sport fishing restoration funds.

Funding: The Sport Fishing Restoration funds come from taxes on fishing equipment and motor boat fuel taxes.

Cost Sharing: States must contribute any amount above the amount available through the Sport Fishing Restoration Funds.

Deadline: Ongoing

Wetlands Program Development Grants

Sponsor Agency: US Environmental Protection Agency

Contact: Stafford Madison Madison.Stafford@epa.gov

www.epa.gov/owow/watershed/academy/fund/wetlandsp.htm

Eligibility: States, tribes, local governments, intergovernmental organizations

Overview: Provides financial assistance to support development of new, or augmentation and enhancement of existing wetland programs. Projects must clearly demonstrate a direct link to an increase in the participant's ability to protect its wetland resources.

Funding: FY00 \$15 million

Cost Sharing: Grant will provide 75%

Deadline: Varies

Bring Back the Natives Grant Program

Sponsor Agency: National Fish and Wildlife Foundation

Contact: www.nfwf.org/programs.htm

Northeast Region contact: Eric Hammerling (202) 857-6166 hammerling@nfwf.org

Eligibility: Local governments, states, and local nonprofit organizations

Overview: Assists in restoring damaged or degraded riverine habitats and their native aquatic species through watershed restoration and improved land management.

Funding: FY00 \$4.5 million

Cost Sharing: No

Deadline: None, applications accepted through the year

Five Star Restoration Program

Sponsor Agency: US Environmental Protection Agency

Contact: US EPA Office of Wetlands, Oceans and Watersheds

202-260-8076

pai.john@epa.gov

Eligibility: Any public or private entity that engages in community based restoration

Overview: EPA provides funds to four intermediary organizations, the National Association of Counties, the National Fish and Wildlife Foundation, the Wildlife Habitat Council and the National Association of Service and Conservation Corps. These agencies then administer sub grants to support community-based wetland and riparian restoration projects that emphasize long term ecological, educational, and/or socio-economical benefits to a watershed. Projects must include multiple partners (volunteer groups, corporations, private landowners, government, nonprofits, etc.).

Cost Sharing: No, information and technical support exchange necessary.

Deadline: January/ February

Watershed Assistance Grants

Sponsor Agency: U.S. Environmental Protection Agency

Contact: Office of Wetlands, Oceans and Watersheds

Ariel Rios Bldg.

1200 Pennsylvania Ave., NW

Washington, DC 20460

202-260-4538

Cole.james@epa.gov

Eligibility: Nonprofits, tribes, local governments

Overview: Funds are provided to support organizational development and capacity building for watershed partnerships with diverse membership. The EPA establishes a relationship with one or more eligible entities to support watershed partnership, organizational development and long term effectiveness.

Funding: Maximum funds for one partnership: \$30,000.00

Cost Sharing: Match is encouraged but not required

Deadline: Varies

Community-Based Restoration Program

Sponsor Agency: National Oceanic and Atmospheric Administration

Contact: US Department of Commerce

National Oceanic and Atmospheric Administration

Office of Habitat Conservation, FHC3

1315 East-West Highway

Silver Spring, MD 20910

301-713-0174

chris.doley@noaa.gov

Eligibility: State, territorial, local, or tribal governments; regional governmental bodies; public or private agencies or organizations; universities and colleges; private and nonprofit organizations

Overview: Provides funds for small-scale, locally driven habitat restoration projects that foster natural resource stewardship within communities. Partnerships are sought at the national and local level to contribute funding, land, technical assistance, workforce support, or other in-kind services. The program emphasizes the use of a grassroots, bottom-up approach to restoring fishery habitat across coastal America.

Funding: FY00 up to \$ 2 million

Cost Sharing: Grants are cooperative agreements, no set cost-sharing ratio

Deadline: As posted on the NOAA web site

Federal Aid in Wildlife Restoration

Sponsor Agency: U.S. Fish and Wildlife Service

Contact: The Division of Federal Aid

Fw9_Federal_Aid@fws.gov

Eligibility: State agencies

Overview: Distributed to states to provide funding for the selection, restoration, information produced by these projects. "Teaming with Wildlife" is one of the Wildlife Restoration programs that may be applicable for invasive species work.

Funding: Funds are derived from an 11 percent federal tax on sport hunting guns, ammunition, and archery equipment and a 10 percent tax on handguns. The amount each state receives is determined by a formula considering the total area of the state and the number of licensed hunters in that state. The state covers the full cost of any approved project and then applies for reimbursement through Federal Aid.

Cost Sharing: State must provide 25%, Federal will support 75%

Deadline: Program dependant, email above address for details

Challenge Grants

Sponsor Agency: National Fish and Wildlife Foundation

Contact: Eric Hammerling

hammerling@nfwf.org

Eligibility: Federal, state, and local governments, educational institutions, nonprofit organizations

Overview: Awards funds for projects that promote species and habitat conservation that involve multiple community partners and have an evaluation component to project outcomes.

Funding: Most awards are between \$25,000-\$75,000 with some small grants and some over \$150,000

Cost Sharing: Non-federal dollars or goods and services of equal value must match each dollar awarded. Participants are encouraged to achieve at least a 2:1 ratio for each federal dollar.

Deadline: Revolving application process with Board of Directors decisions made October 31 and March 31

Pulling Together Initiative

Sponsor Agency: National Fish and Wildlife Foundation

Contact: Gary Kania 202-857-0166

kania@nfwf.org

Eligibility: Federal agencies, state and local governments, private landowners

Overview: Provides funds supporting partnerships in developing long-term weed management projects within the scope of integrated pest management strategy.

The goals of the initiative are to (1) prevent, manage or eradicate invasive and noxious plants through a coordinate program of public/private partnerships; and (2) increase public awareness of the adverse impacts of invasive and noxious plants.

Funding: Contact Gary Kania

Cost Sharing: Yes, federal money must be matched by state, local or private funds

Deadline: Contact Gary Kania

Coastal Ocean Programs

Sponsor Agencies: U.S. Department of Commerce

Center for Sponsored Coastal Ocean Research/Coastal Ocean Program

(CSCOR/COP), National Ocean Service (NOS), National Oceanic and Atmospheric Administration (NOAA)

Contact: Leslie McDonald 301-713-3338 ex. 137

CSCOR/COP Grants Administrator

Eligibility: All qualified non-federal and federal researchers. Participants must be affiliated with a non-profit institution.

Overview: Provides predictive capability for managing coastal ecosystems through sponsorship of research. COP supports research on issues critical to estuaries, coastal waters, and Great Lakes and translates findings into accessible information.

Funding: Average between \$5,000-500,000

FY00 \$8.5 million

Cost Sharing: No cost sharing requirements

Deadline: Check specific funding announcements

RESEARCH GRANTS

MIT Sea Grant Request for Proposals

Sponsor Agencies: MIT Sea Grant Program

Contact: Richard Morris 617-252-7042

rgmorris@mit.edu

Eligibility: Faculty and senior researchers at universities and colleges and senior researchers at non-profit organizations

Overview: Solicitation for proposals that address the research needs identified by MIT Sea Grant in the following four themes: 1) Coastal Management and Utilization; 2) Coupled Ocean Observing and Modeling; 3) Marine Biotechnology; and 4) Technical Development. This includes proposals for regional projects and the Advisory Services and Educational Program.

Funding: Maximum annual funding per research project: \$75,000. Maximum annual funding for education and outreach projects: \$25,000

Sharing: 50/50

Aquatic Nuisance Species Research and Outreach

Sponsor Agencies: National Sea Grant Program, National Oceanic and Atmospheric Administration, U.S. Department of Commerce

Contact: Leon M. Cammen, Aquatic Nuisance Species Coordinator, National Sea Grant College Program, NOAA

1315 East-West Highway

Silver Spring, MD 20910

Or contact local program director

MIT Sea Grant Director:

Chryssostomos Chryssostomosidis

chrys@deslab.mit.edu

Eligibility: Any individual, public or private corporation or partnership or other association or entities (including institutions of higher education, institutes, non-federal laboratories), or any State or political subdivision of the state or agency.

Overview: Provides support to projects to prevent and/or control nonindigenous species invasions in all US marine waters, the Great Lakes, and Lake Champlain. Projects will be selected through national competitions.

Improved Methods for Ballast Water Treatment and Management and Prevention of Small Boat Transport of Invasive Species

Sponsor Agencies: National Sea Grant Program, National Oceanic and Atmospheric Administration, U.S. Department of Commerce and U.S. Fish and Wildlife Services, U.S. Department of the Interior

Contact: Dr. Leon Cammen 301-713-2435x136

leon.cammen@noaa.gov

www.nsgo.seagrant.org/research/nonindigenous/RFP00.html

Eligibility: Any person may apply. Applications from non-federal and eligible federal applicants will be competed against each other. Non-federal applicants will be funded through a project grant or cooperative agreements and federal agencies will be funded through an inter-agency transfer.

Overview: Provide support to projects to improve ballast water treatment and management in the Chesapeake Bay and Great Lakes in particular (Sea Grant) and in US coastal and Great Lakes waters in general (Service). Also to support projects to reduce the transport of invasive species by small boats.

Biology of Weedy and Invasive Plants

Sponsor Agency: NRI, Cooperative State Research, Education and Extension Service, Department of Agriculture

Contact: Program Director 202-401-6466

apark@reeusda.gov

Eligibility: Anyone

Overview: Provides support to research that leads to an improved understanding of the extent of genetic and phenotypic diversity within and between plant populations, species composition within a community, and or species competitiveness and invasiveness. The program also supports proposals aimed at understanding plant population dynamics and interactions between agricultural settings and lands of conservation. Support will also be given to development of new methods of controlling the spread weeds or invasive plants.

Appendix F

Summary of Research Activities

General

James T. Carlton
Williams College
jcarlton@williams.edu

Dr. Carlton has worked extensively on aquatic invasive species in New England and around the world. His publications and accomplishments cover a wide range of expertise, focusing on dispersal vectors, ecological and evolutionary impacts, community structure, and management and prevention issues relevant to aquatic invasive species. Currently, he is working with L. David Smith, Shannon Willard, and Judith Pederson on an investigation into the transport vectors of New England. He is the founding editor in Chief of the new international journal *Biological Invasions* and was Co-Chair of the Marine Biodiversity Committee of the National Academy of Sciences, which produced *Understanding Marine Biodiversity: A Research Agenda for the Nation* (1995).

Carlton is a member of the Steering Committee of the U.N. Global Invasive Species Program (GISP), and was Chair from 1991 to 2000 of the Working Group on Introductions and Transfers of Marine Organisms of the International Council for the Exploration of the Sea (ICES). He has testified five times on introduced species issues before Senate and House subcommittees, and was Principal Investigator of the "Shipping Study" mandated under 1990 federal law. In April 1999 Dr. Carlton was the first scientist to receive the U.S. Government's interagency Recognition Award for Significant and Sustained Contributions to the Prevention and Control of Nonindigenous Species in America's Aquatic Ecosystem.

Representative Publications:

Carlton, J.T., and J.B. Geller. 1993. Ecological roulette: The global transport of nonindigenous marine organisms. *Science* 261:78–82

Carlton, J.T. 1996. Marine bioinvasions: the alteration of marine ecosystems by nonindigenous species. *Oceanography* 9:36–43

Carlton, J.T. 1996. Pattern, process, and prediction in marine invasion ecology. *Biological Conservation* 78:97–106

Grateloupia

Martine Villalard-Bohnsack
Roger Williams University
mwillbohns@adelphia.net

Martine Villalard-Bohnsack focuses on two aspects of the *Grateloupia doryphora* invasion in Rhode Island waters. The first, in collaboration with Marilyn Harlin (University of Rhode Island) involves studies on the geographical spread of the species, morphological variations in relation to environmental factors, recruitment strategies, development and ecological impacts of the invasion. The second investigation's focus, conducted with Marcie Marston (Roger Williams University), explored the source of the Rhode Island *Grateloupia* and genetic variation within the species. The taxonomy of *G. doryphora* is also being examined in conjunction with Marc Verlaque (University of Marseille, France).

Representative Publications:

Villalard-Bohnsack, M., and M. Harlin. 1997. The appearance of *Grateloupia doryphora* on the northeast coast of North America. *Phycologia* 36(4): 324–328.

Villalard-Bohnsack, M., and M. Marston. 2000. The Molecular Genetics to investigate the geographic origin and vector of invasive red algae. J. Pederson (ed.). *Marine Bioinvasions: Proceedings of the First National Conference*. MIT Sea Grant, Cambridge, MA.

Marcie Marston
Roger Williams University
mfm@alpha.rwu.edu

Marcie Marston is a molecular biologist and geneticist focused on the genetic diversity and origin of the Rhode Island invasive seaweed, *Grateloupia*. The specific objectives of her project are to analyze and then continue to monitor any changes in the genetic diversity of the *G. doryphora* population in the Narragansett Bay, to identify the geographical origin(s) of the parental stock of the Rhode Island population, and to examine the genetic relationships of *Grateloupia* species from locations around the world. DNA have been isolated from over 50 individuals representing all 14 locations and this genetic information is being used to construct phylogenetic trees to examine the relationships among individuals and to try to identify the geographic origin of the Rhode Island population. The data of Marcie Marston and her coworker suggests that there is an “invasive” genotype/species of *Grateloupia* that has been expanding in range and it appears as though the Rhode Island species originated from one of the European populations.

Representative Publications:

Marston, M.F., and M. Villalard-Bohnsack. Genetic variability and possible geographic origins of an invasive species, *Grateloupia doryphora* (Halymeniaceae, Rhodophyta) in Rhode Island, USA. To be submitted to the *Journal of Phycology* (in prep)

Marston, M.F., and M. Villalard-Bohnsack. 2000. The use of molecular genetics to investigate the geographic origin of an invasive red algae. J. Pederson (ed.). *Marine Bioinvasions. Proceedings from the First National Conference*. MIT Sea Grant, Cambridge, MA.

Green Crab

Phragmites

Laura Meyerson

Dr. Laura Meyerson is an Assistant Professor of Habitat Restoration Ecology at the University of Rhode Island. Her research includes the ecosystem-level effects of *Phragmites* on marsh ecosystem, competition with native species and the potential for cross-breeding of introduced *Phragmites* with native *Phragmites*.

Meyerson, L.A., K. Saltonstall, R.M. Chambers. In press (Invited). *Phragmites australis* in eastern North America: a historical and ecological perspective. In Anthropogenic Modification of North American Salt Marshes, B.R. Silliman, M.D. Bertness, and D. Strong (eds.).

Farnsworth, E. J., and L.A. Meyerson. 2003. Comparative ecophysiology of four wetland plant species along a continuum of invasiveness. *Wetlands* 23(4): 750–762.

Meyerson, L.A. 2000. Ecosystem-level effects of Invasive species: A *Phragmites* case study in two freshwater tidal marsh ecosystems on the Connecticut River. Doctoral Thesis, Yale University, New Haven, CT.

Meyerson, L.A., K.A. Vogt, and R.M. Chambers. 2000. Linking the success of *Phragmites australis* to the decoupling of ecosystem nutrient cycles. In Concepts and Controversies of Tidal Marsh Ecology, (M. Weinstein and D. Kreeger, Eds.). Kluwer pp. 817–834.

Meyerson, L.A., K. Saltonstall, L. Windham, E. Kiviat, and S. Findlay. 2000. A Comparison of *Phragmites australis* in freshwater and brackish marsh environments in North America. *Wetlands Ecology and Management* 8(2/3):89–103.

Meyerson, L.A., R.M. Chambers and K.A. Vogt. 1999. The Effects of *Phragmites* Removal on Nutrient Pools in a Freshwater Tidal Marsh Ecosystem. *Biological Invasions* 1(2/3):129–136.

Farnsworth, E. J., and L. A. Meyerson. 1999. Species composition and inter-annual dynamics of a freshwater tidal plant community following removal of the invasive grass, *Phragmites australis*. *Biological Invasions* 1(2/3):115–127.

Lisa Drake
U.S. Coast Guard Academy
lisa.a.drake@uscg.mil

Dr. Drake is a Lecturer in Marine Science at the U.S. Coast Guard Academy. Her invasive species research focuses on the microbial ecology of ballast water, sediments, and biofilms; marine policy with respect to ship-borne invasive species.

Representative Publications:

Drake LA, M.A. Doblin, F.C. Dobbs. In press (Invited). Potential microbial bioinvasions via ships' ballast water, sediment, and biofilm. *Marine Pollution Bulletin*.

Drake LA, G.M. Ruiz, B.S. Galil, T.L. Mullady, D.O. Friedmann and F.C. Dobbs 2002. Microbial ecology of ballast water during a trans-oceanic voyage. *Marine Ecology Progress Series* 233: 13-20. <http://www.int-res.com/abstracts/meps/v233/p13-20.html>

Drake LA, Choi K-H, G.M. Ruiz and F.C. Dobbs. 2001. Global redistribution of bacterioplankton and virioplankton communities. *Biological Invasions* 3: 193-199.

Ruiz GM, T.K. Rawlings, F.C. Dobbs, L.A. Drake, T. Mullady, A. Huq and R.R. Colwell. 2000. Global spread of microorganisms by ships. *Nature* 408: 49-50.

Appendix G

Rhode Island list of Aquatic Invasive Species

DRAFT List of Non-native Aquatic Species Located in or near RI

Developed by Rhode Island Natural History Survey, April 2007, for the RI Aquatic Invasive Species Working Group
Please comment to dgregg@rinhs.org

Kingdom	division/phylum	class	order	family	Family Common Name	Scientific Name	Common Name	Invasive Status	Nativity	RI Status	RIISC Status	Other State	References
Animalia						Alphaproteo bacter	[juvenile oyst. disease]		Unknown	Unknown	Not assessed	ME	r1,
Animalia	Annelida	Polychaeta	Aciculata	Polynoidae	Scale Worms	Harmothoe imbricata (Linnaeus, 1769)			Cryptogenic	Unknown	Not assessed		r14,r22,
Animalia	Annelida	Polychaeta	Aciculata	Polynoidae	Scale Worms	Lepidonotus squamatus (Linnaeus, 1767)		Unknown	Unknown	Unknown	Not assessed		r14,r22,
Animalia	Annelida	Polychaeta	Canalipalpata	Serpulidae	Plume Worms	Janua pagenstecheri (Quatrefages, 1865)		Potentially Invasive	Non-Native (NA)	Established	Not assessed		r9,r14,r22,
Animalia	Annelida	Polychaeta	Canalipalpata	Spionidae	Plume Worms	Boccardia proboscidea	Spionid worm		Unknown	Unknown	Not assessed	ME	r9,
Animalia	Arthropoda	Branchiopoda	Diplostraca	Cercopagidae		Bythotrephes cederstroemii Schodler, 1877	Spiny Water Flea		Unknown	Unknown	Not assessed	NY	r1,r25,
Animalia	Arthropoda	Branchiopoda	Diplostraca	Cercopagidae		Cercopagis pengoi (Ostroumov, 1891)	Waterflea, Fishhook		Unknown	Unknown	Not assessed		r1,
Animalia	Arthropoda	Branchiopoda	Diplostraca	Daphniidae		Daphnia lumholzi (SARS, 1885)	Daphnia	Unknown	Non-Native (RI)	Unknown	Not assessed		r1,
Animalia	Arthropoda	Malacostraca	Amphipoda	Aoridae		Microdeutopus gryllotalpa Costa, 1855	Tube-Building Amphipod	Unknown	Unknown	Unknown	Not assessed		r22,
Animalia	Arthropoda	Malacostraca	Amphipoda	Caprellidae		Caprella equilibra Say, 1918	Skeleton Shrimp		Unknown	Unknown	Not assessed		r22,
Animalia	Arthropoda	Malacostraca	Amphipoda	Caprellidae		Caprella mutica Schurin, 1935	Japanese Skeleton Shrimp	Potentially Invasive	Non-Native (NA)	Established	Not assessed		r9,r14,r22,
Animalia	Arthropoda	Malacostraca	Amphipoda	Caprellidae		Caprella penantis Leach, 1814		Unknown	Cryptogenic	Unknown	Not assessed		r22,
Animalia	Arthropoda	Malacostraca	Amphipoda	Caprellidae		Paracaprella tenuis Mayer, 1903		Unknown	Unknown	Unknown	Not assessed		r14,
Animalia	Arthropoda	Malacostraca	Amphipoda	Chelundae		Chelura terebrans Philippi, 1839	Wood-boring amphipod		Unknown	Unknown	Not assessed		r7,
Animalia	Arthropoda	Malacostraca	Amphipoda	Corophiidae		Corophium volutator Pallas, 1766			Unknown	Unknown	Not assessed	ME	r7,r9,
Animalia	Arthropoda	Malacostraca	Amphipoda	Gammaridae		Gammarus daiberi Bousfield, 1989	amphipod		Unknown	Unknown	Not assessed		r22,
Animalia	Arthropoda	Malacostraca	Decapoda	Camboridae	Crayfishes	Orconectes clarkii	Red Swamp Crayfish		Unknown	Unknown	Not assessed	ME	r1,
Animalia	Arthropoda	Malacostraca	Decapoda	Camboridae	Crayfishes	Orconectes obscurus (Hagen, 1870)	Allegheny Crayfish		Unknown	Unknown	Not assessed	ME	r1,
Animalia	Arthropoda	Malacostraca	Decapoda	Camboridae	Crayfishes	Orconectes rusticus (Girard, 1852)	Rusty Crayfish		Unknown	Unknown	Not assessed	ME, NH, VT, MA,	r1,r14,r25,
Animalia	Arthropoda	Malacostraca	Decapoda	Camboridae	Crayfishes	Procambarus acutus (Girard, 1852)	White River Crayfish		Unknown	Unknown	Not assessed	ME	r1,
Animalia	Arthropoda	Malacostraca	Decapoda	Grapsidae	Marsh crabs, Shore crabs	Eriocheir sinensis H. Milne-Edwards, 1853	Chinese Mitten Crab		Unknown	Unknown	Not assessed		r1,r3,r22,
Animalia	Arthropoda	Malacostraca	Decapoda	Grapsidae	Marsh crabs, Shore crabs	Hemigrapsus sanguineus (De Haan, 1853)	Japanese Shore Crab	Widespread and invasive	Non-Native (NA)	Established	Not assessed	MA, U.S., ME	r1,r7,r9,r14,r18,r22,
Animalia	Arthropoda	Malacostraca	Decapoda	Portunidae	Swimming crabs	Carcinus maenas (Linnaeus, 1758)	Green Crab	Widespread and invasive	Non-Native (NA)	Established	Not assessed	ME	r1,r7,r9,r14,r18,r22,
Animalia	Arthropoda	Malacostraca	Decapoda	Varunidae		Hemigrapsus penicillatus (De Haan, 1835)			Unknown	Unknown	Not assessed		r22,
Animalia	Arthropoda	Malacostraca	Isopoda	Janiridae		Ianropsis Sars, 1897		Potentially Invasive	Non-Native (NA)	Established	Not assessed		r9,r14,r22,
Animalia	Arthropoda	Malacostraca	Isopoda	Janiridae		Jaera marina	Little Shore Isopod	Unknown	Cryptogenic	Unknown	Not assessed		r22,
Animalia	Arthropoda	Malacostraca	Isopoda	Ligiidae		Ligia oceanica (Linnaeus, 1767)	Rock Louse, Sea Slater		Unknown	Unknown	Not assessed		r9,
Animalia	Arthropoda	Malacostraca	Isopoda	Limnoriidae		Limnoria Leach, 1814		Unknown	NA	Unknown	Not assessed		r7,
Animalia	Arthropoda	Malacostraca	Isopoda	Limnoriidae		Limnoria tripunctata Menzies, 1951A	Gribble	Unknown	Unknown	Unknown	Not assessed		r22,
Animalia	Arthropoda	Malacostraca	Isopoda	Scyphacidae		Armadilloniscus ellipticus (Harger, 1878)	Isopod	Unknown	Unknown	Unknown	Not assessed		r22,
Animalia	Arthropoda	Malacostraca	Mysida	Mysidae		Mysis relicta Loven	Opossum Shrimp		Unknown	Unknown	Not assessed	ME	r1,
Animalia	Arthropoda	Malacostraca	Tanaidacea	Paratanaididae		Leptocheila savignyi		Unknown	Unknown	Unknown	Not assessed		r22,
Animalia	Arthropoda	Malacostraca	Tanaidacea	Tanaididae		Tanais dulongii (Audouin, 1826)	Tanaid Shrimp	Unknown	Cryptogenic	Unknown	Not assessed		r11,r22,
Animalia	Arthropoda	Malacostraca	Thoracica	Chthamalidae		Chthamalus fragilis Darwin, 1854		Unknown	Non-Native (RI)	Unknown	Not assessed		r14,r22,
Animalia	Chordata	Actinopterygii	Cypriniformes	Cyprinidae	Minnows and Carps	Carassius auratus (Linnaeus, 1758)	Goldfish	Under Observation	Non-Native (NA)	Established	Not assessed	ME	r1,r14,
Animalia	Chordata	Actinopterygii	Cypriniformes	Cyprinidae	Minnows and Carps	Ctenopharyngodon idella (Valenciennes in Cuvier and Valenciennes, 1844)	Grass Carp, White Amur		Unknown	Unknown	Not assessed	CT	r2,r14,
Animalia	Chordata	Actinopterygii	Cypriniformes	Cyprinidae	Minnows and Carps	Cyprinus carpio Linnaeus, 1758	Carp	Potentially Invasive	Non-Native (NA)	Established	Not assessed	ME, VT	r1,r14,r25,
Animalia	Chordata	Actinopterygii	Cypriniformes	Cyprinidae	Minnows and Carps	Leuciscus idus (Linnaeus, 1758)	Ide	Unknown	Non-Native (NA)	Established	Not assessed		r14,
Animalia	Chordata	Actinopterygii	Cypriniformes	Cyprinidae	Minnows and Carps	Scardinius erythrophthalmus (Linnaeus, 1758)	European Rudd		Unknown	Unknown	Not assessed	ME, VT	r1,r2,r14,r25,
Animalia	Chordata	Actinopterygii	Cypriniformes	Cyprinidae	Minnows and Carps	Tinca tinca (Linnaeus, 1758)	Tench		Unknown	Unknown	Not assessed	NY	r25,
Animalia	Chordata	Actinopterygii	Esociformes	Esocidae	Pikes	Esox lucius Linnaeus, 1758	Northern Pike	Under Observation	Non-Native (RI)	Established	Not assessed	ME	r1,r14,
Animalia	Chordata	Actinopterygii	Esociformes	Esocidae	Pikes	Esox masquinongy Mitchell, 1824	Muskellunge		Unknown	Unknown	Not assessed	CT, ME	r1,
Animalia	Chordata	Actinopterygii	Esociformes	Umbidae	Mudminnows	Umbra limi (Kirtland, 1840)	Central Mudminnow		Unknown	Unknown	Not assessed	ME	r1,
Animalia	Chordata	Actinopterygii	Perciformes	Blenniidae	Blennies	Hypsoblennius ionthas Jordan and Gilbert, 1882)	Blenny		Unknown	Unknown	Not assessed		r7,
Animalia	Chordata	Actinopterygii	Perciformes	Centrarchidae	Sunfishes	Lepomis macrochirus Rafinesque, 1819	Bluegill	Under Observation	Non-Native (RI)	Established	Not assessed	ME, NH	r1,r14,
Animalia	Chordata	Actinopterygii	Perciformes	Centrarchidae	Sunfishes	Micropterus dolomieu Lacépède, 1802	Smallmouth Bass	Under Observation	Non-Native (RI)	Established	Not assessed	ME	r1,r14,

DRAFT List of Non-native Aquatic Species Located in or near RI

Developed by Rhode Island Natural History Survey, April 2007, for the RI Aquatic Invasive Species Working Group
Please comment to dgregg@rinhs.org

Kingdom	division/phylum	class	order	family	Family Common Name	Scientific Name	Common Name	Invasive Status	Nativity	RI Status	RIISC Status	Other State	References
Animalia	Chordata	Actinopterygii	Perciformes	Centrarchidae	Sunfishes	<i>Micropterus salmoides</i> (Lacepede, 1802)	Largemouth Bass	Under Observation	Non-Native (RI)	Established	Not assessed	ME	r1,r14,
Animalia	Chordata	Actinopterygii	Perciformes	Centrarchidae	Sunfishes	<i>Pomoxis nigromaculatus</i> (Lesueur, 1829)	Black Crappie	Under Observation	Non-Native (RI)	Established	Not assessed	ME	r1,r14,
Animalia	Chordata	Actinopterygii	Perciformes	Channidae	Snakeheads	<i>Channa micropeltes</i> (Cuvier in Cuvier and Valenciennes, 1831)	Giant Snakehead	Unknown	Non-Native (NA)	Not Established	Not assessed	ME, MA	r3, r14
Animalia	Chordata	Actinopterygii	Perciformes	Channidae	Snakeheads	<i>Channa argus</i> (Cantor, 1842)	Northern Snakehead	Unknown	Non-Native (NA)	Not Established	Not assessed	MS, NY	r3
Animalia	Chordata	Actinopterygii	Perciformes	Gobiidae	Gobies and True Gobies	<i>Gobionellus hastatus</i> Girard, 1858	Goby	Unknown	Unknown	Unknown	Not assessed		r7,
Animalia	Chordata	Actinopterygii	Perciformes	Gobiidae	Gobies and True Gobies	<i>Neogobius melanostomus</i> (Pallas, 1814)	Round Goby	Unknown	Unknown	Unknown	Not assessed	NY	r1,r14,r25,
Animalia	Chordata	Actinopterygii	Perciformes	Gobiidae	Gobies and True Gobies	<i>Neogobius monachus</i>	Round Goby	Unknown	Unknown	Unknown	Not assessed		r2,
Animalia	Chordata	Actinopterygii	Perciformes	Gobiidae	Gobies and True Gobies	<i>Proterorhinus marmoratus</i> (Pallas, 1814)	Tubenose Goby	Unknown	Unknown	Unknown	Not assessed	NY	r25,
Animalia	Chordata	Actinopterygii	Perciformes	Percidae	Perches and Darters	<i>Gymnocephalus cernuus</i> (Linnaeus, 1758)	Eurasian ruffe	Unknown	Unknown	Unknown	Not assessed		r1,r25,
Animalia	Chordata	Actinopterygii	Perciformes	Percidae	Perches and Darters	<i>Sander vitreus</i> (Mitchill, 1818)	Pike, Walleye	Unknown	Unknown	Unknown	Not assessed		r1,
Animalia	Chordata	Actinopterygii	Salmoniformes	Salmonidae	Trout and Salmon	<i>Oncorhynchus mykiss</i> (Walbaum, 1792)	Rainbow Trout	Potentially Invasive	Non-Native (RI)	Established	Not assessed		r14,
Animalia	Chordata	Actinopterygii	Salmoniformes	Salmonidae	Trout and Salmon	<i>Salmo trutta</i> Linnaeus, 1758	Brown Trout	Potentially Invasive	Non-Native (NA)	Established	Not assessed		r14,
Animalia	Chordata	Actinopterygii	Scorpaeniformes	Scorpaenidae	Scorpionfishes	<i>Pterois volitans</i> (Linnaeus)	Red Lionfish, Firefish	Unknown	Unknown	Unknown	Not assessed		r22,
Animalia	Chordata	Actinopterygii	Siluriformes	Clariidae	Labyrinth Catfishes	<i>Clarias batrachus</i> (Linnaeus, 1758)	Walking Catfish	Unknown	Unknown	Unknown	Not assessed	CT	r2,r14,
Animalia	Chordata	Actinopterygii	Siluriformes	Ictaluridae	Bullhead Catfishes	<i>Ameiurus catus</i> (Linnaeus, 1758)	White Catfish	Unknown	Non-Native (RI)	Established	Not assessed		r1,r14,
Animalia	Chordata	Actinopterygii	Siluriformes	Ictaluridae	Bullhead Catfishes	<i>Ameiurus natalis</i> (Lesueur, 1819)	Yellow Bullhead	Unknown	Non-Native (RI)	Established	Not assessed		r14,
Animalia	Chordata	Amphibia	Caudata	Proteidae	Giant Salamanders	<i>Necturus maculosus</i> (Rafinesque, 1818)	Common Mudpuppy	Unknown	Non-Native (RI)	Not Established	Not assessed	ME	r1,r14,
Animalia	Chordata	Amphibia	Caudata	Salamandridae	Newts	<i>Cynops pyrogaster</i> (Boie, 1826)	Japanese Firebellied Salamander	Unknown	Non-Native (NA)	Not Present	Not assessed	MA	r1,
Animalia	Chordata	Ascidiacea	Enterogona	Ascididae		<i>Ascidella aspersa</i> (OF Müller, 1776)	Sea Squirt	Potentially Invasive	Non-Native (NA)	Established	Not assessed	MA, CT	r1,r6,r7,r14,r22,
Animalia	Chordata	Ascidiacea	Enterogona	Didemnidae		<i>Didemnum lutarium</i> Van Name, 1910	Compound Sea Squirt	Unknown	Unknown	Unknown	Not assessed		r22,
Animalia	Chordata	Ascidiacea	Enterogona	Didemnidae		<i>Didemnum Savigny</i> , 1816	Colonial Tunicate; Ascidian, Sea Squirt	Potentially Invasive	Non-Native (NA)	Established	Not assessed		r9,r11,r22,
Animalia	Chordata	Ascidiacea	Enterogona	Didemnidae		<i>Didemnum lahillei</i> Hartmeyer, 1909	Compound Sea Squirt	Potentially Invasive	Non-Native (NA)	Established	Not assessed		r14,r18,
Animalia	Chordata	Ascidiacea	Enterogona	Didemnidae		<i>Didemnum vexillum</i> Kott, 2002	a Tunicate	Unknown	Unknown	Unknown	Not assessed		r22,
Animalia	Chordata	Ascidiacea	Enterogona	Didemnidae		<i>Diplosoma listerianum</i> (Milne-Edwards, 1841)	Compound Sea Squirt	Unknown	Non-Native (NA)	Established	Not assessed	MA	r1,r7,r9,r13,r14,r22,
Animalia	Chordata	Ascidiacea	Enterogona	Didemnidae		<i>Diplosoma macdonaldi</i> Herdman, 1888	a Tunicate	Potentially Invasive	Non-Native (NA)	Established	Not assessed		r14,r27,
Animalia	Chordata	Ascidiacea	Phlebobranchia	Cionidae		<i>Ciona intestinalis</i> (Linnaeus, 1767)	Sea Squirt	Unknown	Cryptogenic	Unknown	Not assessed		r7,r14,r22,
Animalia	Chordata	Ascidiacea	Stolidobranchia	Molgulidae		<i>Molgula manhattensis</i> (De Kay, 1843)	Sea Grape	Unknown	Cryptogenic	Unknown	Not assessed		r7,r9,r14,r18,r22,
Animalia	Chordata	Ascidiacea	Stolidobranchia	Styelidae		<i>Botrylloides diegensis</i> Ritter and Forsyth, 1917	California Tunicate	Unknown	Non-Native (NA)	Established	Not assessed		r14,
Animalia	Chordata	Ascidiacea	Stolidobranchia	Styelidae		An Orange Sheath Tunicate	Under Observation	Unknown	Non-Native (NA)	Established	Not assessed	ME	r1,r7,r9,r14,r18,r22,
Animalia	Chordata	Ascidiacea	Stolidobranchia	Styelidae		<i>Botryllus schlosseri</i> (Pallas, 1766)	Golden Star Tunicate	Unknown	Non-Native (NA)	Established	Not assessed	MA	r1,r7,r9,r14,r18,r22,
Animalia	Chordata	Ascidiacea	Stolidobranchia	Styelidae		<i>Styela clava</i> Herdman, 1881	Asian Tunicate	Unknown	Non-Native (NA)	Established	Not assessed	ME	r1,r7,r14,r22,
Animalia	Chordata	Ascidiacea	Stolidobranchia	Styelidae		<i>Styela partita</i> (Stimpson, 1852)	Rough Sea Tunicate	Potentially Invasive	Non-Native (NA)	Established	Not assessed	MA	r22,
Animalia	Chordata	Ascidiacea	Stolidobranchia	Styelidae		<i>Styela plicata</i> (Lesueur, 1823)	Asian tunicate	Unknown	Unknown	Unknown	Not assessed		r7,r22,
Animalia	Chordata	Aves	Anseriformes	Anatidae	Swans, Geese, and Ducks	<i>Cygnus olor</i> (Gmelin)	Mute Swan	Potentially Invasive	Non-Native (NA)	Established	Not assessed	ME, VT	r1,r14,r18,r22,r25,
Animalia	Chordata	Aves	Ciconiiformes	Ardeidae	Bitterns and Herons	<i>Bubulcus ibis</i> (Linnaeus, 1758)	Cattle Egret	Unknown	Non-Native (NA)	Established	Not assessed		r55
Animalia	Chordata	Mammalia	Rodentia	Echimyidae	Spiny Rats	<i>Myocastor coypus</i> (Molina, 1782)	Nutria	Unknown	Unknown	Not Present	Not assessed		r1

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Kingdom	division/phylum	class	order	family	Family Common Name	Scientific Name	Common Name	Invasive Status	Nativity	RI Status	RIISC Status	Other State	References
Animalia	Chordata	Reptilia	Testudines	Emydidae	Box and Water Turtles	<i>Trachemys scripta elegans</i> (Wied-Neuwied, 1839)	Red-eared Slider	Under Observation	Non-Native (NA)	Established	Not assessed	MA, ME	r1,r14,
Animalia	Ciliophora	Ciliata	Peritrichida	Vorticellidae		<i>Vorticella</i>	Ciliate		Unknown	Unknown	Not assessed		r22,
Animalia	Cnidaria	Anthozoa	Actiniaria	Diadumenidae		<i>Diadumene lineata</i> (Verrill, 1869)	Orange Striped Anemone	Unknown	Non-Native (NA)	Established	Not assessed		r8,r14,r18,r22,
Animalia	Cnidaria	Hydrozoa	Hydroida	Bougainvillidae		<i>Garveia franciscana</i> (Torrey, 1902)	hydroid	Potentially Invasive	Non-Native (NA)	Established	Not assessed		r14,
Animalia	Cnidaria	Hydrozoa	Hydroida	Campanulariidae		<i>Campanularia</i> Lamarck, 1816	hydroid	Unknown	NA	Unknown	Not assessed		r22,
Animalia	Cnidaria	Hydrozoa	Hydroida	Campanulariidae		<i>Clytia hemisphaerica</i> (Linnaeus, 1758)	hydroid	Potentially Invasive	Cryptogenic	Unknown	Not assessed		r11,r14,r22,
Animalia	Cnidaria	Hydrozoa	Hydroida	Campanulariidae		<i>Gonothyrea loveni</i> (Allman, 1859)	hydroid	Unknown	Unknown	Unknown	Not assessed		r22,
Animalia	Cnidaria	Hydrozoa	Hydroida	Campanulariidae		<i>Laomedea calceolifera</i> (Hincks, 1871)	hydroid	Unknown	Cryptogenic	Unknown	Not assessed		r11,r14,r22,
Animalia	Cnidaria	Hydrozoa	Hydroida	Campanulariidae		<i>Obelia bidentata</i> Clark, 1875	Doubletoothed Hydroid	Potentially Invasive	Cryptogenic	Unknown	Not assessed		r11,r14,r22,
Animalia	Cnidaria	Hydrozoa	Hydroida	Campanulariidae		<i>Obelia dichotoma</i> (Linnaeus, 1758)	Sea Thread Hydroid	Potentially Invasive	Cryptogenic	Unknown	Not assessed		r11,r14,r22,
Animalia	Cnidaria	Hydrozoa	Hydroida	Campanulariidae		<i>Obelia geniculata</i> (Linnaeus, 1758)	Knotted Thread Hydroic	Unknown	Cryptogenic	Unknown	Not assessed		r14,r22,
Animalia	Cnidaria	Hydrozoa	Hydroida	Campanulariidae		<i>Obelia longissima</i> (Pallas, 1766)	hydroid	Potentially Invasive	Cryptogenic	Unknown	Not assessed		r11,r14,r22,r24,
Animalia	Cnidaria	Hydrozoa	Hydroida	Campanuliniidae		<i>Opercularella lacerata</i> (Johnson, 1847)	hydroid	Potentially Invasive	Unknown	Unknown	Not assessed		r22,
Animalia	Cnidaria	Hydrozoa	Hydroida	Clavidae		<i>Cordylophora caspia</i> (Pallas, 1771)	hydroid	Potentially Invasive	Non-Native (NA)	Established	Not assessed		r8,r11,r14,r22,
Animalia	Cnidaria	Hydrozoa	Hydroida	Haleciidae		<i>Halecium halecium</i> (Linnaeus, 1758)	Herringbone Hydroid	Potentially Invasive	Cryptogenic	Unknown	Not assessed		r11,r14,
Animalia	Cnidaria	Hydrozoa	Hydroida	Olinidiidae		<i>Craspedacusta sowerbyi</i> Lankester, 1880	freshwater jellyfish	Unknown	Non-Native (NA)	Established	Not assessed		r14,
Animalia	Cnidaria	Hydrozoa	Hydroida	Sertulariidae		<i>Dynamena pumila</i> (Linnaeus, 1758)	hydroid	Unknown	Unknown	Unknown	Not assessed		r14,r22,
Animalia	Cnidaria	Hydrozoa	Hydroida	Tubulariidae		<i>Ectopleura larynx</i> Kott, 2002	hydroid	Unknown	Unknown	Unknown	Not assessed		r22,
Animalia	Ctenophora	Tentaculata	Lobata	Bolinopsidae		<i>Mnemiopsis leidyi</i> A. Agassiz, 1865	Sea-walnut, Leidy's Comb Jelly	Unknown	Native	Established	Not assessed		r11,r14,r19,
Animalia	Ectoprocta	Gymnolaemata	Cheilostomata			<i>Tangenella appendiculata</i>		Unknown	Unknown	Unknown	Not assessed	MA	r7,
Animalia	Ectoprocta	Gymnolaemata	Cheilostomata			<i>Tangenella muelleri</i>		Unknown	Unknown	Unknown	Not assessed	MA	r7,
Animalia	Ectoprocta	Gymnolaemata	Cheilostomata	Aeteidae		<i>Aetea anguina</i> (Linnaeus, 1758)		Unknown	Unknown	Unknown	Not assessed		r7,r22,
Animalia	Ectoprocta	Gymnolaemata	Cheilostomata	Bugulidae	Fan Bryozoans	<i>Bugula neritina</i> (Linnaeus, 1758)	Spiral-tufted Bushy Bryozoan	Unknown	Non-Native (NA)	Established	Not assessed	CT	r7,r8,r14,r22,
Animalia	Ectoprocta	Gymnolaemata	Cheilostomata	Bugulidae	Fan Bryozoans	<i>Bugula simplex</i> Hincks, 1886		Unknown	Unknown	Unknown	Not assessed		r14,r22,
Animalia	Ectoprocta	Gymnolaemata	Cheilostomata	Bugulidae	Fan Bryozoans	<i>Bugula stolonifera</i> Ryland		Potentially Invasive	Non-Native (NA)	Established	Not assessed		r14,r22,
Animalia	Ectoprocta	Gymnolaemata	Cheilostomata	Cheiloporinidae		<i>Cryptosula pallasiana</i>		Unknown	Unknown	Unknown	Not assessed		r14,r22,
Animalia	Ectoprocta	Gymnolaemata	Cheilostomata	Electridae		<i>Electra crustulenta</i> (Pallas, 1776)	Bryozoan		Unknown	Unknown	Not assessed		r22,
Animalia	Ectoprocta	Gymnolaemata	Cheilostomata	Electridae		<i>Electra pilosa</i> (Linnaeus, 1768)		Potentially Invasive	Cryptogenic	Unknown	Not assessed		r11,r14,r22,
Animalia	Ectoprocta	Gymnolaemata	Cheilostomata	Membraniporidae		<i>Conopeum reticulum</i> L.	Bryozoan		Unknown	Unknown	Not assessed		r22,
Animalia	Ectoprocta	Gymnolaemata	Cheilostomata	Membraniporidae		<i>Membranipora membranacea</i> (Linnaeus, 1767)	White Lace bryozoan, Kelp bryozoan	Unknown	Non-Native (NA)	Established	Not assessed	MA, ME	r1,r4,r6,r7,r8,r14,r18,r22,
Animalia	Ectoprocta	Gymnolaemata	Ctenostomata	Alcyoniidae		<i>Alcyonidium Lamouroux</i> , 1813		Potentially Invasive	Non-Native (NA)	Established	Not assessed		r8,r14,r22,
Animalia	Ectoprocta	Gymnolaemata	Ctenostomata	Arachnidiidae		<i>Bulbella abscondita</i> Braem, 1951			Unknown	Unknown	Not assessed	MA	r7,
Animalia	Ectoprocta	Gymnolaemata	Ctenostomata	Nolellidae		<i>Anguinea palmata</i> Van Beneden, 1845	Bryozoan		Unknown	Unknown	Not assessed		r22,
Animalia	Ectoprocta	Gymnolaemata	Ctenostomata	Vesicularioidea		<i>Bowerbankia gracilis</i> Leidy		Unknown	Unknown	Unknown	Not assessed		r14,r22,
Animalia	Ectoprocta	Gymnolaemata	Ctenostomata	Vesicularioidea		<i>Bowerbankia imbricata</i> (Adams, 1800)		Potentially Invasive	Cryptogenic	Unknown	Not assessed		r11,r14,r22,
Animalia	Entoprocta	[Not assigned]	Pedicellinida	Pedicellinidae		<i>Barentsia benedeni</i> Foettinger	Nodding Head	Unknown	Non-Native (NA)	Established	Not assessed	MA	r7,r14,r22,
Animalia	Mollusca	Bivalvia	Myoidea	Teredinidae	Shipworms	<i>Teredo bartschi</i> W. Clapp, 1923	Shipworm		Non-Native (RI)	Unknown	Not assessed	LIS	r7,r22,
Animalia	Mollusca	Bivalvia	Myoidea	Teredinidae	Shipworms	<i>Teredo furcifera</i> von Martens, 1894	Shipworm		Unknown	Unknown	Not assessed	LIS	r7,
Animalia	Mollusca	Bivalvia	Myoidea	Teredinidae	Shipworms	<i>Teredo navalis</i> Linnaeus, 1758	Naval Shipworm	Unknown	Non-Native (RI)	Unknown	Not assessed	MA, ME	r1,r7,r8,r18,r22,
Animalia	Mollusca	Bivalvia	Ostreoida	Ostreidae	True Oysters	<i>Crassostrea anakensis</i>	Sumnoe Oyster		Unknown	Unknown	Not assessed		r22,
Animalia	Mollusca	Bivalvia	Ostreoida	Ostreidae	True Oysters	<i>Crassostrea gigas</i> (Thunberg, 1793)	Pacific oyster		Unknown	Unknown	Not assessed		r1,r7,
Animalia	Mollusca	Bivalvia	Ostreoida	Ostreidae	True Oysters	<i>Ostrea edulis</i> Linnaeus, 1758	European Oyster	Unknown	Non-Native (NA)	Established	Not assessed	ME, NH, RI, CT	r5,r7,r8,r9,r14,r18,r22,r41
Animalia	Mollusca	Bivalvia	Veneroida	Corbiculidae		<i>Corbicula fluminea</i> (O. F. Müller, 1774)	Asiatic Clam	Under Observation	Non-Native (NA)	Established	Not assessed	CT, NY, MA	r1,r7,r14,r25,r46,
Animalia	Mollusca	Bivalvia	Veneroida	Dreissenidae	Zebra Mussels	<i>Dreissena bugensis</i> Andrusov, 1897	Quagga Mussel		Unknown	Not Present	Not assessed	NY	r14,r25,

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Kingdom	division/phylum	class	order	family	Family Common Name	Scientific Name	Common Name	Invasive Status	Nativity	RI Status	RIISC Status	Other State	References
Animalia	Mollusca	Bivalvia	Veneroida	Dreissenidae	Zebra Mussels	Dreissena polymorpha (Pallas, 1771)	Zebra Mussel		Non-Native (RI)	Unknown	Not assessed	CT, VT	r1,r2,r7,r14,r22,r25,r51,
Animalia	Mollusca	Bivalvia	Veneroida	Dreissenidae	Zebra Mussels	Mytilopsis leucophaea (Conrad, 1831)	False Mussel	Unknown	Non-Native (NA)	Established	Not assessed		r5,r7,r14,r22,
Animalia	Mollusca	Bivalvia	Veneroida	Mactridae		Rangia cuneata (G. B. Sowerby I, 1831); Venerupis philippinarum (A. Adams and Reeve, 1850)	Atlantic Rangia		Non-Native (RI)	Unknown	Not assessed		r7,r22,
Animalia	Mollusca	Bivalvia	Veneroida	Veneridae	Venus Clams		Manilla clam		Unknown	Unknown	Not assessed		r7,
Animalia	Mollusca	Gastropoda	Archaeopulmonata	Ellobiidae		Myosotella myosotis (Draparnaud, 1801)	European Melampus, Salt Marsh Snail	Unknown	Non-Native (NA)	Established	Not assessed	MA	r7,r14,
Animalia	Mollusca	Gastropoda	Architaenioglossa	Viviparidae		Cipangopaludina chinensis (Gray, 1834)	Chinese Mysterysnail	Potentially Invasive	Non-Native (NA)	Established	Not assessed	MA, ME, VT	r1,r14,r25,
Animalia	Mollusca	Gastropoda	Architaenioglossa	Viviparidae		Cipangopaludina japonica (von Martens, 1861)	Mud Snail		Unknown	Unknown	Not assessed		r1,
Animalia	Mollusca	Gastropoda	Mesogastropoda	Littorinidae		Littorina littorea (Linnaeus, 1758)	Common Periwinkle	Potentially Invasive	Non-Native (NA)	Established	Not assessed		r7,r8,r9,r14,r18,r22,
Animalia	Mollusca	Gastropoda	Neogastropoda	Euccinidae		Rapana venosa (Valenciennes, 1846)	Veined Rapa Whelk		Unknown	Unknown	Not assessed	VA	r1,r22,
Animalia	Mollusca	Gastropoda	Neotaenioglossa	Bithyniidae		Bithynia tentaculata (Linnaeus, 1758)	Faucet Snail		Unknown	Unknown	Not assessed	VT	r25,
Animalia	Mollusca	Gastropoda	Neotaenioglossa	Truncatellidae		Truncatella subcylindrica Linnaeus, 1758	Looping Snail	Unknown	Non-Native (NA)	Not Established	Not assessed		r3,r5,r11,r14,r29,
Animalia	Mollusca	Gastropoda	Nudibranchia	Tergipedidae		Tenellia adspersa (Nordmann, 1845)	Miniature Aeolis	Potentially Invasive	Non-Native (NA)	Established	Not assessed		r7,r22,
Animalia	Mollusca	Gastropoda	Nudibranchia	Tritoniidae		Tritonia plebeia Johnston, 1825	Sea slug		Non-Native (RI)	Unknown	Not assessed	MA, NH	r7,r8,
Animalia	Mollusca	Gastropoda	Sacoglossa	Stiligeridae		Placida dendritica (Alder and Hancock, 1843)	Sacoglossan slug		Unknown	Unknown	Not assessed		r7,
Animalia	Mollusca	Gastropoda	Stylommatophora	Helicidae		Cepaea nemoralis (Linnaeus, 1758)	Banded Grove Snail	Unknown	Non-Native (NA)	Established	Not assessed		r14,
Animalia	Mollusca	Gastropoda	Stylommatophora	Zonitidae		Oxychilus cellarius (Muller, 1774)	Cellar Glass-snail	Unknown	Non-Native (NA)	Established	Not assessed		r14,
Animalia	Myxozoa	Myxosporea	Bivalvulida	Myxobolidae		Myxobolus cerebralis	Whirling Disease	Unknown	Non-Native (RI)	Unknown	Not assessed	RI (as cited in	r1,r17,
Animalia	Nemata	Secernentea	Camallanida			Anguillicola crassus (Kuwahara, Niimi and Hagaki, 1974)	Eel nematode, Swim-bladder nematode		Unknown	Unknown	Not assessed		r22,
Animalia	Platyhelminthes	Cestoda	Proteocephalida	Proteocephalidae		Proteocephalus ambloplitis (Leidy, 1887)	Bass Tapeworm		Unknown	Unknown	Not assessed	ME	r1,
Animalia	Platyhelminthes	Turbellaria	Polycladida			Convoluta convoluta (Abildgaard 1806)	Flatworm		Unknown	Unknown	Not assessed		r9,
Animalia	Porifera	Calcarea	Leucosolenida	Sycettidae		Scypha Gray, 1821		Potentially Invasive	Non-Native (NA)	Established	Not assessed		r14,r22,
Animalia	Porifera	Calcarea	Leucosoleniida	Leucosoleniidae		Leucosolenia Bowerbank, 1864		Potentially Invasive	Non-Native (NA)	Established	Not assessed		r14,r22,
Animalia	Porifera	Demospongiae	Halichondrida	Halichondriidae		Halichondria bowerbanki Burton, 1930	Deadman's Finger sponge	Unknown	Non-Native (NA)	Established	Not assessed		r14,r22,
Animalia	Protozoa	Filosa	Aconchulinida	Gromiidae		Gromia oviformis Dujardin, 1835	Rhizopod protist	Unknown	Unknown	Unknown	Not assessed		r22,
Monera	Bacteria	Schizomycetes	Eubacteriales	Brucellaceae		Brucella sp.	bacterium (cause of Brucellosis)	Unknown	Non-Native (RI)	Established	Not assessed		r44
Monera	Bacteria	Schizomycetes	Eubacteriales	Achromobacteraceae		Flavobacterium	Lobster shell disease		NA	Unknown	Not assessed		r33,r34,r35,
Monera	Bacteria	Schizomycetes	Pseudomonadales	Spirillaceae		Vibrio carchariae	vibrio	Unknown	Unknown	Unknown	Not assessed		r49
Monera	Bacteria	Schizomycetes	Pseudomonadales	Spirillaceae		Vibrio parahaemolyticus	vibrio	Unknown	Unknown	Unknown	Not assessed		r47
Monera	Bacteria	Schizomycetes	Rickettsiales	Rickettsiaceae		Rickettsia	Rickettsia		Unknown	Unknown	Not assessed		r1,r37,r38,
Monera	Cyanophycota	Cyanophyceae	Stigonematales	Mastigocladaceae		Brachytrichia quoyi Bornet and Flachault	Blue-green Algae		Unknown	Unknown	Not assessed		r22,
Plantae	Bacillariophyta	Bacillariophyceae	Centrales	Eupodiscaceae		Odontella sinensis (Grev.) Grunow	diatom	Unknown	Non-Native (NA)	Established	Not assessed		r14,r22,
Plantae	Bacillariophyta	Bacillariophyceae	Leptocylindrales	Leptocylindraceae		Leptocylindrus danicus Cl.	diatom	Unknown	Unknown	Not Established	Not assessed		
Plantae	Bacillariophyta	Coscinodiscophyceae	Coscinodiscales	Coscinodiscaceae		Coscinodiscus wailesii	diatom	Restricted and invasive	Non-Native (NA)	Established	Not assessed		r7,r14,r22,
Plantae	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Thalassiosiraceae		Thalassiosira kuschirensis Takano	Diatom	Unknown	Unknown	Unknown	Not assessed		r11,r14,
Plantae	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Thalassiosiraceae		Thalassiosira punctigera Castracane, 1886) Hasle, 1983	Centric diatom		Unknown	Unknown	Not assessed		r22,

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Plantae	Chlorophyta	Ulvothyceae	Cladophorales	Cladophoraceae		Cladophora sericea (Huds.) Kutz.		Unknown	Native	Established	Not assessed		r7,r14,r22,
Plantae	Chlorophyta	Ulvothyceae	Codiales	Codiaceae		Codium fragile tomentosoides (van Goor) P.C. Silva	Dead-man's Fingers	Widespread and invasive	Non-Native (NA)	Established	Not assessed	ME	r1,r7,r9,r10,r14,r18,r22,r28,
Plantae	Chrysochyta	Pelagophyceae				Aureococcus anophagefferens Harg. & Sieb.	Brown Tide	Unknown	Cryptogenic	Unknown	Not assessed		r7,r18,r22,
Plantae	Magnoliophyta	Liliopsida	Alismatales	Butomaceae		Butomus umbellatus L.	Flowering Rush		Unknown	Unknown	Not assessed	CT (potentially invasive), VT, ME	r1,r12,r14,r23,r25,
Plantae	Magnoliophyta	Liliopsida	Arales	Araceae	Arum Family	Pistia stratiotes L.	Water Lettuce	Potentially Invasive	Non-Native (NA)	Established	RIISC: Potentially invasive: has been found in state	CT (Potentially invasive)	r12,r14,
Plantae	Magnoliophyta	Liliopsida	Arales	Lernaceae	Duckweed Family	Spirodela punctata (G.F.W. Mey.) C.H. Thompson	Dotted duckweed		Unknown	Unknown	Not assessed		r26,
Plantae	Magnoliophyta	Liliopsida	Cyperales	Cyperaceae	Sedge Family	Carex kobomugi Ohwi	(barley) Sedge	Under Observation	Non-Native (NA)	Established	Not assessed	MA (potentially invasive)	r12,r14,r22,
Plantae	Magnoliophyta	Liliopsida	Cyperales	Cyperaceae	Sedge Family	Cyperus amunicus Maxim.	Golden Flatsedge		Unknown	Unknown	Not assessed		r26,
Plantae	Magnoliophyta	Liliopsida	Cyperales	Cyperaceae	Sedge Family	Cyperus flavescens L.	Umbrella-sedge, Flatsedge, Nutsedge	Unknown	NA	Not Present	Not assessed		r26,
Plantae	Magnoliophyta	Liliopsida	Cyperales	Cyperaceae	Sedge Family	Cyperus pseudovegetus Steud.	Marsh or Clay-flatsedge		Unknown	Unknown	Not assessed		r26,
Plantae	Magnoliophyta	Liliopsida	Cyperales	Poaceae	Grasses	Agrostis stolonifera var. palustris (Hudson) Farw.	Creeping or Carpet Bent	Unknown	Non-Native (NA)	Established	Not assessed		
Plantae	Magnoliophyta	Liliopsida	Cyperales	Poaceae	Grasses	Alopecurus geniculatus L.	Marsh- or Water-foxtail	Unknown	Non-Native (NA)	Established	Not assessed		r26,
Plantae	Magnoliophyta	Liliopsida	Cyperales	Poaceae	Grasses	Calamagrostis epigeios (L.) Roth	Feathertop		Unknown	Unknown	Not assessed		r26,
Plantae	Magnoliophyta	Liliopsida	Cyperales	Poaceae	Grasses	Diplachne fascicularis (Lam.) Beauv	Salt-meadow grass		Unknown	Unknown	Not assessed		r26,
Plantae	Magnoliophyta	Liliopsida	Cyperales	Poaceae	Grasses	Diplachne uninervia (J. Presl) Parodi	Mexican Sprangletop		Unknown	Unknown	Not assessed		r26,
Plantae	Magnoliophyta	Liliopsida	Cyperales	Poaceae	Grasses	Elytrigia pungens auct. non (Pers.) Tutin	Seabeach or Saltmarsh wheatgrass		Unknown	Unknown	Not assessed		r26,
Plantae	Magnoliophyta	Liliopsida	Cyperales	Poaceae	Grasses	Glyceria maxima (Hartman) Holmb.	English water grass		Unknown	Unknown	Not assessed	CT (potentially invasive), MA (likely invasive)	r1,r12,r14,r26,
Plantae	Magnoliophyta	Liliopsida	Cyperales	Poaceae	Grasses	Phragmites australis (Cav.) Trin. ssp. australis	Common or Tall Reed, Phragmites, Reed Grass, Phrag, Pampas Grass (RI Colloq.)	Widespread and invasive	Non-Native (RI)	Established	RIISC: needs more research	MA, VT, CT (widespread/invasive), ME	r1,r12,r14,r15,r22,r23,r25,r26,r48,
Plantae	Magnoliophyta	Liliopsida	Cyperales	Poaceae	Grasses	Poa trivialis L.	Rough Bluegrass, Rough-stalked Meadow-grass	Unknown	Non-Native (NA)	Established	RIISC: Widespread & invasive	MA, NH	r14
Plantae	Magnoliophyta	Liliopsida	Hydrocharitales	Hydrocharitaceae	Frog's-bit Family	Hydrilla verticillata (L. f.) Royle	Hydrilla		Unknown	Unknown	RIISC: Potentially invasive [no RI records to date]	ME, VT, CT (restricted/invasive), MA	r1,r12,r14,r23,r25,r26,
Plantae	Magnoliophyta	Liliopsida	Hydrocharitales	Hydrocharitaceae	Frog's-bit Family	Hydrocharis morsus-ranae L.	European frogbit		Unknown	Unknown	Not assessed	MA (likely invasive), ME, NH, VT	r1,r14,r25,
Plantae	Magnoliophyta	Liliopsida	Juncales	Juncaceae	Rush Family	Juncus brachycarpus Engelm.	Short-fruited Rush	Unknown	Unknown	Unknown	Not assessed		r26,
Plantae	Magnoliophyta	Liliopsida	Juncales	Juncaceae	Rush Family	Juncus effusus var. effusus	Soft Rush	Unknown	Non-Native (NA)	Established	Not assessed		
Plantae	Magnoliophyta	Liliopsida	Liliales	Iridaceae	Iris Family	Iris pseudacorus L.	Yellow Flag or Iris, Water-flag	Under Observation	Non-Native (NA)	Established	RIISC: needs more research	MA, CT (widespread/invasive), ME, VT	r1,r12,r14,r15,r23,r25,r26,
Plantae	Magnoliophyta	Liliopsida	Liliales	Pontederiaceae	Pickeralweed Family	Eichhornia crassipes (Martius) Solms-Laub.	Water-hyacinth	Potentially Invasive	Non-Native (NA)	Established	RIISC: Potentially invasive: has been found in state	MA	r12,r14,r26,

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Plantae	Magnoliophyta	Liliopsida	Najadales	Hydrocharitaceae	Frog's-bit Family	<i>Egeria densa</i> Planchon	Brazilian Water-weed	Potentially Invasive	Non-Native (NA)	Established	RIISC: Potentially invasive: has been found in state	MA (likely invasive), ME, VT, NH, CT (restricted/invasive)	r1,r12,r14,r23,r25,r26,
Plantae	Magnoliophyta	Liliopsida	Najadales	Najadales	Water Nymphs	<i>Najas minor</i> All.	Water-nymph, Brittle Water-nymph	Unknown	Non-Native (RI)	Unknown	RIISC: Potentially invasive	MA (likely invasive), ME, VT	r1,r7,r12,r14,r23,r25,
Plantae	Magnoliophyta	Liliopsida	Najadales	Potamogetonaceae	Pondweed Family	<i>Potamogeton crispus</i> L.	Curly Pondweed	Widespread and invasive	Non-Native (NA)	Established	RIISC: Widespread & invasive	MA, ME, VT, NH, CT (widespread/invasive)	r1,r12,r14,r22,r23,r25,r26,
Plantae	Magnoliophyta	Magnoliopsida	Araliales	Apiaceae	Carrot family	<i>Conium maculatum</i> L.	Poison Hemlock	Unknown	Non-Native (NA)	Established	Not assessed		
Plantae	Magnoliophyta	Magnoliopsida	Araliales	Apiaceae	Carrot family	<i>Daucus carota</i> L.	Queen Anne's Lace, Wild Carrot, Devil's-plague, Bird's-nest	Under Observation	Non-Native (NA)	Established	Not assessed		r14,r54,
Plantae	Magnoliophyta	Magnoliopsida	Araliales	Araliaceae	Ivy and Ginseng Family	<i>Aralia spinosa</i> L.	Devil's-walking-stick, Hercules'-club, Angelica-tree	Unknown	Non-Native (RI)	Established	Not assessed		
Plantae	Magnoliophyta	Magnoliopsida	Asterales	Asteraceae	Sunflowers	<i>Gnaphalium uliginosum</i> L.	Marsh- or Low Cudweed	Unknown	Non-Native (NA)	Established	Not assessed		
Plantae	Magnoliophyta	Magnoliopsida	Asterales	Asteraceae	Sunflowers	<i>Tussilago farfara</i> L.	Coltsfoot, Coughwort, Son-before-the-father	Unknown	Non-Native (NA)	Established	Not assessed	CT (restricted/invasive), MA (likely invasive)	r12,r14,r23,
Plantae	Magnoliophyta	Magnoliopsida	Callitrichales	Callitrichaceae	Water-Starwort Family	<i>Callitriche stagnalis</i> Scop.	pond water-starwort	Unknown	Unknown	Unknown	Not assessed	CT (potentially invasive)	r12,r14,r23,r26,
Plantae	Magnoliophyta	Magnoliopsida	Capparales	Brassicaceae	Mustard family	<i>Cakile maritima</i> Scop.	Sea rocket	Unknown	Unknown	Unknown	Not assessed		r9,r22,
Plantae	Magnoliophyta	Magnoliopsida	Capparales	Brassicaceae	Mustard family	<i>Rorippa amphibia</i> (Linnaeus) Besser	Amphibian Yellow Cress	Unknown	Non-Native (RI)	Not Confirmed	Not assessed	MA (likely invasive), VT	r14,r25,r26,
Plantae	Magnoliophyta	Magnoliopsida	Capparales	Brassicaceae	Mustard family	<i>Rorippa microphylla</i> (Boenn.) Hylander	(small-leaved) Watercress	Unknown	Non-Native (NA)	Established	Not assessed	CT (widespread/invasive)	r12,r14,r23,r26,
Plantae	Magnoliophyta	Magnoliopsida	Capparales	Brassicaceae	Mustard family	<i>Rorippa nasturtium-aquaticum</i> (L.) Hayek	True Watercress	Restricted and invasive	Non-Native (NA)	Established	RIISC: Restricted & invasive	CT (Potentially invasive)	r12,r14,r26,
Plantae	Magnoliophyta	Magnoliopsida	Capparales	Brassicaceae	Mustard family	<i>Rorippa palustris</i> ssp. <i>palustris</i> (L.) Bess.	Marsh Yellowcress	Unknown	Unknown	Unknown	Not assessed		r26,
Plantae	Magnoliophyta	Magnoliopsida	Caryophyllales	Amaranthaceae	Amaranth Family	<i>Amaranthus tuberculatus</i> (Moq.) Sauer	Water-hemp	Unknown	Unknown	Unknown	Not assessed		r26,
Plantae	Magnoliophyta	Magnoliopsida	Caryophyllales	Caryophyllaceae	Caryophyllacées, Pinks	<i>Lychnis flos-cuculi</i> L.	Ragged Robin, Cuckoo-flower	Unknown	Non-Native (NA)	Established	RIISC: Potentially invasive: has been found in state	MA	r14
Plantae	Magnoliophyta	Magnoliopsida	Caryophyllales	Caryophyllaceae	Caryophyllacées, Pinks	<i>Saponaria officinalis</i> L.	Soapwort, Bouncing-bet	Potentially Invasive	Non-Native (NA)	Established	Not assessed		
Plantae	Magnoliophyta	Magnoliopsida	Caryophyllales	Caryophyllaceae	Caryophyllacées, Pinks	<i>Stellaria aquatica</i> (Linnaeus) Scopoli	Giant Chickweed	Unknown	Non-Native (RI)	Not Confirmed	Not assessed		r26,
Plantae	Magnoliophyta	Magnoliopsida	Caryophyllales	Chenopodiaceae	Goosefoot family	<i>Bassia hyssopifolia</i> (Pallas) Kuntze	Five-hook or Hyssop-leaved Bassia	Unknown	Non-Native (NA)	Established	Not assessed		
Plantae	Magnoliophyta	Magnoliopsida	Celastrales	Celastraceae	Bittersweet family	<i>Celastrus orbiculatus</i> Thunb.	Asiatic or Oriental Bittersweet	Widespread and invasive	Non-Native (NA)	Established	Not assessed		
Plantae	Magnoliophyta	Magnoliopsida	Fabales	Fabaceae	Legume family	<i>Medicago alba</i> Medikus	White Sweet Clover, White Melilot	Widespread and invasive	Non-Native (NA)	Established	Not assessed		
Plantae	Magnoliophyta	Magnoliopsida	Fagales	Betulaceae	Alder, Birch	<i>Alnus glutinosa</i> (L.) Gaertner	Black or European Alder	Unknown	Non-Native (RI)	Not Established	Not assessed		r14

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Plantae	Magnoliophyta	Magnoliopsida	Haloragales	Haloragaceae	Water-milfoil Family	Myriophyllum aquaticum (Vell.) Verdc.	parrot feather		Unknown	Unknown	Not assessed	CT (potentially invasive), MA (likely invasive), ME, VT	r1,r12,r14,r23,r25,
Plantae	Magnoliophyta	Magnoliopsida	Haloragales	Haloragaceae	Water-milfoil Family	Myriophyllum heterophyllum Michx.	(Diverse-leaved) Water-milfoil, Variable Water-milfoil	Unknown	Non-Native (RI)	Established	RIISC: Restricted & invasive	MA, ME, VT, NH	r1,r12,r14,r15,r23,r25,r26,
Plantae	Magnoliophyta	Magnoliopsida	Haloragales	Haloragaceae	Water-milfoil Family	Myriophyllum spicatum L.	European Water-milfoil	Potentially Invasive	Non-Native (NA)	Established	RIISC: Potentially invasive [RI Records in 2006]	MA, ME, VT	r1,r12,r14,r23,r25,r26,
Plantae	Magnoliophyta	Magnoliopsida	Lamiales	Lamiaceae	Mint Family	Lycopus europaeus Linnaeus	European Water Horehound	Unknown	Non-Native (NA)	Established	Not assessed		r26,
Plantae	Magnoliophyta	Magnoliopsida	Lamiales	Lamiaceae	Mint Family	Stachys palustris var. palustris	Woundwort, Marsh Hedge-nettle	Unknown	Non-Native (NA)	Established	Not assessed		r26,
Plantae	Magnoliophyta	Magnoliopsida	Myrtales	Lythraceae	Loosestrife family	Lythrum salicaria L.	Purple Loosestrife	Widespread and invasive	Non-Native (NA)	Established	RIISC: Widespread & invasive	MA, VT, CT (widespread/invasive), ME	r1,r12,r14,r15,r22,r23,r25,r26,
Plantae	Magnoliophyta	Magnoliopsida	Myrtales	Lythraceae	Loosestrife family	Lythrum virgatum L.	Wand-loosestrife		Unknown	Unknown	Not assessed		r26,
Plantae	Magnoliophyta	Magnoliopsida	Myrtales	Onagraceae	Evening-primrose Family	Epilobium hirsutum L.	Hairy Willow-herb	Unknown	Non-Native (NA)	Established	Not assessed	MA (likely invasive)	r14,r26,
Plantae	Magnoliophyta	Magnoliopsida	Myrtales	Trapaceae	Water Chestnuts	Trapa natans L.	Water-nut, Water-chestnut	Potentially Invasive	NA	Not Present	No record. RIISC: Potentially invasive	MA, VT, NH, CT (restricted/invasive)	r1,r12,r14,r15,r23,r25,r26,
Plantae	Magnoliophyta	Magnoliopsida	Nymphaeales	Cabombaceae	Water-shield Family	Cabomba caroliniana A. Gray	Fanwort	Widespread and invasive	Non-Native (RI)	Established	RIISC: Widespread & invasive	MA, ME, VT, NH, CT (restricted/invasive)	r1,r12,r14,r15,r23,r25,r26,
Plantae	Magnoliophyta	Magnoliopsida	Nymphaeales	Nelumbonaceae		Nelumbo lutea Willdenow	American Lotus, Yellow Lotus, Water-chinquapin, Sacred Bean, Pond-nuts	Unknown	Non-Native (RI)	Not Established	Not assessed	CT (potentially invasive)	r12,r14,r23,r26,
Plantae	Magnoliophyta	Magnoliopsida	Nymphaeales	Nymphaeaceae		Nymphaea odorata ssp. tuberosa (Paine) Wiersma & Hellquist	Tuberous water-lily		Unknown	Unknown	Not assessed		r26,
Plantae	Magnoliophyta	Magnoliopsida	Papaverales	Papaveraceae	Poppy Family	Glaucium flavum Crantz	Sea- or Horn-poppy	Unknown	Non-Native (NA)	Established	Not assessed	MA	r14,r22,
Plantae	Magnoliophyta	Magnoliopsida	Polygonales	Polygonaceae	Buckwheat family	Polygonum cespitosum Blume	Oriental Ladythumb		Non-Native (NA)	Not Confirmed	Not assessed		
Plantae	Magnoliophyta	Magnoliopsida	Primulales	Primulaceae	Primrose Family	Lysimachia nummularia L.	Moneywort	Potentially Invasive	Non-Native (NA)	Established	Not assessed	MA	r14
Plantae	Magnoliophyta	Magnoliopsida	Ranunculales	Berberidaceae	Barberry Family	Berberis thunbergii DC.	Japanese Barberry	Widespread and invasive	Non-Native (NA)	Established	RIISC: Invasive--want research on cultivars	CT, MA, NH	r14
Plantae	Magnoliophyta	Magnoliopsida	Rosales	Rosaceae	Rose Family	Potentilla rivalis Nutt.	Brook cinquefoil		Unknown	Unknown	Not assessed		r26,
Plantae	Magnoliophyta	Magnoliopsida	Rosales	Rosaceae	Rose Family	Rosa multiflora Thunb.	Multiflora-rose	Widespread and invasive	Non-Native (NA)	Established	Not assessed		
Plantae	Magnoliophyta	Magnoliopsida	Rosales	Rosaceae	Rose Family	Rosa rugosa Thunb.	Rugose, Winkled, Beach-, or Japanese Rose, Saltspray Rose	Restricted and invasive	Non-Native (NA)	Established	RIISC: needs more research	CT (potentially invasive)	r12,r14,r22,r23,r54,
Plantae	Magnoliophyta	Magnoliopsida	Salicales	Salicaceae	Willow Family	Salix cinerea L.	Gray Florist's Willow	Potentially Invasive	Non-Native (NA)	Established	Not assessed	NY	
Plantae	Magnoliophyta	Magnoliopsida	Sapindales	Rutaceae	Citrus Fruit Family	Phellodendron Rupr.	Corktree		Non-Native (NA)	Established	Not assessed		
Plantae	Magnoliophyta	Magnoliopsida	Scrophulariales	Acanthaceae		Hygrophila polysperma (Roxb.) T. Anders.	East Indian hygrophila		Unknown	Unknown	Not assessed	VT (?not listed in VT plan)	r14,r25,

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Plantae	Magnoliophyta	Magnoliopsida	Scrophulariales	Scrophulariaceae	Figworts	Glossostigma cleistanthum W.R.Barker	Mudmat	Potentially Invasive	Non-Native (RI)	Established	RIISC: Potentially invasive: trying to determine which is our species		r14,r20,
Plantae	Magnoliophyta	Magnoliopsida	Scrophulariales	Scrophulariaceae	Figworts	Veronica beccabunga L.	Brooklime		Unknown	Unknown	Not assessed	CT (potentially invasive)	r14,r23,r26,
Plantae	Magnoliophyta	Magnoliopsida	Solanales	Menyanthaceae		Nymphoides peltata (S.G. Gmelin) Kuntze	Yellow Floating Heart	Unknown	Non-Native (RI)	Not Confirmed	Not assessed	MA (likely invasive), ME, VT	r1,r12,r14,r23,r25,r26,
Plantae	Phaeophyta	Phaeophyceae	Dictyosiphonales	Striariaceae		Stictyosiphon sorifera	brown alga	Unknown	Non-Native (NA)	Established	Not assessed		r14,
Plantae	Phaeophyta	Phaeophyceae	Dictyosiphonales	Striariaceae		Striaria attenuata	Brown Alga	Unknown	Non-Native (NA)	Established	Not assessed		r14,
Plantae	Phaeophyta	Phaeophyceae	Fucales	Fucaceae		Fucus serratus L.		Unknown	Non-Native (NA)	Established	Not assessed		r7,r28,
Plantae	Phaeophyta	Phaeophyceae	Fucales	Sargassaceae		Sargassum muticum Yendo	[Asian species of seaweed]		Unknown	Unknown	Not assessed		r22,
Plantae	Phaeophyta	Phaeophyceae	Laminariales			Undaria pinnatifida (Harvey) Suringar	Wakame (a coldwater kelp)		Unknown	Unknown	Not assessed		r22,
Plantae	Pteridophyta	Filicopsida	Hydropteridales	Salviniaceae		Salvinia minima Baker	Water-fern, water spangles		Unknown	Unknown	Not assessed		r26,
Plantae	Pteridophyta	Filicopsida	Hydropteridales	Salviniaceae		Salvinia molesta Mitchell	Water Fern		Unknown	Unknown	Not assessed		r1,r12,r14,r25,
Plantae	Pteridophyta	Filicopsida	Marsileales	Marsileaceae		Marsilea quadrifolia Linnaeus	European Water-clover	Potentially Invasive	Non-Native (NA)	Not Established	Not assessed	CT (potentially invasive)	r12,r14,r23,
Plantae	Pyrrophycophyta	Dinophyceae	Dinamoebales	Pfiesteriaceae		Pfiesteria piscicida Steidinger and Burkholder, 1996	Pfiesteria	Unknown	Cryptogenic	Unknown	Not assessed		r21,r22,
Plantae	Pyrrophycophyta	Dinophyceae	Ebriales	Hermesinaceae		Hermesinum adriaticum Zach.		Unknown	Unknown	Unknown	Not assessed		r22,
Plantae	Pyrrophycophyta	Dinophyceae	Gonyaulacales	Goniodomataceae		Alexandrium minutum Halim, 1960			Unknown	Unknown	Not assessed		r7,
Plantae	Rhodophyta	Florideophyceae	Ceramiales	Ceramaceae		Antithamion nipponicum			Non-Native (RI)	Unknown	Not assessed	LIS	r7,
Plantae	Rhodophyta	Florideophyceae	Ceramiales	Ceramaceae		Antithamion pectinatum (Mont.) Brauner in Athanasiadis et Tittley		Unknown	Non-Native (RI)	Unknown	Not assessed		r9,r22,r28,
Plantae	Rhodophyta	Florideophyceae	Ceramiales	Rhodomelaceae		Neosiphonia harveyi (J.Bailey) M.S.Kim, H.G.Choi, et G.V.Saunders		Unknown	Non-Native (NA)	Established	Not assessed		r7,r14,r18,r22,r28,r39,r40,r45,r52,r53
Plantae	Rhodophyta	Florideophyceae	Halimiales	Halymeniaceae		Grateloupia turuturu Yamada	Red alga	Under Observation	Non-Native (NA)	Established	Not assessed		r9,r14,r28,
Plantae	Rhodophyta	Florideophyceae	Rhodymeniales	Lomentariaceae		Lomentaria clavellosa (Turn.) Gaillon		Unknown	Non-Native (RI)	Unknown	Not assessed		r9,r14,r28,
Plantae	Rhodophyta	Florideophyceae	Rhodymeniales	Lomentariaceae		Lomentaria orcadensis (Harv.) Collins ex W.R.Taylor		Unknown	Native	Established	Not assessed		r7,r9,
Plantae	Rhodophyta	Rhodophyceae	Bangiales	Bangiaceae		Porphyra suborbiculata	Red alga		Unknown	Unknown	Not assessed		r9,r22,
Plantae	Rhodophyta	Rhodophyceae	Bangiales	Bangiaceae		Porphyra yezeensis	Nori		Unknown	Unknown	Not assessed	ME, ME	r1,r7,
Plantae	Rhodophyta	Rhodophyceae	Bonnemaisoniales	Bonnemaisoniaceae		Bonnemaisonia hamifera Har.	Red Alga	Restricted and invasive	Non-Native (NA)	Established	Not assessed		r9,r14,r22,r28,
Plantae	Rhodophyta	Rhodophyceae	Gigartinales	Dumontiaceae		Dumontia contorta (S.G.Gmelin) Rupr.		Unknown	Native	Unknown	Not assessed		r9,r22,
Plantae	Rhodophyta	Rhodophyceae	Gigartinales	Fucellariaceae		Fucellana lumbricalis (Hudson)			Unknown	Unknown	Not assessed		r7,
Plantae	Rhodophyta	Rhodophyceae	Gigartinales	Phylloporaceae		Gymnogongrus C. F. P. Martius, 1833			Unknown	Unknown	Not assessed		r7,
Plantae	Rhodophyta	Rhodophyceae	Rhodymeniales	Champiaceae		Lomentaria davellosa			Unknown	Unknown	Not assessed	CT-NH	r7,
Protozoa						Bonamia ostrea	[Bonamia oyster disease]		Non-Native (RI)	Unknown	Not assessed	ME	r7,r9,
Protozoa	Ciliophora	Ciliata	Peritrichida	Vorticellidae		Zoothamnium	Ciliate	Potentially Invasive	Non-Native (NA)	Established	Not assessed		r22,
Protozoa	Dinoflagellida					Amoebophya sp. Koeppen	parasitic dinoflagellate		NA	Unknown	Not assessed		r43,
Protozoa	Dinoflagellida					Perkinsus marinus	Dermo Disease	Unknown	Cryptogenic	Unknown	Not assessed	MA, ME	r1,r7,r18,r22,r42,
Protozoa	Labyrinthomorpha					[Quahog Parasite Unknown]	Quahog Parasite Unknown, QPX	Unknown	Unknown	Unknown	Not assessed	MA, ME	r1
Protozoa	Protozoa	Haplosporea	Haplosporida	Haplosporidiidae		Haplosporidium costalis	[SSO (Seaside organism)]		Unknown	Unknown	Not assessed	MA	r22,

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Protozoa	Protozoa	Haplosporea	Haplosporida	Haplosporidiidae		Haplosporidium nelsoni	MSX (Multinucleate Sphere X) Disease	Unknown	Non-Native (RI)	Unknown	Not assessed	MA, ME	r7, r18, r22, r42,
Protozoa	Protozoa	Sporozoa				Neoparamoeba pemaquidensis (Page, 1987)	Lobster paramoeba		Unknown	Unknown	Not assessed		r1, r22,
Virus	RNA viruses	Group V (-ssRNA)		Orthomyxoviridae		Orthomyxovirus	Infectious Salmon Anemia Virus		Unknown	Unknown	Not assessed	ME	r1,
Virus	RNA viruses	Group V (-ssRNA)	Mononegavirales	Rhabdoviridae	Rhabdoviruses	Viral Hemorrhagic Septicemia (VHS)	Viral Hemorrhagic Septicemia (VHS)	Unknown	Unknown	Unknown	Not assessed	NY	