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***A MODEL COMPREHENSIVE STATE MANAGEMENT  
PLAN FOR THE PREVENTION AND CONTROL OF  
NONINDIGENOUS AQUATIC NUISANCE SPECIES***

**REPORT TO THE GREAT LAKES STATES**

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(Approved by the Great Lakes Panel on Aquatic Nuisance Species)

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## ***PREFACE***

This report is presented to the Great Lakes states as guidance in developing comprehensive state management plans under Section 1204 of the federal *Nonindigenous Aquatic Nuisance Prevention and Control Act* (P.L. 101-646) (*NANPCA*). Although prepared specifically for the Great Lakes states, this model plan also has application for other states and Canadian provinces.

This report is based on the findings of a regional workshop (May 1995) titled *Aquatic Nuisance Species/Coastal Management Programs: Toward a Regional Strategy in the Great Lakes Basin*. That workshop, as well as this report and an associated proceedings document, were made possible by a grant from the National Oceanic and Atmospheric Administration to the Michigan Department of Natural Resources under Section 308 of the Coastal Zone Management Act.

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Questions and comments on this report can be directed to the Great Lakes Commission at: The Argus II Building, 400 Fourth Street, Ann Arbor, MI 48103-4816; phone: 313-665-9135; fax: 313-665-4370; e-mail: [glc@great-lakes.net](mailto:glc@great-lakes.net).

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**TABLE OF CONTENTS**

<b>PREFACE</b> .....	i
<b>I. HOW TO USE THIS MODEL</b> .....	1
<b>II. RECOMMENDED COMPONENTS OF A STATE MANAGEMENT PLAN</b> .....	2
<b>1) EXECUTIVE SUMMARY</b> .....	2
<b>2) NONINDIGENOUS AQUATIC NUISANCE SPECIES BACKGROUND</b> .....	3
<b>3) POLICY BACKGROUND</b> .....	7
<b>4) MANAGEMENT ACTIONS</b> .....	10
Goal I: Preventing new introductions of nonindigenous aquatic nuisance species into the Great Lakes and inland waters of the state .....	10
Goal II: Limiting the spread of established populations of nonindigenous aquatic nuisance species into uninfested waters of the state .....	14
Goal III: Abating harmful ecological, economic, social and public health impacts resulting from infestations of nonindigenous aquatic nuisance species .....	17
<b>5) IMPLEMENTATION</b> .....	20
Example Implementation Schedule .....	21
Example Timeline .....	22
<b>6) PROGRAM MONITORING AND EVALUATION</b> .....	23
<b>7) GLOSSARY</b> .....	24
<b>8) RECOMMENDED APPENDICES</b> .....	25
Section 1204 of <i>Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990</i> List of members of relevant task forces/committees State laws and regulations <i>Information/Education Strategy for Aquatic Nuisance Prevention and Control</i> , prepared by the Information/Education Subcommittee, Great Lakes Panel on Aquatic Nuisance Species Other relevant management plans Reference Materials Emergency contacts Literature Cited .....	26
<b>III. ATTACHMENT 1: <i>Information/Education Strategy for Aquatic Nuisance Prevention and Control</i>, Prepared by the Information/Education Subcommittee of the Great Lakes Panel on Aquatic Nuisance</b>	

## I. HOW TO USE THIS MODEL

This document is a model to guide Great Lakes states in the development of state comprehensive management plans for the prevention and control of nonindigenous aquatic nuisance species as called for in the federal *Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990* (Public Law 101-646) (*NANPCA*). (Note that in this document, reference to aquatic nuisance species will imply that the species is nonindigenous.) It is recommended that each state's plan include the following eight sections: 1) executive summary; 2) nonindigenous aquatic nuisance species (ANS) background; 3) policy background; 4) management actions; 5) implementation; 6) program monitoring and evaluation; 7) glossary; and 8) appendices.

The executive summary should include a brief overview of the state management plan, including a statement of purpose for the plan. The nonindigenous ANS background should provide a brief history of the invasion of aquatic nuisance species in the Great Lakes region, including a state-specific historical perspective. It should feature species that have caused significant ecological and/or socio-economic impacts in the region/state to illustrate the need for prevention and control of aquatic nuisance species. The policy background should present a brief overview of *NANPCA*, as well as any relevant state-specific legislation/policies. The management actions section should outline the goals, problems, strategic actions and tasks that are designed to guide the state in addressing ANS problems. Reference to the *Information/Education Strategy for Aquatic Nuisance Prevention and Control* (prepared by the Information/Education Subcommittee of the Great Lakes Panel on Aquatic Nuisance Species) is recommended, when applicable, to assist in developing strategic actions and tasks for the state management plan (refer to **Attachment 1**). The implementation section should contain task-specific details on lead and cooperating agencies, budget and sources of funds, and timelines. The program monitoring and evaluation section should explain how the state will monitor/evaluate implementation progress and initiate adjustments, as needed. The glossary should provide definitions of terms that are consistent with those presented in *NANPCA*. The appendices should include supporting documentation for the management plan.

To help ensure success in using this model as guidance in shaping individual state management plans, the states are encouraged to involve responsible agencies and interested stakeholders in the planning and implementation process. These groups should include, among others, federal, state, and local governmental agencies, scientists, local and state decisionmakers, recreational user groups, industry and business representatives, environmental/conservation groups and citizens. A public review process of the state management plan will be required for eligibility for federal approval and supporting grants.

It is important to note that the following model is offered as guidance to the states to assist in the development of their management plans, and to facilitate a certain level of regional direction and coordination regarding the state management plans of the Great Lakes region.

This model, however, should be considered a flexible tool that can be modified to most effectively address the needs and interests of the individual states. In developing a state management plan, efforts should be taken to ensure that it is consistent with the planning, management and policy initiatives of the other Great Lakes states working on the plans.

## **II. RECOMMENDED COMPONENTS OF A STATE MANAGEMENT PLAN**

### **1) EXECUTIVE SUMMARY**

*(Note: The executive summary should provide a brief synopsis of each section of the state management plan. The executive summary also should include a general statement on the purpose of the state management plan as articulated in NANPCA. The statement of purpose should be augmented with a state-specific perspective. Also recommended for inclusion is an overview of the goals on which the plan is based.)*

The purpose of the comprehensive state management plan is to provide guidance on management actions to address the prevention, control and impacts of nonindigenous aquatic nuisance species that have invaded or may invade the Great Lakes and inland waters of the state. The development of a state management plan, as called for in Section 1204 of the *Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990* (P.L. 101-646) (*NANPCA*) provides an opportunity for federal cost-share support for implementation of the plan. Approval of the management plan by the national Aquatic Nuisance Species (ANS) Task Force is also required for a state to be eligible for federal cost-share support.

Section 1204 requires that the management plan identifies those areas or activities within the state, other than those related to public facilities, for which technical and financial assistance is needed to eliminate or reduce the environmental, public health and safety risks associated with aquatic nuisance species. The content of each state plan is to focus on the identification of feasible, cost-effective management practices and measures to be taken on by state and local programs to prevent and control ANS infestations in a manner that is environmentally sound.

The goals of this model state management plan are designed to address different stages of ANS invasion: 1) the introduction of nonindigenous species transported from water bodies from other parts of the continent or world; 2) the spread of an established, reproducing ANS population to other water bodies and 3) the colonization of ANS populations within water bodies, including the harmful impacts resulting from colonization.

The three goals on which the model state management plan is based are as follows:

- Goal I: Preventing new introductions of nonindigenous aquatic nuisance species into the Great Lakes and inland waters of the state.
- Goal II: Limiting the spread of established populations of nonindigenous aquatic nuisance species into uninfested waters of the state.

- Goal III: Abating harmful ecological, economic, social and public health impacts resulting from infestation of nonindigenous aquatic nuisance species.

## **2) NONINDIGENOUS AQUATIC NUISANCE SPECIES BACKGROUND**

*(Note: The following text is suggested information for use in the introduction of each state's management plan. Each state should use this material, as appropriate, and add additional state-specific information, as available.)*

The introduction of nonindigenous aquatic nuisance species into the Great Lakes and inland state waters is a source of biological pollution that threatens not only the ecology of the region and states' water resources, but also the economic, societal and public health conditions of the region and states. The Great Lakes and connecting channels and rivers form the largest surface freshwater system in the world. The water resources of the Great Lakes region are an integral part of activities such as recreation and tourism valued at \$15 billion annually, \$6.89 billion of which is related to the fishing industry. Approximately 75,000 jobs are supported by sport fisheries; and commercial fisheries provide an additional 9,000 jobs (U.S. Fish and Wildlife Service, 1995).

The Great Lakes region has been subject to the invasion of aquatic nuisance species since the settlement of the region by Europeans. Since the 1800s, at least 139 nonindigenous aquatic organisms have colonized habitats of the Great Lakes ecosystem. The bulk of these species include: plants (59), fish (25), algae (24), mollusks (14) and oligochaetes (7). About 55 percent of these species are native to Eurasia; 13 percent are native to the Atlantic Coast. Although the obvious impacts of some of the most abundant species are being determined, most of the aquatic nuisance species and their direct and indirect impacts are not known.

As use of the Great Lakes intensified as a transportation route for commerce, the rate of introduction of aquatic nuisance species also increased. More than one-third of the organisms have been introduced in the past 30 years, a surge coinciding with the opening of the St. Lawrence Seaway. Other human activities contributing to the transport and dispersal of aquatic nuisance species in the Great Lakes and inland state waters include release of organisms from the ballast water of ships, transport and release from the bottom of ships, movement or intentional release of aquaculture and fishery species along with their associated (free-living and parasitic) organisms, release of organisms associated with pet industries or pest management practices, recreational boating, bait handling, water transport, and ornamental and landscape practices.

A newly introduced species, if it becomes established through reproduction, can disrupt the natural ecosystem balance by altering the composition, density and interactions of native species. This disruption can cause significant changes to the ecosystem, such as alterations to the foodwebs, nutrient dynamics and biodiversity. New introductions also can cause costly socio-economic impacts even if effective prevention and control mechanisms are established. Eventually, each newly introduced species will become integrated into an ecosystem that is in a constant state of flux; or the population will not survive and become extinct (New York State Department of Environmental Conservation, 1993).

Approximately 10 percent of the Great Lakes' nonindigenous aquatic species have resulted in significant negative ecological and economic impacts. The following examples portray the extensive ecological and economic impacts caused by aquatic nuisance species that have been introduced into the Great Lakes region.

The invasion of the sea lamprey in the 1940s has resulted in substantial economic losses to recreational and commercial fisheries, and has required annual expenditures of millions of dollars to finance control programs. During the 1940s and 1950s, the sea lamprey, a top predator which kills fish by attaching to its prey and feeding on body fluids, devastated populations of whitefish and lake trout. The predation of the sea lamprey on this valuable commercial fishery permitted populations of commercially less valuable fish to proliferate. In 1992, annual sea lamprey control costs and research to reduce its predation were approximated at \$10 million annually. The total value of the lost fishing opportunities plus indirect economic impacts could exceed \$500 million annually (Office of Technology Assessment, 1993).

The nonindigenous populations of alewife increased rapidly in the Great Lakes during the 1940s and 1950's because of the suitability of the habitat and the fact that predators were not sufficiently abundant to check their growth. Consequently, periodic die-offs fouled recreational beaches and blocked municipal and industrial water intakes. While the alewife out-competed and suppressed whitefish, yellow perch, emerald shiners and rainbow smelt, it subsequently became a fish preyed upon by introduced trout and salmon. The alewife has permanently altered the existing predator-prey relationships in the Great Lakes ecosystem.

The ruffe, a Eurasian fish of the perch family, was introduced to North America in the 1980s, most likely through the ballast water of a seagoing vessel. This aquatic nuisance species has few predators, no commercial or recreational value and is replacing valuable native fishes. Since its introduction, the ruffe has become established in the nearshore waters of western Lake Superior, with an estimated average rate of range expansion of 18 shoreline miles per year. By the fall of 1994, ruffe populations were found in Michigan waters of Lake Superior and in August of 1995, three ruffe were discovered in a commercial harbor in northern Lake Huron, more than 300 miles east of the previously known range. The ruffe has become the most abundant species in Duluth Harbor. Based on observations of present ruffe migration rates along with native fish population displacements in Lake Superior, as well as past experience of ruffe in European waters, it appears that ruffe will be in direct competition with yellow perch and whitefish populations. Walleye populations are affected indirectly through a change in the food chain composition brought on by the proliferation of the ruffe. Based on moderate estimates of expected declines of yellow perch, whitefish and walleye, the annual economic loss to the U.S. sport and commercial fisheries is estimated at approximately \$119 million if the ruffe suddenly proliferates to all lake regions (Leigh, 1994).

The round goby and the tubenose goby were introduced via ballast water into the St. Clair River, near Detroit in 1990. The tubenose goby has not thrived, but the round goby has



spread into Lake Erie and Lake Michigan where the largest population is found. The round goby was observed in the St. Louis River Estuary in Lake Superior during the summer of 1995. The primary concern with the round goby is the tremendous range expansion exhibited since its introduction in 1990. It is a very aggressive fish, and feeds voraciously upon bottom-feeding fishes (e.g., sculpin, darters and logperch), snails, mussels and aquatic insects. The Great Lakes fisheries, particularly those in Lake Michigan and Lake Erie, are threatened by this aquatic nuisance species due to its robust characteristics and ability to displace native species from prime habitat and spawning areas.

The spiny water flea, a likely ballast water introduction, is a tiny crustacean with a sharply barbed tail spine. The northern Europe native was first found in Lake Huron in 1984. The spiny water flea is now found throughout the Great Lakes and in some inland lakes. Although researchers do not know what effect the invader will have on the ecosystem, resource managers suspect that the water flea competes directly for food with small fish such as perch.

The zebra mussel, another ballast water introduction, is one of the best known invaders of the Great Lakes region and other areas of the country where it has spread. This aquatic nuisance species has caused serious economic and ecosystem impacts. The zebra mussel, a highly opportunistic mollusk, reproduces rapidly and consumes microscopic aquatic plants and animals from the water column in large quantities. The potential impact on the fishery can be profound due to changes in food availability and spawning areas, to name a few. Economic impacts are as pervasive as the ecosystem impacts. Great Lakes municipalities, utilities and industries due to the infestation of zebra mussel in their intake/discharge pipes have significant costs associated with monitoring, cleaning and controlling infestations. According to a recent economic impact study, each of 84 Great Lakes water users reported average total expenditures of \$513,600 over the five-year period from 1989 to 1994 (Hushak et al., 1995). By the end of this century, water users across the country are expected to spend between \$2 billion and \$3 billion cleaning clogged water intakes (Ruiz et al., 1995). Commercial and recreational vessels and beach areas also are vulnerable to the negative impacts of the zebra mussel.

Nonindigenous aquatic plants also have been introduced to the Great Lakes region and inland waters. Purple loosestrife is a wetland plant from Europe and Asia that was introduced to the east coast of North America in the 1800s. Purple loosestrife invades marshes and lakeshores, replacing cattails and other wetland plants. This nonindigenous plant is unsuitable to meet habitat needs such as cover, food or nesting sites for a wide range of native wetland animals including ducks, geese, rails, bitterns, muskrats, frogs, toads and turtles.

Eurasian water milfoil, unintentionally introduced to North America from Europe, has spread into inland lakes primarily by boats. Milfoil can proliferate in high densities in lakes, producing habitat conditions that cause serious impairments to commercial fishing and water recreation such as boating, fishing and swimming. The plant's surface canopy also can out-compete and eliminate native aquatic vegetation, as well as threaten native fish and wildlife

populations.

Numerous aquatic nuisance species have been introduced and dispersed in the Great Lakes and inland waters of each state by various pathways. The environmental and socio-economic costs resulting from ANS infestations will only continue to rise with further ANS introductions. Although an awareness of the problems caused by aquatic nuisance species is emerging, the solutions are not readily apparent. This comprehensive state management plan for nonindigenous aquatic nuisance species provides guidance for management actions to address the prevention, control and impacts of aquatic nuisance species that have invaded or may invade the Great Lakes region and inland state waters.

### **3) POLICY BACKGROUND**

*(Note: The following text offers exemplary language for the "policy background" section of each state management plan. This text is limited to an overview of NANPCA, with a special emphasis on Section 1204 language addressing state management plans. This text should be followed by state-specific background on institutional arrangements, and provisions for ANS prevention and control on the state level.)*

The prevention and control of aquatic nuisance species have global implications that require policies and programs at various levels of government. The following overview of the federal *Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990* (Public Law 101-646) (*NANPCA*), delineates the basic role of federal, regional and state government in the act's implementation. *NANPCA* has served as an important resource in the development of this model state management plan and the states are strongly advised to acknowledge the guidelines of the act in the implementation of the state plans.

#### **Federal Role**

*NANPCA* is the federal legislation which calls upon each state to develop and implement a comprehensive state management plan for the prevention and control of aquatic nuisance species. The act, established for the prevention and control of the unintentional introduction of nonindigenous aquatic nuisance species, is based on the following five objectives as listed in Section 1002 of *NANPCA*:

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

*NANPCA* was primarily created in response to the zebra mussel invasion of the Great Lakes, where this ballast water introduction has caused serious ecological and socio-economic impacts. Although the zebra mussel invasion of the Great Lakes has played a central role in prompting passage of the federal legislation, *NANPCA* has been established to prevent the occurrence of new ANS introductions and to limit the dispersal of aquatic nuisance species already in U.S. waters.

The national Aquatic Nuisance Species (ANS) Task Force, co-chaired by the U.S. Fish and Wildlife Service and the National Oceanic and Atmospheric Administration, was established under Section 1201 of *NANPCA* to coordinate governmental efforts related to nonindigenous aquatic nuisance species in the United States with those of the private sector and other North

American interests. An important role of this federal group in the implementation of *NANPCA* is to facilitate national policy direction in support of the act. The ANS Task Force (consisting of seven federal agency representatives and eight ex officio members representing nonfederal governmental entities) has adopted the *Aquatic Nuisance Species Program* under Section 1202 of the act which recommends the following essential elements:

- **Prevention:** Establish a systematic risk identification, assessment and management process to identify and modify pathways by which nonindigenous aquatic nuisance species spread.
- **Detection and Monitoring:** Create a National Nonindigenous Aquatic Nuisance Species Information Center to coordinate efforts to detect the presence and monitor the distributional changes of all nonindigenous aquatic nuisance species, to identify and monitor native species and other effects, and to serve as a repository for that information.
- **Control:** The Task Force or any other potentially affected entity may recommend initiation of a nonindigenous aquatic nuisance species control program. If the Task Force determines, using a decision process outlined in the control program, that the species is a nuisance and control is feasible, cost effective and environmentally sound, a control program may be approved.

The ANS Task Force recommends research, education and technical assistance as strategies to support the elements listed above.

The ANS Task Force also provides national policy direction as a result of protocols and guidance that have been developed through the efforts of the following working committees: Research Protocol/Coordination Committee, Intentional Introduction Policy Review Committee, Great Lakes Panel on Aquatic Nuisance Species, Ruffe Control Committee, Risk Assessment and Management Committee, Detection and Monitoring Committee, Zebra Mussel Coordination Committee and the Brown Tree Snake Control Committee.

One role of the federal government in the prevention of unintentional introductions of aquatic nuisance species is defined under Section 1101 of *NANPCA*, which mandates the establishment of regulations for ballast water management aimed at limiting introductions through transoceanic shipping. U.S. regulations control the discharge of ballast from all vessels entering Great Lakes waters, thus far the only region in the United States to be regulated. The regulations have been enforced by the U.S. Coast Guard since May 1993, with active assistance from the Canadian Coast Guard and Seaway authorities. (The Canadian federal government has yet to enact federal ballast water management regulations; voluntary guidelines are in place.) The need has been identified for a federal research program to develop innovative technology for ballast water management.

## **Regional Role**

Great Lakes regional coordination is addressed under Section 1203 of *NANPCA* which calls upon the Great Lakes Commission to convene the Great Lakes Panel on Aquatic Nuisance Species. Panel membership is drawn from a wide range of federal, state, provincial and regional agencies, private sector user groups, Sea Grant programs and environmental organizations, to ensure that the positions of the Panel provide a balanced and regional perspective on Great Lakes issues. The Panel's responsibilities for the Great Lakes region are sixfold: 1) identify Great Lakes priorities; 2) make recommendations to the national ANS Task Force; 3) assist the ANS Task Force in coordinating federal programs within the region, 4) advise public and private individuals on control efforts; and 5) submit annually a report to the ANS Task Force describing prevention, research and control activities in the Great Lakes Basin.

## **State Role**

The comprehensive state management plans for aquatic nuisance species are addressed in Section 1204 of *NANPCA*. Section 1204 requires that the management plan "identifies those areas or activities within the state, other than those related to public facilities, for which technical and financial assistance is needed to eliminate or reduce the environmental, public health and safety risks associated with aquatic nuisance species." The content of each state plan is to focus on the identification of feasible, cost-effective management practices and measures to be pursued by state and local programs to prevent and control aquatic nuisance species infestations in a manner that is environmentally sound. As part of the plan, federal activities are to be identified for prevention and control measures, including direction on how these activities should be coordinated with state and local efforts. Section 1204 also states that in the development and implementation of the management plan, the state needs to involve appropriate local, state and regional entities, as well as public and private organizations that have expertise in ANS prevention and control.

The state management plans are to be submitted to the national ANS Task Force for approval. If the plan meets the requirements of the ANS Task Force, the plan becomes eligible for federal cost-share support. If not, the plan is returned to the state with recommended modifications. (New York is the first and only Great Lakes state, thus far, with an approved plan, resulting in \$68,000 in federal cost-share support from the U.S. Fish and Wildlife Service.) Plans may be implemented with other funds supplied by state and cooperative agencies. Further details on the state management plans can be found in Section 1204 of the act.

#### 4) MANAGEMENT ACTIONS

*(Note: This section of the model should present the state's management goals, associated problem statements, and the strategic actions and tasks needed to address them. It is recommended that each state's plan center upon the three goals stated below. Each is accompanied by a problem statement, strategic action(s), and task(s). Much of the text is presented in generic form and should be readily adoptable to each state's management plan. State-specific information should be incorporated into the text where relevant. Reference to the Great Lakes Panel's Information/Education Strategy for Aquatic Nuisance Prevention and Control is recommended, when applicable, to assist in developing strategic actions and tasks for the state management plan (refer to **Attachment 1**).*

The goals of this model state management plan are designed to address different stages of ANS invasion: 1) the introduction of the nonindigenous species transported from water bodies from other parts of the continent or world; 2) the spread of an established, reproducing ANS population to other water bodies; and 3) the colonization of ANS populations within water bodies, including the harmful impacts resulting from colonization.

The three goals on which the model state management plan is based are as follows:

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- Goal III: Abating harmful ecological, economic, social and public health impacts resulting from infestation of nonindigenous aquatic nuisance species.

##### **Goal I: Preventing new introductions of nonindigenous aquatic nuisance species into the Great Lakes and inland waters of the state.**

*Problem: The introduction of nonindigenous aquatic nuisance species into the Great Lakes region, including inland state waters, frequently causes environmental, socio-economic and public health impacts. The severity of these impacts is not known or recognized on a wide-scale basis, impeding the investment of resources needed to prevent new ANS introductions. Also, a delayed "crisis-response" approach often limits the vision and opportunity for the prevention of new introductions, leaving the region with ANS management problems that are economically costly, technically challenging, if not unfeasible to solve, and frequently irreversible. Although 139 nonindigenous aquatic species already have been introduced into the Great Lakes ecosystem, new introductions are still highly likely. The prevention of new introductions is critical in ameliorating ANS problems in the Great Lakes region and in individual states.*

*Multiple mechanisms transport aquatic nuisance species into the Great Lakes and inland state waters; some such mechanisms transcend the authority of a single state to control. A prime*

*example is ballast water discharge from transoceanic shipping, the largest source of nonindigenous aquatic species invasions world-wide (Carlton, 1985). The absence of interjurisdictional authority is problematic in regulating the transoceanic vectors transporting aquatic nuisance species to the Great Lakes. Cooperative efforts are necessary between state, federal (i.e., Coast Guard) and international agencies to promulgate and enforce regulations to ensure that ballast management practices and other related transport mechanisms are employed to prevent ANS introductions.*

*Current technology is frequently inadequate to prevent new introductions of aquatic nuisance species into the Great Lakes and inland state waters. Research on prevention strategies to minimize ANS transport, such as innovative ballast water management technology, is critical in the effective prevention of ANS introductions. Ongoing studies by the U.S. and Canadian Coast Guards indicate that it is especially important to deal with the difficult problem posed by vessels entering the Great Lakes with residual unpumpable ballast water and sediment in their tanks. This medium, potentially harboring a variety of aquatic nuisance species, is often mixed with Great Lakes fresh water and discharged at another Great Lakes port. In order to achieve more effective emptying or flushing of these tanks, the feasibility of altering the current design of ballast tanks needs to be examined.*

*Other significant transport mechanisms increasing the potential for new introduction of aquatic nuisance species into the Great Lakes and inland state waters include the aquaculture business, commercial barge traffic, recreational boating, the bait industry and fish stocking activities—all of which have the potential to introduce aquatic nuisance species as well as associated parasites and other disease organisms. In some cases, such activities are subject to little or no regulations. In cases where laws/regulations do exist, they are frequently not well-publicized and/or enforced. User groups that could potentially introduce aquatic nuisance species into the Great Lakes region/states are generally not adequately informed of ANS prevention practices.*

***Strategic Action: In partnership with other states, develop state-specific and regional listings of aquatic nuisance species that have the potential to infest the Great Lakes and inland state waters. As part of this cooperative effort, identify existing and potential transport mechanisms that facilitate new ANS introductions.***

Task: Research and/or support research on the movement of aquatic nuisance species on a global scale, and use findings to help predict potential ANS invasions in the Great Lakes and inland state waters.

***Strategic Action: Establish interjurisdictional approaches to facilitate legislative, regulatory and other actions needed for the prevention of new ANS introductions into the Great Lakes and inland state waters.***

Task: Establish and support coalitions among the Great Lakes states, including ANS officials from the state natural resource agencies, the Coastal States Organization and

coastal managers, tribal groups, recreational boater and angler groups and other concerned resource users. Assist coalitions in promoting federal legislation and programmatic support for the prevention of new ANS introductions in the region/state.

Task: Establish and support an interjurisdictional process to ensure compatibility and consistency between Great Lakes states and between states and federal agencies. (Federal consistency, a tool implemented by coastal management programs to ensure that federal activities/projects are compatible with enforceable policies of the state, is recommended to facilitate interjurisdictional endeavors.)

Task: Initiate and implement a Great Lakes regional approach through the Great Lakes Panel on Aquatic Nuisance Species to prevent new introductions of aquatic nuisance species into the Great Lakes and inland state waters.

***Strategic Action: Promulgate, publicize and enforce state legislation and regulations to prevent new ANS introductions into state waters, including both the Great Lakes and inland waters.***

Task: Establish an interagency task force (with representation from public and private sectors) to develop regulations for state legislative consideration. State coastal management personnel should play a role in the process to ensure that proposed rules for this are consistent with and build upon existing authorities. (Note: A recommended resource to facilitate this process is the national ANS Task Force publication, *Findings, Conclusions, and Recommendations of the Intentional Introductions Policy Review* (see literature citations).)

Task: Develop and implement an outreach program that informs relevant groups of the regulations, their rationale and compliance procedures.

Task: Develop and implement enforcement programs.

***Strategic Action: Develop/maintain monitoring programs in the Great Lakes region/states to provide for early detection and prevention of infestations of aquatic nuisance species into unaffected watersheds.***

Task: Establish/participate in monitoring programs that emphasize partnerships between federal/state/local agencies; business/industry; academic institutions; and resource user groups. The feasibility of various technologies (e.g., Geographic Information Systems (GIS)) should be explored in designing such programs.

***Strategic Action: Conduct or support research regarding management options that will help prevent new introductions of aquatic nuisance species into the Great Lakes and inland state waters.***



Task: Assess the transport mechanisms potentially responsible for new ANS introductions into the Great Lakes and inland state waters. Develop preventive action plans to interrupt pathways of introduction.

Task: Analyze current shipping practices regarding the transport of aquatic nuisance species into the Great Lakes and determine the need for improvement of current controls on vessels to impede this transport.

Task: Conduct research on ballast water management as a primary ANS transport mechanism. Research should focus on the feasibility of retrofitting and redesigning current ballast tanks in order to allow more effective flushing or filtering of both full tanks and those holding unpumpable residual ballast.

Task: Examine climate change scenarios in relation to habitat alterations in the Great Lakes region to predict the potential effect on new ANS introductions into the Great Lakes and inland state waters.

***Strategic Action: Conduct an effective information/education program on the prevention of new ANS introductions in the Great Lakes and inland state waters.***

(Note: A recommended resource to assist in accomplishing this strategic action is the Great Lakes Panel's *Information/Education Strategy for Aquatic Nuisance Prevention and Control* (refer to **Attachment 1**.)

Task: Identify the relevant Great Lakes regional/state user groups (i.e. shipping industry, aquaculture business, recreational boating/angler groups, bait and tackle establishments, state agency stocking programs) and secure representation from each group on an advisory team that takes an active role in the development of the ANS state management plan.

Task: Develop information/education strategies for resource user groups identified as playing a significant role in ANS introduction. Information/education efforts should focus on the practices that can help prevent ANS transport and introduction into the Great Lakes and inland state waters. As part of information/education initiatives, identify, when appropriate, the need for a regulatory approach in the prevention of ANS introductions.

Task: Establish monitoring/tracking programs to evaluate the effectiveness of information/education efforts.

**Goal II: Limiting the spread of established populations of nonindigenous aquatic nuisance species into uninfested waters of the state.**

*Problem: The spread of established populations of nonindigenous aquatic nuisance species into uninfested state waters is largely via human activity, such as boat transfers, ballast exchange, bait handling, water transport, and ornamental and landscape practices. Limiting the spread of such populations is problematic due to the numerous pathways of dispersal, the complex ecological characteristics associated with ANS populations and the lack of feasible technology that is needed to limit the spread.*

*Many public and private resource user groups are not aware of existing infestations of aquatic nuisance species in the Great Lakes and inland state waters, and why they cause priority problems locally, regionally and beyond. The probability of ANS spread to other waters can increase when resource user groups are not aware of how their routine activities can cause the dispersal of aquatic nuisance species into uninfested water bodies. An information/education program is needed to provide information on why the spread of ANS populations needs to be limited, how the ANS populations can be reduced, and the value of a healthy aquatic ecosystem that supports a diverse native aquatic community. Information/education programming is also critical to strengthening public/private support for and statewide participation in ANS management strategies.*

*It also is difficult to manage the spread of aquatic nuisance species, since infestation frequently occurs in watersheds that occupy more than one state. Cooperation among Great Lakes states sharing ANS-infested watersheds is needed to implement consistent management strategies that will effectively limit the spread of ANS populations.*

***Strategic Action: Identify and prioritize aquatic nuisance species whose spread should be limited.***

Task: Establish an advisory group, with representation from all stakeholders affected by the ANS problems in the state, to guide in the selection of aquatic nuisance species that merit management.

Task: Develop and implement a process to prioritize those aquatic nuisance species that merit management. (Note: An assessment of ANS impacts discussed under Goal III is recommended for this process. Also, a recommended resource to facilitate this prioritization process is the National Park Service publication, *Handbook for Ranking Exotic Plants for Management and Control* (see literature citations).)

***Strategic Action: Monitor the spread of those aquatic nuisance determined to be a state priority.***

Task: Design a monitoring program to provide information that will help in

developing an effective strategy to limit the spread of selected ANS populations. A network approach, including federal/regional/state/local agencies, public/private groups and academic institutions, is recommended. Variables to monitor include population size, structure and range; rate of growth; type of habitat; distribution; impacts on native species; and economic and other impacts on human communities.

Task: Develop identification materials for each aquatic nuisance species that is being monitored to facilitate participation of all stakeholders.

***Strategic Action: Develop and implement management strategies to limit the spread of each aquatic nuisance species determined to be a state priority.***

Task: Based on identified dispersal pathways, develop voluntary and regulatory approaches to limit the spread of aquatic nuisance species. Also, identify the best available technology for each management strategy and include an environmental impact assessment, where necessary.

Task: Implement a watershed approach to limit the spread of aquatic nuisance species within the state.

Task: Establish cooperative policies with states sharing watersheds to limit the spread of ANS populations.

***Strategic Action: Inform and educate the appropriate resource user groups on the management strategies needed to limit the spread of targeted ANS populations. To support this effort, the target groups should be informed on how the spread of aquatic nuisance species threatens the health of a diverse native aquatic community, and other harmful ANS impacts. Volunteer groups, such as lake associations and outdoor recreation groups, should be actively involved in these outreach efforts.***

(Note: A recommended resource to assist in accomplishing this strategic action is the Great Lakes Panel's *Information/Education Strategy for Aquatic Nuisance Prevention and Control* (refer to **Attachment 1**.)

Task: Assess existing ANS information/education programs (i.e., Sea Grant, cooperative extension, state natural resource agencies). Build on the strengths and address the weaknesses of these programs.

Task: Identify pathways that disperse aquatic nuisance species (i.e., recreational boaters/anglers, commercial and sport fishers, bait handling, water transport, ornamental and landscape practices) and inform these groups on practices to help limit the spread. This outreach program should focus on changing the behavior of user groups to limit the spread of targeted ANS populations in the Great Lakes and state inland waters.

Task: In cooperation with other Great Lakes states, establish a voluntary intra-lake ballast water management program that will inform ship owners, captains, engineers and other commercial shipping personnel of how to improve ballast management practices to impede the transfer of aquatic nuisance species within the Great Lakes system.

Task: Coordinate with state coastal management programs to ensure, where appropriate, that public access projects and interpretive displays include information about aquatic nuisance species.

Task: Establish monitoring/tracking programs to evaluate the effectiveness of information/education efforts.

***Strategic Action: Promulgate, publicize and enforce state regulations to limit the spread of aquatic nuisance species within the state.***

Task: Establish an interagency task force (with representation from public and private sectors) to develop regulations for state legislative consideration. State coastal management personnel should play a role in the process to ensure that proposed rules for this are consistent with and build upon extant authorities.

Task: Develop and implement an outreach program that informs relevant groups of the regulations and why they exist, and compliance procedures.

Task: Develop and implement enforcement programs.

***Strategic Action: Support/coordinate scientific research between state and federal agencies and academic institutions that investigate potential management strategies to limit the spread of ANS populations and associated environmental impacts.***

Task: Prioritize research needs to help in establishing program structure.

Task: Conduct priority research, or promote the conduct of such research via federal research initiatives, academia or the private sector.

Task: Develop a technology transfer program to be used in distributing research findings. (The Internet-based Great Lakes Information Network is the recommended vehicle for this process.)

**Goal III: Abating harmful ecological, economic, social and public health impacts resulting from infestations of nonindigenous aquatic nuisance species.**

*Problem: The infestation of nonindigenous aquatic nuisance species in the Great Lakes and inland state waters can cause, to varying degrees, ecological, economic, social and public health impacts. Strategies to control aquatic nuisance species in infested water bodies, in efforts to abate their impacts, are not always known or technically and/or economically feasible. Control strategies also must be designed so as not to cause significant environmental impacts.*

*The infestation of aquatic nuisance species in the Great Lakes and inland state waters can alter or disrupt existing relationships and ecological processes. Without co-evolved parasites and predators, some nonindigenous aquatic species out-compete and even displace aquatic native plant or animal populations. As part of this process, the invading species also can influence to some extent the foodwebs, nutrient dynamics and biodiversity of the ecosystem. To abate the ecological impacts of the invading organism, it is necessary to understand the mechanisms by which the species disrupts the natural balance of the ecosystem.*

*The Great Lakes and inland state waters provide valuable economic benefits for the region/state, some of which include commercial and sport fisheries, recreational use and water usage by manufacturers, industry and electric power companies. Some introduced aquatic nuisance species to the Great Lakes region/state have provided economic benefits, such as those supporting the aquaculture business and sport fishing industry. However, several aquatic nuisance species have been found to cause adverse economic impacts. For instance, the zebra mussel infests the intake/discharge pipes of hundreds of facilities that use raw water from the Great Lakes, causing extensive monitoring and control costs. The Eurasian water milfoil forms thick mats on the surface of water, which can interfere with many types of water recreational activities, such as swimming, water skiing and sailing. The invasion of the ruffe in Duluth-Superior Harbor appears to be causing the displacement of perch and whitefish populations, which could pose a serious threat to the commercial and sport fishing industry if the ruffe invasion spreads throughout the Great Lakes and inland state waters.*

*Organisms invading the Great Lakes and inland state waters can threaten public health through the introduction of disease, concentration of pollutants, contamination of drinking water, toxic algae blooms and other harmful human health effects (Ohio Sea Grant College Program, 1995). An extensive monitoring system for these aquatic nuisance species needs to be established to prevent human health problems from occurring in the Great Lakes region/state.*

*It is often difficult to assess the ecological, socio-economic and public health impacts of aquatic nuisance species in terms that are meaningful to decisionmakers and the general public. Action(s) to abate ANS impacts through control strategies is frequently impeded by*

*circumstances, such as the absence of political support and the lack of resources needed to effectively develop and implement control strategies.*

***Strategic Action: Assess the ecological, socio-economic and public health impacts of aquatic nuisance species in the Great Lakes and inland state waters. Use this assessment as guidance to develop action levels that warrant implementation of control strategies (Note: Consult New York State's Department of Environmental Conservation (NYSDEC) management plan for a useful assessment of ANS impacts (i.e., beneficial, innocuous, nuisance, detrimental), which may helpful in determining action levels for control. Also, a recommended resource to facilitate this process is the National Park Service publication, Handbook for Ranking Exotic Plant for Management and Control, (see literature citations).)***

Task: Identify and assess the damages of aquatic nuisance species that threaten the ecological health of the Great Lakes region.

Task: Identify and assess the damages of aquatic nuisance species that threaten public safety and/or human health of the state's residents.

Task: Identify and assess economic costs for each aquatic nuisance species causing damage to water users.

***Strategic Action: Based on the above impact assessments, develop and implement control strategies, including physical, chemical and biological mechanisms, to eradicate or reduce populations of targeted aquatic nuisance species in the Great Lakes and inland state waters (i.e., those aquatic nuisance species identified by each state as causing detrimental ecological, economic, social and/or public health impacts).***

Task: Establish protocols that will provide guidance in designing and implementing control strategies. An example from the NYSDEC management plan contains the following criteria for design of such methods:

- *The control strategy must not create problems greater than those related to the aquatic nuisance species itself;*
- *A control strategy must not have serious, long-term impacts to the environment or non-target organisms;*
- *There must be a need to control the aquatic nuisance species due to causing, or the potential of causing, adverse impacts;*
- *The control strategy must not reduce the human utilization of the water body (with the exception of those waters with special resource designation) or threaten human health;*
- *Control efforts should be directed against the areas significantly impacted, and not be broad and general in nature;*
- *The control strategy must have a reasonable likelihood of succeeding.*

These criteria may be applicable to other states.

Task: Support/coordinate scientific research between state and federal agencies and academic institutions that investigate potential control strategies and associated environmental impacts. Develop a technology transfer program to be used in distributing research findings. (The Internet-based Great Lakes Information Network is the recommended vehicle for this process.)

Task: Establish mechanism(s) to ensure that the control strategies developed and implemented by the state are done so in coordination with federal agencies, tribal authorities, local governments, interjurisdictional organizations and other appropriate entities (*NANPCA*, Section 1202).

Task: Establish mechanism(s) to ensure that the control strategies are based on the best available scientific information and conducted in an environmentally sound manner (*NANPCA*, Section 1202).

***Strategic Action: Develop and implement means of adapting human activities to accommodate infestations of aquatic nuisance species.***

(Note: Specific tasks, which will vary from one state to the next, should be inserted here).

***Strategic Action: Conduct an information/education program providing information on ANS impacts and related control strategies. Utilize existing groups/programs responsible for information dissemination (Sea Grant, state natural resource agencies, cooperative extension services, coastal management programs) when appropriate.***

(Note: A recommended resource to assist in accomplishing this strategic action is the Great Lakes Panel's *Information/Education Strategy for Aquatic Nuisance Prevention and Control* (refer to **Attachment 1**.)

Task: Design programs targeting public agencies needed in promoting management action to abate impacts; user groups needed for effective control of targeted species; and communities that need to learn how to live with aquatic nuisance species problems.

Task: Establish monitoring/tracking programs to evaluate the effectiveness of information/education efforts.

## 5) IMPLEMENTATION

*(Note: Implementation in terms of tasks, budgets and timelines is an important component of any state management plan. The following implementation schedule and timeline, excerpted from the Great Lakes Panel's Information/Education Strategy, are presented for illustrative purposes only. It is recommended that each state use this general tabular format as guidance for inserting its own specific plan goals, strategic actions and tasks.)*

To facilitate effective implementation of the state management plan, the state authorities are strongly encouraged to carefully assign the office(s) best suited to implement the plan. This process will entail the establishment of an infrastructure of agencies equipped to address the identified strategic actions and tasks of the plan.



**EXAMPLE IMPLEMENTATION SCHEDULE**

**Goal II: Limiting the spread of established nonindigenous aquatic nuisance species into uninfested waters of the state.**

<b>Strategic Actions Tasks</b>	<b>Lead Agency</b>	<b>Cooperating Organizations</b>	<b>Source of Funding</b>	<b>Budget (State/Federal)</b>	<b>Status/Progress Report</b>
<u>Information/Education</u> Evaluate existing ANS outreach program	Great Lakes Panel (GLP)	State Nat.Res. Agency, Sea Grant, State Coastal Mgmt. Prog., Tribal Authority, Academic Instit. USFWS, U.S. Coast Guard	GLP (staff support) State Agencies (staff support)	State: \$5,000 Federal: (to be determined)	Preliminary stages of development
<u>Information/Education</u> Identify ANS dispersal groups and inform on management practices	State agencies	Sea Grant, Coastal Mgmt. Prog., GLP, Tribal Auth., U.S. Coast Guard, Lake Assoc.	Coastal Mgmt. Program (Access Project), Sea Grant Project Funding, watercraft surcharges	State: (to be determined) Federal: (to be determined)	(to be determined)
<u>Information/Education</u> Establish outreach activities in support of ballast management program	U.S. Coast Guard	Lake Carriers' Assoc., USFWS, Sea Grant, state agencies	Shipping Assoc., U.S. Coast Guard, State Coastal Mgmt. Prog.	State: (to be determined) Federal: (to be determined)	(to be determined)

(Note: This Implementation Schedule is presented for illustrative purposes only.)

**EXAMPLE TIMELINE**

(quarterly timeline to cover a three year-period)

**Goal II: Limiting the spread of established nonindigenous aquatic nuisance species into uninfested waters of the state.**

<b>Strategic Actions Tasks</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>
<u>Information/Education</u> Evaluate existing ANS outreach program	X-----	----X										
<u>Information/Education</u> Identify ANS dispersal groups and inform of control practices				X-----	-----	-----	-----	-----X				
<u>Information/Education</u> Establish voluntary ballast management program		X-----	-----	--- X								

(Note: This three-year timeline is presented for illustrative purposes only)

## 6) PROGRAM MONITORING AND EVALUATION

*(Note: An monitoring/evaluation section should be included in each state management plan as a means to monitor progress, evaluate implementation problems/needs and make necessary "mid-course" corrections. Each state's management plan will be unique; the monitoring/evaluation methodology will vary from one state to the next. The following recommendations are presented as guidance to the states when developing their own evaluation plan.)*

- An oversight committee or subcommittee should be established within the plan implementation process for the purposes of conducting the monitoring/evaluation efforts, disseminating the results and identifying plan amendments that address outcomes.
- The three plan goals, as presented earlier, should provide the focal point for monitoring/evaluation. Means to assign measurable objectives to these goals should be pursued to provide meaningful evaluation.
- The evaluation effort should place a special emphasis on funding needs to successfully accomplish goals and associated tasks. This information will be useful for program planning purposes.
- The evaluation process should be inclusive, involving those with implementation responsibility, resource user groups and others affected by plan implementation. An emphasis should be placed on identifying evaluation findings with applicability to other states.
- The preparation and dissemination of an annual report highlighting implementation progress, including an evaluation of the efficacy of the plan's strategies and tasks, is strongly recommended. The target audience of the report should include the general public and local, state and federal decisionmakers. Incorporation of these program reports in the biennial water quality reports to the U.S. Congress and U.S. Environmental Protection Agency (Section 305b reports of the federal Clean Water Act) is advised, to broaden awareness of ANS issues.

## 7) GLOSSARY

*(Note: The management plan should include a glossary presenting clear definitions of selected terms used in the plan. For illustrative purposes, a series of definitions follows, drawn from Section 1003 of NANPCA with the exception of that marked with (\*). It is recommended to use terms defined in NANPCA when appropriate. Each state will want to add other terms/definitions, as needed.)*

**aquatic nuisance species:** An aquatic nuisance species that threatens the diversity or abundance of native species, the ecological stability of infested waters, or commercial, agricultural, aquaculture or recreational activities dependent on such waters. (Note: For purposes of the state management plans, reference to an aquatic nuisance species will imply that the species is nonindigenous.)

**ballast water:** Any water and associated sediments used to manipulate the trim and stability of a vessel.

**environmentally sound:** Methods, efforts, actions or programs to prevent introductions or control infestations of aquatic nuisance species that minimize adverse impacts to the structure and function of an ecosystem and adverse effects on nontarget organisms and ecosystems and emphasize integrated pest management techniques and nonchemical measures.

**federal consistency (\*):** A requirement under the Coastal Zone Management Act that stipulates that federal actions that are reasonably likely to affect land or water use or natural resources of the coastal zone be consistent with the enforceable policies of a coastal state's federally approved coastal management program (CMP). A coastal state reviews the federal action to determine if the proposed action will be consistent with the CMP.

**Great Lakes:** Lake Ontario, Lake Erie, Lake Huron (including Lake St. Clair), Lake Michigan, Lake Superior, and the connecting channels (Saint Mary's River, Saint Clair River, Detroit River, Niagara River, and Saint Lawrence River to the Canadian Border), and includes all other bodies of water within the drainage basin of such lakes and connecting channels.

**nonindigenous species:** Any species or other viable biological material that enters an ecosystem beyond its historic range, including any such organism transferred from one country to another.

**waters of the United States:** The navigable waters and the territorial sea of the United States.

**unintentional introduction:** An introduction of nonindigenous aquatic species that occurs as the result of activities other than the purposeful or intentional introduction of the species involved, such as the transport of nonindigenous species in ballast or in water used to transport fish, mollusks or crustaceans for aquaculture or other purposes.

## 8) RECOMMENDED APPENDICES

*(Note: The following information is recommended to be included as appendices to the management plan. Each state may identify additional materials.)*

- Section 1204 of the *Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990* (P.L. 101-646)
- List of members of relevant task forces/committees
- State laws and regulations
- *Information/Education Strategy for Aquatic Nuisance Prevention and Control*, prepared by the Information/Education Subcommittee of the Great Lakes Panel on Aquatic Nuisance Species
- Other relevant management plans
- Reference materials
- Emergency contacts
- Literature cited (see next page)

## LITERATURE CITED

(Note: It is recommended that each management plan include a section for citation of literature. The following list is provided for illustrative purposes based on the literature used in this document.)

Aquatic Nuisance Species Task Force (D. James Baker, Under Secretary of Commerce for Oceans and Atmosphere and Mollie Beattie, Director of U.S. Fish and Wildlife Service). 1994. *Report to Congress: Findings, Conclusions, and Recommendations of the Intentional Introductions Policy Review*.

Carlton, J.T. 1985. *Transoceanic and Interoceanic Dispersal of Coastal Marine Organisms: The Biology of Ballast Water*. Oceanography and Marine Biology, An Annual Review: volume 23.

Hushak, L.J., Y. Deng, M. Bielen. 1995. *The Cost of Zebra Mussel Monitoring and Control*. ANS Digest: volume 1, number 1.

Leigh, P. 1994. *Benefits and Costs of the Ruffe Control Program for the Great Lakes Fishery*. National Oceanic and Atmospheric Administration Report.

New York State Department of Environmental Conservation, Division of Fish and Wildlife. 1993. *Nonindigenous Aquatic Species Comprehensive Management Plan*.

Ohio Sea Grant College Program. 1995. *Sea Grant Zebra Mussel Report: An Update of Research and Outreach: 1988-1994*. The Ohio State University.

Ruiz, G.M., A.H. Hines, L.D. Smith, J.T. Carlton. 1995. *An Historical Perspective on Invasion of North American Waters by Nonindigenous Aquatic Species*. ANS Digest: volume 1, number 1.

U.S. Congress, *Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990*, Public Law 101-646.

U.S. Congress, Office of Technology Assessment. 1993. *Harmful Nonindigenous Species in the United States*. OTA-F565.

U.S. Department of the Interior, National Park Service. 1991. *Handbook for Ranking Exotic Plant for Management and Control*. Authored by R.D. Hiebert and James Stubbendieck. (Copies of this report (Natural Resources Report NPS/NRMWRO/NRR-93/08) are available from: Publications Coordinator, National Park Service, Natural Resources Publications Office, P.O. Box 2587 (WASO-NRPO), Denver, CO 80225-0287).

U.S. Fish and Wildlife Service, Department of the Interior. 1995. *Report to Congress: Great Lakes Fishery Resources Restoration Study*.