THE CURRENT STATE OF AQUATIC INVASIVE SPECIES IN CENTRAL NEW YORK

A report prepared by Kristy LaManche, Planner

Central New York Regional Planning and Development Board

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Invasive species continue to be an escalating problem throughout the United States (US) despite strong, but patchy research, control and eradication efforts. Since the 1800's, over 160 nonindeginous aquatic species have become established in the US, including 24 species of fish, 9 mollusks and 61 plant species[1]. The continued spread of new and existing invasive species threatens aquatic biodiversity, causes changes to habitats and ecosystems, disrupts food chains and impacts economic enterprises such as fisheries, boating, power production and international trade.

Methods of Introduction and Overland Transport

Most aquatic species introductions are the direct result of ballast water releases. Ballast water, used by commercial shipping vessels to balance their loads, may contain as many as 4,000 different species at any one time, according to the World Wildlife Fund[2]. Despite attempts to expel the ballast water prior to entering the Great Lakes, 90% of the ships still contain a slushy mixture of sediment and water, commonly referred to as residual ballast[3]. These vessels, referred to as NOBOBs (no ballast on board), pose a significant threat to US waters because the residual ballast provides a suitable habitat for plant seeds, resting stages of aquatic animals, and other life forms to remain viable until they can come into contact with large amounts of freshwater again.

For many years, environmentalists have tried to prevent ballast water releases in the Great Lakes and stop transoceanic shipping all together. These actions could have significant impacts on international trade and cause the prices of goods and services to rise dramatically. Therefore, eliminating international shipping is not a viable option. Consequently, researchers across the globe have been studying the contents of ballast water and are investigating various treatment options. Some have looked at the use of extreme temperatures or radiation to kill the living organisms and seed bank within the residual ballast, while others have searched for chemicals that will successfully remove the threat of viable organisms in the ballast. To date, no procedure(s) or chemical(s) has been identified that will successfully treat the vast array of "hitchhikers" (aquatic invasive species) in residual ballast.

Additionally, the Coast Guard and its International Partners have not established guidelines, known as discharge standards, for the quality or contents of ballast water to be expelled at foreign ports. Without a discharge standard, researchers and the shipping industry do not have a reasonable idea of how much, if any, ballast or residual ballast, can be emptied into foreign waterbodies without risking exotic species invasions. Therefore, scientists continue to develop protocols and test chemical(s) and materials that will effectively treat all residual ballast organisms in a timely manner and remove the threat of invasive species introductions 100% of the time. The challenge will continue to be finding a procedure or chemical(s) that will not

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[1] Horan, R.D., and R. Lupi. 2004. Economic incentives for controlling trade-related biological invasions in the Great Lakes. NAREA Workshop on Trade and the Environment. Halifax, Nova Scotia. June.
[2] Plant Ark. 2004. UN Agrees on Laws Against "Alien" Marine Invaders. 16 February. www.planetark.com dailynewsstory.drm/newsid/23827/story.htm. Accessed on February 7, 2004.
[3] Horan, R.D., and R. Lupi. 2004. Economic incentives for controlling trade-related biological invasions in the Great Lakes. NAREA Workshop on Trade and the Environment. Halifax, Nova Scotia. June.

accumulate in the water, is cost effective and won't add significant costs or time delays to the shipping industry.

Until a formidable process and discharge standard is identified, several Great Lakes States have taken it upon themselves to prevent ballast water introductions. Some, such as the State of Michigan, have passed legislation that identifies ballast water as pollution and requires that ships obtain a permit before ballast water can be discharged. The permitting process takes into account the amount of ballast, origin of the ballast and other factors that will determine the potential invasive species threat to the Great Lakes System. If the permitting agency finds that the transoceanic vessel's ballast is highly contaminated, it will not issue a permit for discharge and the vessel must retain its ballast until a safe release can be made. Additionally, a coalition of Great Lakes States petitioned the Coast Guard in 2004, asking them to act on the problems posed by NOBOBs[4]. These States have even reported legal efforts to get the EPA to regulate ballast water through the Clean Water Act.

As a result of the 2004 International Ballast Water Convention, the US Coast Guard now requires all vessels transiting to US waters with ballast water that was taken within 200 nautical miles of any coast after operating beyond the US Exclusive Economic Zone (EEZ) conduct one of the following: mid-ocean ballast water exchange prior to entering US waters; retain ballast water on board while in US waters; or use a Coast Guard approved alternative environmentally sound method to treat the ballast water[5]. Despite years of research and new ballast water legislation, new aquatic invasive species are introduced into our freshwater bodies at a rate of 1 every 28 weeks[6].

Ballast water releases are not responsible for all aquatic invasive species introductions in the Great Lakes and throughout the US. Some infestations of aquatic plants and animals can be linked to the aquarium industry, retail sales in live fish markets, ornamental water garden plant sales, and water related recreational activities. Due to sparse regulations and limited enforcement, retail sales of exotic fish species continue to occur. Often times, these exotic fish are released into ponds, lakes and streams when the owner no longer wants to care for them or the fish outgrow their surroundings.

Some of the most problematic exotic and invasive plant species, such as water chestnut, Eurasian watermilfoil and purple loosestrife, can be purchased over the Internet and shipped throughout the United States. Up until a few years ago, some of these plants could also be purchased at nurseries and garden centers in New York State.

For example, the highly aggressive, exotic snakehead fish can be purchased over the Internet and shipped throughout the United States. In 2002 the Department of the Interior and the US Fish and Wildlife Service proposed a new federal rule to prohibit the sale and transport of snakeheads in the United States, in an attempt to combat Internet sales and shipping. Importers reacted by

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[4] Horan, R.D., and R. Lupi. 2004. Economic incentives for controlling trade-related biological invasions in the Great Lakes. NAREA Workshop on Trade and the Environment. Halifax, Nova Scotia. June.
[5] Lovell, S.J. and S.F. Stone. 2005. The economic impacts of aquatic invasive species: A review of the literature. United States Environmental Protection Agency.
[6] Ricciardi, A. 2006. Fear of Another Invasion. The Post Standard. Monday, August 14, 2006

ratcheting up their trade in these fish. Whereas some 16,500 snakeheads were imported into the United States between 1997 and 2000, by the summer of 2002, 6,000 or more arrived at U.S. ports each month. The rule, which went into effect on October 4, 2002 prohibits importation of live fish or eggs of any of 28 snakehead species native to lands spanning from Africa to the Asian Pacific. Violators can receive fines of $5,000 to $10,000 and prison sentences of up to 6 months[7].

Live fish markets have also been linked to the introduction of non-native fish species, including the snakehead fish and several varieties of carp. Since some species cannot survive in small tanks for extended lengths of time, market owners have been accused of discarding them in local waterbodies when the fish are not sold quickly. In a different scenario, customers are thought to be responsible for the release of these live fish because some of them purchase the fish for reasons other than consumption, such as cultural or religious activities. It is believe that once the ceremonial activities are completed, the non-native fish are released into nearby lakes, ponds or streams.

The aquaculture industry has also been linked to the introduction of several exotic species in the United States. In the case of the bighead carp, aquaculturists in the Midwest imported carp to help control weed growth in their stock ponds. In the early 1990's a significant flood occurred and the carp escaped the aquaculture facility and entered nearby streams and rivers. Eventually, new carp populations were established in the surrounding states and have plagued the Mississippi River basin ever since. A similar situation has occurred for several other invasive fish species that were brought to the United States for the aquaculture industry.

Various types of water recreation sports and activities can also be a vector and mechanism for overland transport of aquatic invasive species. It has been well documented that several species of non-native plants and animals become attached to boat hulls and propellers, trailers, live wells and fishing equipment. Many inland waterbodies have become infested with zebra mussels, water chestnut, Eurasian milfoil, fishhook and spiny water fleas, and other invasive species because of accidental introductions by water enthusiasts. The use of live fish, as bait, by fisherman can also be problematic in the fight against aquatic invasive species. Some of the fish sold by tackle shops as bait are not native to the areas that they are sold in. Therefore, if the baitfish escapes the bucket or is not killed via consumption by a predatory fish, there is a chance that the baitfish could survive and proliferate in the waterbody. Also, when fishermen add new water to their bait bucket, there is the potential for the mixing of freshwater from the two different sources. This action creates an opportunity for the release of microscopic organisms, bacteria, resting stages of animals and other small creatures to be released and potentially become established.

Another vector of introduction and overland transport of invasive species is waterfowl and mammals that frequent lakes, rivers, streams and ponds. Some aquatic plant seeds are equipped with spines, which help them stick to the feathers and fur of water loving birds or mammals. If the seeds become stuck on the bird or mammal and then become dislodged when the animal

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[7] Raloff, J. 2002. Finned Pollution Is One Cost of Our Exotic Tastes. Science News Online. Accessed on January 11, 2007. www.sciencenews.org/articles/20021116/toc.asp

enters a different freshwater system, there is the potential for another infestation site. Some aquatic organisms, such as the New Zealand mud snail, have been known to pass through the gut of some species of waterfowl unharmed. Then, when the bird defecates, the snail is reintroduced to the environment and can potentially cause an infestation. Some seeds of aquatic plants have a very thick coating and can also withstand ingestion by waterfowl and other organisms.

Regardless of the exact method of introduction or mechanism of overland transport, invasive aquatic plants and animals continue to be a problem in Upstate New York, the Great Lakes region, and throughout the US. As people become more aware of the consequences of their actions, perhaps Internet sales and illegal possession of invasive species will end. When researchers identify a suitable treatment for ballast water, the health and biodiversity of our native aquatic species and ecosystems will improve.

Economic Consequences of Aquatic Species Introductions

In January of 2005, the National Center for Environmental Economics released a report titled "The Economic Impacts of Aquatic Invasive Species: A review of the literature." The document was created to help the Environmental Protection Agency's Office of Water develop a national estimate of the costs of aquatic invasive species and the benefits of control. It includes a review of the economic literature related to expenditures and treatment options for invasive fish, mollusks, crustaceans, invertebrates, and plants[8]. This report, along with information from a variety of other sources, was used to compile the following assessment of invasive species costs to federal, state and local agencies and organizations charged with the responsibility of managing the freshwater resources of the United States and Canada.

A 1993 study released by the Office of Technology Assessment (OTA) of the US Congress reported the ecological impacts and estimated economic impacts of those invasive species considered harmful. The report examined introduced species to the US during the period from 1906 to 1991 and concluded that sea lamprey, zebra mussel, Asian clam, salt cedar, purple loosestrife, mellaluca and hydrilla are all high impact species. In total, this report estimated that the US spends $100 million dollars per year controlling aquatic plants alone[9].

In August of 2000, the United States General Accounting Office (GAO) released their report on federal and selected state funding to address harmful, non-native terrestrial and aquatic species. The GAO surveyed 10 federal departments including the Departments of Agriculture, Commerce, Defense, the Interior, State, the Treasury, Transportation and the Environmental Protection Agency, as well as the Smithsonian Institute and the National Science Foundation. The states that were included in the report were Florida, California, Hawaii, Idaho, Maryland, Michigan, and New York – seven states that have experienced serious problems with invasive species, are regarded as having strong invasive species programs, and/or provided geographical representation for the survey.

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[8] Lovell, S.J. and S.F. Stone. 2005. The economic impacts of aquatic invasive species: A review of the literature. United States Environmental Protection Agency.

[9] Office of Technology Assessment. United States of America Congress (OTA). 1993. Harmful non-indigenous species in the United States. OTA Publication OTA-F-565. US Government Printing Office, Washington D.C. www.wws.princeton.edu:80/~ota/disk1/1993/9325_n.html.

The GAO found that the federal departments included in the survey allocated over half a billion dollars in funding for activities related to terrestrial and aquatic invasive species throughout fiscal years 1999 ($513.9 million) and 2000 ($631.5 million). The US Department of Agriculture provided the largest amount of funding (mostly directed toward terrestrial non-native species), compared to the rest of the survey respondents, in fiscal year 1999 ($459 million) and 2000 ($556 million). All of the departments surveyed reported that activities to prevent the introduction of invasive species received the greatest percentage of federal funding in both years.

The seven states that were included in the GAO reported spending between $1.6 million and $94.5 million in fiscal year 1999 and between $1.8 million and $127.6 million in fiscal year 2000 on aquatic and terrestrial invasive species activities. In both years, Florida spent the greatest amount of funds ($94.5 million and $127.6 million), followed by California and Hawaii.

In 1999 and 2000, New York State ranked 6th out of the 7 states surveyed for invasive species funding. In 1999 New York State reportedly spent $2.4 million dollars on invasive species control, most of which was allocated to activities related to terrestrial arthropods – mainly the Asian long-horned beetle. According to the GAO report, New York State's top 5 invasive species, in terms of expenditures were Asian long-horned beetles, sea lamprey, Eurasian watermilfoil, zebra mussels, and purple loosestrife. In fiscal year 2000, New York State increased their funding of invasive species activities to $2.6 million.

In 1999, 6 out of the 7 states surveyed reported that control activities received the largest portion of the funding. In 2000, 5 states reported control activities were still the largest funded category, while the others reported either monitoring or prevention activities as the most heavily funded category. In both years, New York State reported that control activities received the greatest amount of funding.

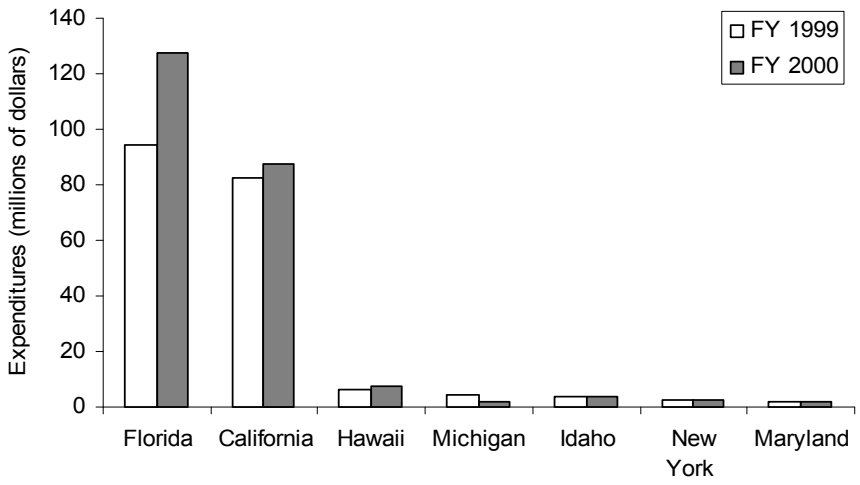

Figure 1. Seven states' expenditures for invasive species activities during fiscal years 1999 and 2000. Source: United States General Accounting Office report (2000).

In 2000, Pimentel et al. released a report that attempted to update and expand on the OTA and several other similar documents. The Pimentel study estimated the total economic damages and associated control costs for the US due to "harmful non-indigenous species" at $138 billion

dollars annually[10]. This number is significantly larger than the OTA's estimate because Pimentel looked at a wider range of species and was able to incorporate more recent data than the 1993 study. In 2001, Pimentel and a different group of researchers released another report that focused on the damages associated with invasive species in 6 countries, including the US. They estimated that the US sustains an estimated environmental loss of $1 billion dollars per year from introduced fish and an additional $2.13 billion and $1.3 billion in losses from arthropods and mollusks, respectively[11].

Species Specific Costs and Expenditures

In addition to estimates of federal expenses related to aquatic invasive species infestations, several reports have begun to assess the costs and damages associated with specific invasive species such as the sea lamprey, zebra mussel, Eurasian watermilfoil, and water chestnut.

Sea Lamprey, *Petromyzon marinus*

The sea lamprey is revered by the sport and commercial fishing industry in the Great Lakes because of its impacts on trout and salmon populations. Several techniques for controlling sea lamprey populations have been implemented since they made their way into the Great Lakes from the Atlantic Ocean. By far, the most successful control technique is the use of a lampricide to eliminate larvae. In 1993, the OTA reported that sea lamprey control and research costs $10 million dollars annually[12], in addition to another $10 million dollars being spent to re-stock trout and salmon populations.

According to the GAO (2000) report, the US Department of State reported that they spent the greatest amount of money ($7.5 million) toward sea lamprey related activities. In the same document, New York State reported spending $275,000 on sea lamprey control in fiscal year 1999; while the State of Michigan spent over $3 million dollars[13]. Other, less expensive, sea lamprey control options include the sterile male release program, barriers and traps. Each of these techniques has helped to limit the invasion of sea lampreys, in conjunction with the lampricide treatments. By 2001, the US was spending over $13 million dollars to control and monitor sea lamprey populations, according to the Invasive Species Council.

Zebra Mussel, *Dreissena polymorpha*

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[10] Pimentel, D., L. Lach, R. Zuniga, and D. Morrison. 2000. Environmental and economic costs of nonindigenous species in the United States. Bioscience. 50(1):53-56.

[11] Pimentel, D. S. McNair, S. Janecka, J. Wightman, C. Simmonds, C. O'Connel, E. Wong, L. Russel, J. Zern, T. Aquino and T. Tsomondo. 2001. Economic and environmental threats of alien plant, animal and microbe invasions. Agriculture, Ecosystems and Environment. 84:1-20.

[12] Office of Technology Assessment. United States of America Congress (OTA). 1993. Harmful non-indigenous species in the United States. OTA Publication OTA-F-565. US Government Printing Office, Washington D.C. www.wws.princeton.edu:80/~ota/disk1/1993/9325_n.html.

[13] United States General Accounting Office (GAO). 2000. Invasive species: Federal and selected state funding to address harmful, nonnative species. Report to Congressional Committees. United States General Accounting Office. Washington, D.C. purl.access.gpo.gov/GPO/LPS8271. Accessed on January 11, 2007.

Zebra mussels are one of the most well known invasive species. Since their introduction in the late 1980's, zebra mussels have impacted water quality, displaced native bivalves and caused millions of dollars in expenses at water treatment and hydropower facilities. Control methods implemented on zebra mussel populations include biocides, chlorine, thermal treatment, and mechanical/manual removal[14]. The GAO report from 2000, states that the Departments of Defense and Commerce both cited zebra mussels as the individual invasive species that received the greatest amount of funding from their agencies in fiscal year 1999. The Department of Defense reported spending $2.7 million, while the Department of Commerce contributed $1.0 million toward zebra mussel related activities. In the same study, New York State listed zebra mussels as one of the state's top 5 invasive species for fiscal year 1999. In total, New York State spent $150,000 toward zebra mussel related prevention, control and research activities.

In the Great Lakes region, it's been estimated that $8 billion has been spent thus far since the zebra mussel's introduction, to mitigate the damage that it has caused; with another $5 billion price tag in the next 10 years. A number of other reports estimate the cost for zebra mussel control, treatment and removal to be around $5 billion dollars[15].

Cataldo estimated that the cost of damages to the commercial shipping, water treatment and power industries over the past 10 years was $3.1 billion dollars[16]. This figure represents the expenses incurred to replace and upgrade existing intake pipes, water filtration equipment and power plant operations to minimize the effects of zebra mussels and prevent them from contaminating and clogging the facilities. A report published by the New York Sea Grant Extension Service estimated the costs of the zebra mussel to the power industry alone were as much as $800 million for plant redesign, and a further $60 million annually for maintenance[17]. Armour et al.[18] stated that the net impact on the US Great Lakes power plants could be over $100 million annually based on one to two day downtime and a 1% reduction in plant heat rate due to zebra mussel biofouling. The USGS estimates that annual control costs of hydroelectric plants are $83,000 per plant, $145,000 for fossil fuel plants, and $822,000 for nuclear plants[19].

In addition to the expenses occurred at electric generation plants, water intake plants located on the Great Lakes have also invested significant amount of time and resources to minimize the impacts of the expanding zebra mussel populations. Average monitoring and control costs from 1989 to 1994 at industries, municipal water supplies, private utilities and public utilities were $0.43 million[20]. The control costs reflect the sum of costs for retrofitting, physical removal,

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[14] Jenkins, P. 2001. Economic impacts of aquatic nuisance species in the Great Lakes. A report prepared by Philip Jenkins and Associates, Ltd. For Environment Canada. Burlington, Ontario.
[15] Lovell, S.J. and S.F. Stone. 2005. The economic impacts of aquatic invasive species: A review of the literature. United States Environmental Protection Agency.
[16] Cataldo, R. 2001. Musseling in on the Ninth District economy. Fedgazette. 13(1):15-17.
[17] Office of Technology Assessment. United States of America Congress (OTA). 1993. Harmful non-indigenous species in the United States. OTA Publication OTA-F-565. US Government Printing Office, Washington D.C. www.wws.princeton.edu:80/~ota/disk1/1993/9325_n.html.
[18] Armour, A.F., Tsou, J.L., and P.M. Wiancko. 1993. Zebra Mussels: The industrial impact. Third International Zebra Mussel Conference. Toronto, Ontario, Canada. February.
[19] Anonymous. 1999. Musseling In. Electric Perspectives. 24(6):14.
[20] Lovell, S.J. and S.F. Stone. 2005. The economic impacts of aquatic invasive species: A review of the literature. United States Environmental Protection Agency.

mechanical exclusion, chemical treatment, and other related costs. Monitoring costs included labor, equipment investment, training, and contracts for services.

Eurasian Watermilfoil, *Myriophyllum spicatum,* and Water Chestnut, *Trapa natans*

Aquatic, invasive plants have spread rapidly throughout the Great Lakes system and have caused flooding, inhibited water recreation, displaced native vegetation, reduced productivity and dissolved oxygen, and lowered waterfront property values. Unfortunately, few species-specific estimates of the harm done by these invasive, aquatic weeds or the benefits of control are available at this time. Methods for controlling aquatic weeds include mechanical harvesting, herbicides, hand pulling, the introduction of native biological predators and the installation of benthic barriers.

In New York State, mechanical harvesters cost over $200,000 per unit. In addition to the harvester, this control option also requires a vessel to transport the harvested material back to shore and a large truck to transport the plants to a dumping site. Depending on the distances involved and the number of trips made with each of these vehicles, costs can get pretty high. The cost of herbicides to chemically treat aquatic plants is equally expensive and can range from a couple hundred dollars to over $1,000 per acre, depending on the chemical used and the dosage level.

From 1906 to 1991, the OTA estimated that $100 million dollars was spent on the control of aquatic plants. Since 1982, the State of Vermont has spent over $3 million dollars in federal, state, and local funds to control Eurasian watermilfoil and water chestnut. In 1999, the State of New York spent $260,000 on activities related to the prevention and control of Eurasian watermilfoil. From 1982 to 2003, over $3 million dollars has been spent on water chestnut control in the Lake Champlain basin, with the largest contribution ($2,066,607) coming from the United States Army Corps of Engineers. New York State has only contributed $487,711 toward water chestnut control efforts on Lake Champlain.

In the Lake Ontario – Finger Lakes Basin, over $100,000 is spent annually on water chestnut harvesting, handpulling, chemical treatments and public education programs, mainly by members of the Central New York Water Chestnut Task Force. Researchers from Cornell University have also spent almost $300,000 to identify a biological control agent for water chestnut.

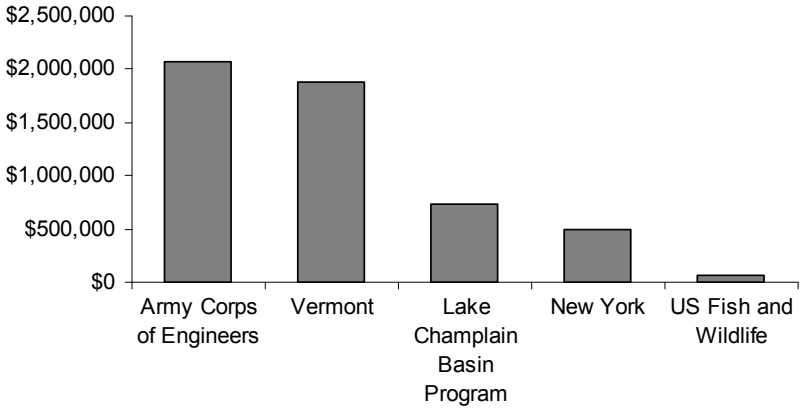

Figure 2. Funds spent on Lake Champlain water chestnut management from 1982 to 2003. Source: www.anr.state.vt.us/dec/waterq/lakes/htm

In order to fully understand the level of damage and destruction that aquatic invasive species have caused on the Great Lakes System and throughout the US, a more comprehensive and universal reporting system for management activities and their associated costs must be created. There is a growing library of information on the invaders themselves, but this report has shown that there is a tremendous gap in availability of the costs associated with the various management approaches. Through the use of the Internet, scientists and managers from around the world are able to communicate and share data. This report suggests the necessary steps should be taken to create a clearinghouse for treatment options, success rates and average costs for all invasive species that are currently being monitored or controlled.

Current Aquatic Invasive Plants of High Priority in Central New York

The following list contains the aquatic invasive plants that are of most concern to the managers, researchers and special interest groups in Upstate New York. This is not a comprehensive listing of the current aquatic invasive plants in any of our freshwater systems.

Curly-leaf pondweed, *Potamogeton crispus*

www.boat-ed.com/in/course/p4-13_wastedischarge.htm

Curly-leaf pondweed, *Potamogeton crispus*, is an aquatic invasive plant native to Europe, Asia and Africa. This submersed, perennial plant was first identified in Keuka Lake in 1879[21] and can be found in almost all freshwater bodies in Upstate New York. The stems of the plant grow 1 to 3 feet long and are covered by reddish-green, wavy leaves. Curly-leaf pondweed plants first appear in early spring and can be found until mid summer. The plant is dormant from July to the December, before it slowly begins to grow, under the ice. Curly-leaf pondweed hinders recreation, especially swimming. The decaying plant material also is a significant problem both in the water and on land. Decaying plant material is a sink for oxygen and a source for nutrients. When the plant material washes on shore, it produces foul odors and is an inconvenience for shoreline property owners. This plant is easily spread via boats, trailers or other equipment. (See Map 1)

Eurasian water milfoil, *Myriophyllum spicatum*

www.boat-ed.com/in/course/p413_wastedischarge.htm

Eurasian water milfoil, *Myriophyllum spicatum*, is an aquatic plant that is native to Europe an Asia. It was first identified in Lake Erie in 1952[22] and has since spread throughout New York State. Eurasian Water Milfoil can be found in fresh to slightly saline water up to depths of 30 feet. The plant itself can grow to lengths of 20 feet and reproduces by seed or fragmentation. The stems of the plant are green to reddish brown and the leaves are green and grow in whorls of 3 to 6. This aquatic nuisance outcompetes native submersed vegetation and forms dense canopies, blocking sunlight penetration to the lake bottom. This plant also interferes with boating, swimming and fishing activities. The decaying plant material is a sink of oxygen in the water column and a source of nutrients for other aquatic life. When the plant material is uprooted and washed onto the shore, decaying plant material is unsightly and produces a foul odor. Boats, trailers and other equipment easily spread this plant from one area to another. (See Map 2)

[21] Mills, E.L., Leach, J.H., Carlton, J.T. and Seacor, C.L. 1993. Exotic species in the Great Lakes: A history of biotic crises and anthropogenic introductions. J. Great Lakes Res. 19(1):1-54.
[22] *Ibid*.

European frog-bit, Hydrocharis morsus-ranae

www.miseagrant.umich.edu/
photos/ais/frogbit.html

European frog-bit, *Hydrocharis morsus-ranae*, is a free-floating aquatic plant native to Europe and Asia. It was first discovered in Lake Ontario in 1972[23]. The dark, heart shaped green to purple leaves of this plant can be found along slow moving sections of freshwater rivers and lakes, in addition to swamps and marshes. This emergent perennial produces tiny, white flowers in the summer. Reproduction takes place when the buds of the plant (turions) break off from the plant and sink to the bottom. European frog-bit is an aquatic nuisance plant mainly because it forms dense canopies on the water's surface, therefore preventing sunlight penetration into the water column. This popular water garden plant is easily spread via water currents, boats, trailers, and waterfowl. (See Map 3)

Starry stonewart, *Nitellopsis obtusa*

www.psteinmann.net/wasserpfl.html

Starry stonewart, *Nitellopsis obtusa*, is an invasive, floating macroalgae that is native to the waters of Europe and Asia. It was first identified in North America in the early 1980's in Lake St. Clair. Starry stonewart is often found floating among masses of coontail and duckweed in slow, deep fresh, or brackish water. Cream colored bulbs are produced at the end of the long, uneven branches. No map available

Water chestnut, *Trapa natans*

www.umext.maine.edu/
onlinepubs/htmpubs/2535.htm

Water chestnut, *Trapa natans*, is an invasive, submerged and emergent annual that is native to Asia. It was introduced into New York State in the early 1800's and has spread throughout the Hudson River, Lake Champlain, and the Oswego-Seneca-Oneida River System. Water chestnut plants can grow up to 20 feet long and produce floating, triangular shaped leaves. The plants are commonly found rooted in slow moving, shallow bays and coves where they form dense canopies of vegetation and inhibit light penetration into the water column. Water chestnut plants produce a seed that has 5 sharp spines and a thick husk. These nutlets can withstand extreme conditions including desiccation and remain viable for several years. Dense stands of water chestnut plants interfere with boat navigation, fishing, swimming, and other recreational activities. When the plant material washes on shore, it produces foul odors and is an inconvenience for shoreline property owners. This plant is easily spread via boats, trailers or other equipment. (See Map 4)

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[23] Mills, E.L., Leach, J.H., Carlton, J.T. and Seacor, C.L. 1993. Exotic species in the Great Lakes: A history of biotic crises and anthropogenic introductions. J. Great Lakes Res. 19(1):1-54.

Current Aquatic Invasive Animals of High Priority in Central New York

The following list contains the aquatic invasive animals that are of most concern to the managers, researchers and special interest groups in Upstate New York. This is not a comprehensive list of the aquatic invasive animals that have infested the freshwater systems of Upstate New York.

Asiatic clam, Corbicula fluminea

www.umext.maine.edu/ onlinepubs/htmpubs/2535.htm

The Asiatic clam, *Corbicula fluminea*, a bivalve native to southern and eastern Asia was first identified in Lake Erie in 1980[24]. They are found in freshwater, can withstand harsh environmental conditions, and primarily feed on phytoplankton. Adults can reach up to 1 inch in length and have an average lifespan of 1 to 4 years. Asiatic clams are known to clog water intake pipes and interfere with wastewater treatment plant operations. They also biofoul power plants and alter benthic substrates. (See Map 5)

Common carp, Cyprinus carpio

www.fishing-guides.co.uk/ fresh.htm

The common carp, *Cyprinus carpio*, is a freshwater fish native to Asia. By 1879, common carp were widespread throughout the Great Lakes system and have been a problem ever since[25]. Common carp have barbels on both sides of their mouth and are often bronze-gold to yellow in color. These toothless, bottom feeders can weigh 8 to 10 pounds and measure over two feet in length. They are found in a range of freshwater habitats, but prefer slow moving water with a soft substrate and vegetation. One mature female can produce up to 300,000 eggs per spawn and some are known to spawn numerous times in one season. The common carp is considered to be a nuisance species because they uproot and destroy native aquatic plants, increase water turbidity by disrupting soft sediments, and displace benthic organisms, fish, and waterfowl. (See Map 6)

[24] Mills, E.L., Leach, J.H., Carlton, J.T. and Seacor, C.L. 1993. Exotic species in the Great Lakes: A history of biotic crises and anthropogenic introductions. J. Great Lakes Res. 19(1):1-54.
[25] *Ibid*.

Fishhook water flea, *Cercopagis pengoi*

library.thinkquest.org/ 03oct/00946/accounts/ invertebrates.htm

The fishhook water flea, *Cercopagis pengoi*, is a predatory crustacean native to Eurasia. It was introduced into the US in the mid to late 1990's. It was first identified in Lake Ontario in 1998[26]. The fishhook water flea can reach up to 0.5 inches in length, with their tail measuring 7 times the length of their body. They reproduce parthenogenically; producing up to 13 offspring at one time. These zooplankton are considered to be an aquatic nuisance because they get wrapped around fishing lines and clog sampling nets. Their existence also poses significant threats to the health of our freshwater fisheries because the fishhook water flea competes with fish and invertebrates for food and is known to disrupt the food chain. (See Map 7)

New Zealand mud snail, Potamopyrgus antipodarum


www.calaverasriver.com/ mudsnail.htm

The New Zealand mud snail, *Potamopyrgus antipodarum*, is a native of New Zealand and Australia that was first identified in Lake Ontario in the early 1990's. The exact source and date of the identification is unknown. This mud snail reproduces parthenogenically and can carpet a streambed or lake bottom in only a few years. They reach lengths of up to 1/4 inches and feed on algae and detritus. The New Zealand mud snail is considered to be an aquatic nuisance species because they can choke out native snails and insects, deprive fish of their main sources of food, multiply rapidly- within two years, over 3 million snails can result from just one snail, and can damage fisheries, particularly salmon and trout, and their native habitats. These aquatic invaders are spread primarily by anglers and can survive up to 25 days outside of streams, if they are in a moist environment, such as inside waders, on muddy wader boots, in live wells, or in cooling systems. Another vector for transport of the mud snail are fish and waterfowl, since the snails often pass through the gut without being digested. When the fish or waterfowl defecate, the mud snail is deposited and can potentially establish a new colony since they are tolerant of a wide range of temperatures. (See Map 8)

Quagga mussel, Dreissena bugensis


nsdi.epa.gov/glnpo/ active/2004/janmar04.html (Photo courtesy of U.S. Geological Survey)

Quagga mussels, *Dreissena bugensis*, are native to the Ukraine and were mostly likely introduced into the US via ballast water from a commercial shipping vessel. The quagga mussel was first sighted in the Great Lakes in September 1989, when one was found near Port Colborne, Lake Erie, though the recognition of the quagga type as a distinct species was not until 1991[27]. In August 1991, a mussel with a different genotype was found in a random zebra mussel sample from the Erie Canal near Palmyra,

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[26] Ricciardi, A. 2001. Facultative introductions among aquatic invaders: Is an "invasion meltdown" occurring in the Great Lakes?" Can. J. Fish Aquat. Sci. 58:2513-2525.

[27] Mills, E. L., G. Rosenberg, A. P. Spidle, M. Ludyanskiy, Y. Pligin, and B. May. 1996. A review of the biology and ecology of the quagga mussel (*Dreissena bugensis*), a second species of freshwater Dreissenid introduced to North America. Amer. Zool. 36:271-286.

New York, and after confirmation that this mussel was not a variety of *D. polymorpha*, the new species was named "quagga mussel" after the "quagga", an extinct African relative of the zebra[28]. Quagga mussels can reach lengths over 2 inches long and tend to have pale to white shells with faint black stripes on them, although color patterns vary widely. Quagga mussels, unlike the zebra mussel, are found in shallow, warm water to deep, oligotrophic, cold-water systems[29]. Quagga mussels are a nuisance species because they biofoul power plants, clog water intake pipes, outcompete native bivalves for food and space, disrupt the food chain, create an unpleasant odor when they are washed onto shore and pose a safety risk to SCUBA divers and swimmers. (See Map 9)

Round goby, Apollonia melansostomus

www.naturewatch.ca/Mixedwood/fish/ff-2.htm

The round goby, *Apollonia melansostomus*, is a freshwater fish that is normally found in Eurasia. It was introduced into the St. Claire River in 1990[30] and was found in Lake Superior by 1995[31]. This bottom-dwelling fish can reach up to 10 inches in length and feeds on zebra mussels and insect larvae. Infestations of the round goby pose a serious threat to our freshwater ecosystems because they spread rapidly. Once established, populations typically increase rapidly. The round goby can displace native fish, eat their eggs and young, take over optimal habitat, spawn multiple times a season, and survive in poor quality water -- giving them a competitive advantage. (See Map 10)

Rusty crayfish, Orconectes rusticus

www.epa.gov/glnpo/
image/viz_iss4.html

The rusty crayfish, *Orconectes rusticus*, is a crustacean native to the Midwest. They are commonly found in Ohio and Kentucky and were identified in the eastern United States, more specifically Lake Ontario, in 1960. Rusty crayfish can reach up to 4 inches in length and are considered to be omnivorous. They can live in lakes, rivers, ponds, and streams. They have a high fecundity; one female can lay 50 to 575 eggs at one time. The rusty crayfish is considered to be a threat to local waterbodies because they consume twice as much food as native crustaceans, they degrade aquatic beds, they feed heavily on benthic invertebrates which in turn depletes the food source of native crustaceans and larval fish, and they out compete native crustaceans for habitat. (See Map 11)

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[28] May, B. and J. E. Marsden. 1992. Genetic identification and implications of another invasive species of Dreissenid mussel in the Great Lakes. Can. J. Fish. Aquat. Sci. 49:1501-1506.

[29] MacIsaac, H. G. 1994. Comparative growth and survival of *Dreissena polymorpha* and *Dreissena bugensis*, exotic mollusks introduced to the Great Lakes. J. Great Lakes Res. 20(4):783-790.

[30] Mills, E.L., Leach, J.H., Carlton, J.T. and Seacor, C.L. 1993. Exotic species in the Great Lakes: A history of biotic crises and anthropogenic introductions. J. Great Lakes Res. 19(1):1-54.

[31] Ricciardi, A. 2001. Facultative introductions among aquatic invaders: Is an "invasional meltdown" occurring in the Great Lakes?" Can. J. Fish. Aquat. Sci. 58:2513-2525.

Sea lamprey, Petromyzon marinus

http://www.invasive.org/browse/detail.cfm?imgnum=1360005

Sea lampreys, *Petromyzon marinus*, are predaceous, eel-like fish that were first identified in Lake Ontario in 1835. They are native to both sides of the Atlantic Ocean and can now be found in many lakes throughout the Great Lakes region. Sea lampreys can reach up to 20 inches in length. The most notable feature of this invasive species is its numerous rows of sharp teeth and razor sharp tongue both of which are used to cut through the thick scales and skin of fish. Sea lampreys are an aggressive parasite, preying on the blood and bodily fluids of fish. Often times their prey dies due to the large, bloody holes inflicted by the lamprey. Most sea lampreys live in the ocean and travel into freshwater to spawn, but a population of sea lampreys is known to live in Lake Ontario and the St. Lawrence River throughout the year. During spawning season, this population of lampreys inhabits the adjacent streams and smaller rivers. A mature female can lay up to 60,000 eggs per year. Young sea lampreys are blind, filter feeders. They will stay in the stream for up to 4 years before beginning their predatory life in the lake. Adult sea lampreys remain in the lake, feeding on fish, for 2 to 20 months before returning to the stream to spawn and die. Sea lampreys are considered to be a nuisance because of the destruction they have caused to populations of fish, especially lake trout. This destruction has had severe implications on the Great Lakes Fishery, as a whole, in addition to economic hardship faced by commercial fisherman and other water/fishery related industries. Since the late 1950's, scientists have used a chemical that selectively kills sea lamprey when they enter the streams to spawn. (See Map 12)

Spiny water flea, Bythotrophes longimanus

www.glerl.noaa.gov/seagrant/GLWL/Zooplankton/Cladocera/Images/DBBythotrephes-03.jpg

The spiny water flea, *Bythotrophes longimanus*, is a crustacean native to Eurasia. They were introduced into the US via ballast water in the early 1980's and were first recorded in Lake Ontario in 1982[32]. The spiny water flea is a predatory zooplankton that can reach up to 1 inch in length and has a long tail spine with barbs. They are found in deep, cool lakes and can produce up to 10 offspring at one time via parthenogenesis. The spiny water flea is a nuisance to fisherman as they can foul fishing lines and down riggers. They are voracious predators and can consume 3 times as much food as native zooplankton, which is detrimental to larval fish and other organisms that feed on native zooplankton. In general, the spiny water flea changes native zooplankton abundance and diversity causing negative impacts on local freshwater food web dynamics. (See Map 13)

[32] Mills, E.L., Leach, J.H., Carlton, J.T. and Seacor, C.L. 1993. Exotic species in the Great Lakes: A history of biotic crises and anthropogenic introductions. J. Great Lakes Res. 19(1):1-54.

Tench, Tinca tinca

www.first-nature.com/fishes

The tench, *Tinca tinca*, is a fish that was introduced into the US for sport fishing purposes. It is native to the temperate regions of Europe and Asia. The tench can reach up to 32 inches in length and weigh in at more than 15 pounds. The tench has very small scales that are embedded into their thick skin, which is covered in a thick layer of mucous. They are usually an olive green - blackish color and have red eyes. Tench are found in shallow, vegetated lakes and ponds, slow moving rivers, and wetlands. The tench is tolerant of a range of conditions and can reproduce rapidly. They are considered to be an aquatic nuisance because they outcompete native fish for food and habitat, increase periphyton and water turbidity, disrupt the food chain, and cause a general decline in water quality. (See Map 14)

Zebra mussel, Dreissena polymorpha

nsdi.epa.gov/glnpo/active/2004/janmar04.html (Photo courtesy of U.S. Geological Survey)

The zebra mussel, *Dreissena polymorpha*, is a bivalve native to the Ponto-Caspian region of Europe. They were first identified in Lake St. Clair in 1988 and have spread throughout all of the Great Lakes. These aggressive filter feeders have a life span of 2 to 4 years, reaching sexual maturity within a year. One female mussel can produce up to 100,000 eggs per year. Zebra mussels can reach lengths of up to 1.5 inches, are triangular in shape with black stripes on the shells, and are found primarily in shallow, highly eutrophic waterbodies. Zebra mussels pose a serious threat to our freshwater resources because they disrupt the food chain by filtering out almost all of the phytoplankton that is less than 40 μm in size, reducing the food supply for native larval and juvenile fish, bivalves and other benthic organisms. Zebra mussels also clog water intake pipes, biofoul power plants, can cause injury to SCUBA divers and bare footed swimmers who come into contact with the sharp shells, create an unpleasant odor when the dead and decaying mussels wash onto shore, and may contribute to harmful algal blooms. Zebra mussels may also present a health hazard by increasing human and wildlife exposure to organic pollutants such as PCBs and PAHs. Studies have shown that zebra mussels can accumulate the pollutants in their tissues in concentrations 300,000 times greater than in the environment[33]. (See Map 15)

The 2007 Aquatic Invasive Species "Watch List" for Upstate New York

The following list contains the aquatic invasive plants and animals that are of most concern to the managers, researchers and special interest groups in Upstate New York. Currently, there are no known populations of these plants within this region, but their presence in surrounding areas of the state and region are a cause for concern. This is not a comprehensive list, but simply a list of the species that seem to be well adapted to this area and pose the most significant threat to the health of our aquatic ecosystems – should they make their way into Upstate New York.

[33] Gulf of Maine website accessed on 01/02/07 at 11:35 am. www.gma.org/surfing/human/zebra.html

Brazilian elodea, *Egeria densa*

www.epa.gov/owow/invasive_species/invasives_management/fifra18.html

Brazilian elodea, *Egeria densa*, is a submersed perennial plant that is native to Brazil, Argentina, and Uruguay. Thought to be released from a household aquarium, it was first identified in Long Island and New York City in 1893. This highly invasive plant forms dense, monotypic stands, which contain lance-shaped leaves in whorls of 4 to 6. Brazilian elodea is found in stagnant or slow moving water in lakes, streams, or ponds. It inhibits recreational activities such as boating, fishing, and swimming. This invasive plant also traps sediment, restricts water movement, displaces native vegetation, and causes fluctuations in water quality. The closest known infestations are located in southern New York State, Pennsylvania and the surrounding New England states. (See Map 16)

Fanwort, Cabomba caroliniana

Photograph © Kerry Dressler
www.ecy.wa.gov/programs/wq/plants/plantid2/photopages/photo_cabomba.html

Fanwort, *Cabomba caroliniana*, is a perennial aquatic plant that is native to the southeastern United States. The plant has two types of leaves: the submersed fan shaped, whorled leaves and the small, alternate floating leaves. Fanwort plants produce small, white to pinkish flowers that float on the water surface. This aquatic invasive plant can reproduce by seed or fragmentation. Fanwort is found in lakes, ponds, and streams that range in depth from 3 to 10 feet. It is also known to take hold in ditches and other slow moving areas. Fanwort is considered to be a nuisance species because it is a highly competitive plant that forms dense stands, displaces native vegetation, can clog or prevent water flow in streams and ditches, and interferes with recreational and agricultural uses of freshwater systems. Infestations of fanwort have been identified in Long Island, the Catskills, and Saratoga County. (See Map 17)

Hydrilla, Hydrilla verticillata

Photograph © Kerry Dressler
www.usgs.nau.edu/swepic/aspDB/unified.asp?Symbol=HYVE3

Hydrilla, *Hydrilla verticillata*, is a submersed perennial plant that is native to Asia. This aggressive, invasive species is found in fresh water lakes, streams, marshes, tidal zones, and ditches where it can grow up to 25 feet in length. Whorls of hydrilla consist of 4 to 8 lance shaped leaves with sharply toothed edges. There are spines on the underside of the leaves. Hydrilla plants produce tiny, white flowers in the fall. The plants rely primarily on the regrowth of stem fragments for reproduction, but can also spread via buds and tubers. Hydrilla is considered to be an aquatic nuisance species because it is tolerant of low light and CO2 levels, giving Hydrilla plants a competitive advantage over many native aquatic plants. Hydrilla grows aggressively and blocks sunlight penetration. It also can interfere with navigation and recreational activities, decrease oxygen levels, cause fish kills, displace native vegetation, and obstruct water flow. Currently, there are no known infestations of Hydrilla in New York State. However, Pennsylvania (Chesapeake Bay watershed) and several other New England States have identified extensive Hydrilla infestations and have been struggling to control them for years. (See Map 18)

Parrot feather, Myriophyllum aquaticum

www.victoria-adventure.org/water_gardening_images/parrots_feather.html

Parrot feather, *Myriophyllum aquaticum*, is a perennial aquatic plant that is native to South America. It has both submerged and emergent feather-like leaves and is found in slow streams, rivers, ditches, and shallow lakes and ponds. Parrot feather plants can grow over 5 feet in length and reproduce mainly by fragmentation outside of its native range. The blue-green emergent leaves of the parrot feather are most distinctive, as they can grow up to a foot above the water surface and look almost like small fir trees[34]. Tiny, white flowers are produced in the spring. Parrot feather is considered to be an aquatic nuisance species because it clogs drainage ditches and canals, causes flooding, interferes with water recreation, changes the physical and chemical properties of streams, and prevents algal growth, which in turn alters the food chain for fish and other aquatic organisms. Currently, there are no parrot feather infestations in New York State. However, populations have been identified along the east coast as far north as Connecticut, New Jersey, and Pennsylvania. (See Map 19)

Yellow floating heart, *Nymphoides peltata*

www.ecy.wa.gov/programs/wq/plants/weeds/floating_heart.html

Yellow floating heart, *Nymphoides peltata*, is a floating, rooted perennial that is native to Europe and Asia. The leaves of this plant are round or heart shaped, and the flowers are bright yellow and contain five petals. Reproduction occurs via seeds and fragmentation. Yellow floating heart plants are found in slow moving lakes, ponds, and reservoirs. They form dense patches, similar to water lilies. Yellow floating heart is considered to be an aquatic nuisance plant because it forms dense colonies that prevent sunlight penetration into the water column. Therefore, stagnant areas with low oxygen levels are created, native plants are shaded out, algae growth is limited, and the aquatic food chain is disrupted. The dense mats of yellow floating heart also inhibit water recreation activities such as boating, swimming, water skiing, and fishing. Currently, infestations of yellow floating heart have been identified throughout the Hudson and Mohawk Rivers, in addition to several embayments in Lake Erie. (See Map 20)

Bighead carp, Hypophthalmichthys nobilis

www.iowadnr.gov/fish/news/exotics/carp.html

The bighead carp, *Hypophthalmichthys nobilis*, is a native of China. These filter feeding fish are voracious eaters and primarily consume zooplankton and algae, although stomach content analysis indicates they can eat other organisms such as mollusks. These fish can grow up to 3 feet in length and weigh up to 60 pounds. They are dark in color, usually greenish-brown and have a large head with a protruding lower jaw. They spawn in rivers and streams where one female can lay 1 million eggs in a season.

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[34] Washington State Department of Ecology. Technical Information About Parrotfeather (*Myriophyllum aquaticum*) http://www.ecy.wa.gov/programs/wq/plants/weeds/aqua003.html. Accessed on 01/03/07.

Bighead carp are considered to be an aquatic nuisance because they outcompete native fish for food and spawning habitat. They also increase turbidity and interfere with water sports such as boating and fishing. Bighead carp have escaped from aquaculture facilities and infested the lower Mississippi River. Currently, an electronic barrier is preventing the bighead and silver carp from entering the Great Lakes through the Chicago shipping canal. The first bighead carp infestation in New York State was identified in Lake Erie in 2000. Aside from Lake Erie, there are currently no known reports of bighead carp in Upstate New York. (See Map 21)

Eurasian ruffe, Gymnocephalus cernuus

www.invasive.org/browse/detail.cfm?imgnum=1354048

The Eurasian ruffe, *Gymnocephalus cernuus*, is a freshwater fish in the perch family that is native to Eurasia. Sharp spines cover their gills, dorsal and anal fins and protect the ruffe from predation by walleye and pike. They are found in lakes and streams and are very tolerant of poor water quality, especially turbidity. They grow quickly and can reach up to 6 inches in length. The Eurasian ruffe reach maturity within their first year and can spawn up to six times per year. They are a highly competitive bottom dwelling fish and often out compete perch and shiners for food and habitat. Eurasian ruffe are considered to be an aquatic nuisance species because of their high rate of reproduction, their ability to feed efficiently and outcompete native percids and their ability to tolerate a range of water quality conditions. Eurasisan ruffe were introduced into the Great Lakes system via ballast water in the late 1980's. Since then, they have infested Lake Huron, Michigan, and Superior. There are no known reports of Eurasian ruffe in New York State at this time. (See Map 22)

Northern cnakehead, *Channa argus*

www.dgif.virginia.gov/fishing/snakehead_faq.html

The northern snakehead, *Channa argus*, is a native fish of Asia. It is one of nearly 30 species of snakeheads that are found throughout Asia and Africa. The northern snakehead is a top level predator that has a protruding lower jaw lined with long teeth. They have torpedo shaped bodies with long dorsal and anal fins that are spineless. Snakeheads eat a variety of organisms including juvenile fish, frogs, and small reptiles. They spawn up to five times per year and can lay up to 15,000 eggs at one time. The adults guard the nest until the young are born. The northern snakehead grows up to 4 feet long and can weigh up to 15 pounds. They can tolerate poor water quality, especially low oxygen levels, by breathing air. The northern snakehead is considered to be a nusiance species because they outcompete native fish for food and habitat, guard their young which increases survival rates, and can tolerate low oxygen levels by breathing air. There are no known infestations of the northern snakehead in New York State. In 2002, the first northern snakeheads were identified in Maryland. Since then, Massachusettes, Pennsylvania, New Jersey, and New Hampshire all have reported infestations as well . (See Map 23)

Silver carp, Hypophthalmichthys molotrix

www.fws.gov/midwest/LaCrosseFisheries/projects/asian_carp_silver.htm

Silver carp, *Hypophthalmicthys molotrix*, are a species of fish that are native to Asia and were introduced into the United States in the early 1990's. They can reach lengths of over 4 feet and weigh more than 100 pounds. Silver carp inhabit lakes, ponds, streams, and rivers. They are bottom dwelling fish that feed mainly on detritus and phytoplankton. They spawn in streams and rivers. Silver carp are considered to be an aquatic nuisance because they outcompete native fish for food and spawning habitat. They also increase turbidity and interfere with water sports such as boating and fishing because they are known to jump out of the water when startled. Silver carp have escaped from aquaculture facilities and infested the lower Mississippi River. Currently, an electronic barrier is preventing the silver and bighead carp from entering the Great Lakes through the Chicago shipping canal. There are no known populations of silver carp on the east coast. (See Map 24)

The Current State of Aquatic Invasive Species in Central New York

In order to assess the current state of aquatic species in Upstate New York, the Central New York Regional Planning and Development Board (CNYRPDB) developed a short survey and solicited feedback from members of federal, state, and local agencies and organizations, in addition to public and private institutions that are charged with the management of lakes, ponds and streams within the area and/or focus a portion of their programs on the fight against invasive species. Ironically, all of the members that responded to the survey belong to the Central New York Water Chestnut Task Force and share a common interest in the control and prevention of numerous aquatic invasive species, in addition to water chestnut.

The first question on the CNYRPDB survey asked each of the survey participants to list the activities that their agency or organization has undertaken in the past few years to address aquatic species issues of concern. The survey respondents reported that the following aquatic invasive plants were targeted for education, hand pulling, harvesting and herbicide treatment programs: Brazilian waterweed, curly-leaf pondweed, eelgrass, Eurasian watermilfoil, European frog-bit, fanwort, hydrilla, muskgrass, parrot feather, and water chestnut. Funds from the Finger Lakes – Lake Ontario Watershed Protection Alliance, county and lake association contributions, grants from the National Fish and Wildlife Foundation, and in-kind time and labor were used to conduct these activities. Water chestnut seemed to be the species of greatest concern throughout the region. Over the past several years, Cayuga, Madison, Onondaga, and Oswego counties have developed extensive education, harvesting, and herbicide control programs to stop the spread of water chestnut. Since the inception of their multi-county cooperative effort, several dense mats of water chestnut have been reduced to areas that are easily managed by hand pulling. The use of herbicides have proven to be a favorable compliment to mechanical harvesting, especially in areas where it is difficult to maneuver the harvester or places where off loading sites are not available.

Up until recently, researchers at Cornell University were actively searching for a biological control agent for water chestnut. They conducted research in the US and China. After months of

field studies and trials, the researchers identified a beetle that feeds almost exclusively on water chestnut plants. Feeding by the *Galerucella birmanica* beetle proved detrimental to water chestnut plants, during the small-scale experiments that were conducted. In addition to these experiments, the researchers also studied wild populations of water chestnut in China. They noted that there were a few species of aquatic beetles that fed on the water chestnut plants, but concluded that *Galerucella birmanica* was host specific and caused great amounts of damage to the water chestnut plants. The researchers at Cornell were nearly ready to import the beetles into the US for further their testing when their funding ran out. After years of promising research, the search for a biological control agent for water chestnut has ended prematurely.

Cayuga, Madison, Onondaga, and Oswego counties have also spent a significant amount of money combating Eurasian watermilfoil infestations throughout the region. Staff from the local Cornell Cooperative Extension and Soil and Water Conservation District Offices have partnered with lake associations and other groups to mechanically harvest the weeds, test the effectiveness of benthic barriers, and research biological control agents.

The following chart summarizes the types of activities being conducted in Upstate New York to combat the spread of aquatic invasive species in the area. In addition to water chestnut and Eurasian milfoil, representatives from federal, state, and local agencies have partnered with lake associations and volunteer organizations to address the spread of several other aquatic plants.

Chart 1. Key aquatic species, areas of infestations, types of activities and estimated costs for treatment in Upstate New York.

Species	Area and Extent of Infestation	Types of Activities (education, hand pulling, harvesting, chemicals, etc.)	Additional Information (cost
Water Chestnut	Cayuga County Sterling Creek, Cross Lake	Cayuga County Handpulling, education	Cayuga County In-kind contributions
	Onondaga County Oneida, Onondaga, Otisco & Skan. Lakes, Seneca/Oneida River	Onondaga County Education, hand pulling,	Onondaga County $5-$25,000 year for education/monitoring all plants*
	Seneca/Oneida Rivers (100 acres)	Harvesting	~$115,000 since 2003 (FL-LOWPA, County, State, NFWF)
	Seneca/Oneida Rivers (100 acres)	Herbicides	~$18,000 since 2003 (FL-LOWPA, NFWF, FL-LOWPA Spec. Proj)
	Oswego County Oswego River, Battle Island to Ox Creek (100 acres total)	Oswego County Harvesting, handpulling, education, herbicides	Oswego County $60,000 per year (average from FLLOWPA and Special Project funding)

Eel grass	Oswego County Harbor/Wright's Landing (9 acres total)	Oswego County Harvesting	Oswego County FLLOWPA funds, contribution from City of Oswego (total cost $5400)
Eurasian Watermilfoil	Cayuga County Multiple lakes (Owasco, Como, Little Sodus Bay, Otter, Cayuga)	Cayuga County Harvesting by SWCD	Cayuga County $126,373 (FLLOWPA and county funds)
	Madison County All county lakes – especially Lebanon and DeRuyter Reservoir and Cazenovia Lake	Madison County Harvesting Biological Control Research	Madison County ~$25,000 for the last 4 years
Eurasian Watermilfoil	Onondaga County Oneida, Otisco, Skaneateles Lakes, Seneca and Oneida Rivers	Onondaga County Education, benthic barrier demo project	Onondaga County* $5-$25,000 year for education/monitoring all plants
	Skaneateles Lake	Management Strategy Group, suction dredge equipment	$4,000 for staffing + $5,200 for equipment (FL-LOWPA)
	Oswego County Harbor/Wright's Landing (9 acres total)	Oswego County Harvesting	Oswego County FLLOWPA funds, City of Oswego (total cost $5400)
Curly leaf pondweed, hydrilla, Brazilian waterweed, Fanwort, parrot feather and frogbit	Onondaga County Oneida, Otisco and Skaneateles Lakes, Seneca and Oneida Rivers	Onondaga County Education, citizen early detection and monitoring program	Onondaga County $5-$25,000 year for education/monitoring all plants*
Muskgrass (Chara)	Onondaga County Tully Lake near shore area	Onondaga County Mechanical harvesting	Onondaga County $18,000 FL-LOWPA, $6,000 Cortland FL-LOWPA, $6,000 from lake association
		Educational materials	$2,000 FL-LOWPA

* Funding was used to address all invasive species concerns in Onondaga County.

The second question on the CNYRPDB survey asked each of the participants to identify gaps in their current invasive species management and eradication programs, in addition to the overall management plan for invasive species in Upstate New York. The survey participants also were asked to list the obstacles and potential costs associated with the activities that they felt would be critical to preventing further infestations of aquatic species in the area.

In general, the survey respondents expressed a need for continued educational programs, especially the ones that focus on prevention, early detection and rapid response. They also felt that there is a need for more research of control options, especially by local universities. In terms of water chestnut control and management, the survey participants expressed the need for increased landowner participation, additional harvesting and chemical treatments, long term biocontrol options, continued education and outreach, and more funding to expand current activities. Unfortunately, there are several obstacles that the survey participants identified including the lack of institutionalized funding, limited access for mechanical harvesting and the lack of equipment and staff to operate and maintain the equipment. Although a precise cost estimate could not be given, at least $200,000 of additional revenue is needed to implement these recommendations. The CNYRPDB's survey also identified the needs, obstacles and estimated costs for the management of European frog-bit, Eurasian watermilfoil and other aquatic plant species. Chart 2 lists all of the recommendations that were identified by the survey respondents.

Chart 2. Activities, obstacles and potential costs for improving and expanding aquatic invasive species control and prevention programs in Upstate New York.

Species	Needs	Obstacles	Potential Cost
Water Chestnut	➢ Increased landowner participation ➢ Additional harvesting and chemical treatments ➢ Long term biocontrol ➢ More outreach and education ➢ More funding to expand current activities	➢ Lack of institutionalized funding ➢ Limited access for harvesting ➢ Lack of equipment and funding to operate programs ➢ Lack of staff ➢ Lack of long term, stable funding vs. grants and appropriations ➢ Preventing further infestations in Oneida Lake and inland waters	$100,000? $150,000 to $200,000/yr for at least 3 yr
European Frog-bit	➢ Education ➢ Control methods	➢ Lack of proven control techniques ➢ It is a free floating plant	?
Eurasian Watermilfoil	➢ Long term control methods ➢ Evaluate suction dredge project in Skaneateles Lake ➢ Additional needs in Otisco Lake	➢ Impossible to eradicate ➢ Lack of institutionalized funding	$15,000 annually

Muskgrass	➢ Success of harvesting needs to be evaluated	➢ Maintaining multi-partner funding / equipment annually	$10,000 annually
All invasives	➢ Continue Weeds Watch Out education program ➢ More education that focuses on prevention, early detection and rapid response ➢ More university research of control options	➢ Time ➢ Money	$10,000 $25,000-$45,000/year for education ??? for research

The third question on the CNYRPDB's survey asked survey participants to list the activities that they are planning for 2007 to prevent, remove and/or control aquatic invasive species in Upstate New York. Based on the responses, water chestnut, Eurasisan watermilfoil, European frog-bit and other aquatic plants will be targeted in 2007. The researchers, educators and managers will be conducting handpulling, education, mechanical harvesting, and herbicide treatment programs throughout Cayuga, Madison, Onondaga and Oswego counties. Funding from the Finger Lakes – Lake Ontario Watershed Protection Alliance (FL-LOWPA), the National Fish and Wildlife Federation and state, county and lake association contributions will be used to conduct these activities.

Chart 3. Proposed activities to prevent, control and remove aquatic invasive species from Upstate New York waterways in 2007.

Species	Area and Extent of Infestation	Types of Activities	Cost and Funding Source
Water Chestnut	Cayuga County Sterling Creek, Cross Lake	Cayuga County Handpulling and education	Cayuga County $3,500 (FLLOWPA funds) + in-kind
	Onondaga County Oneida, Otisco, Onondaga and Skaneateles Lakes, Seneca and Oneida Rivers	Onondaga County Education, Citizen monitoring and rapid response	Onondaga County* $30-$40,000 (EPA, FLWOPA, NFWF, Onondaga County + others)
	Seneca and Oneida River	Harvesting 10 acres Herbicides 40 acres	$40,000 (State and County) 11,000 Inv. Sp Grant + $5,000 FL-LOWPA
	Oswego County Oswego River (est. 50 acres)	Oswego County Harvesting and chemicals	Oswego County Cost unknown

Eurasian watermilfoil	Cayuga County Multiple waterbodies (see above) Madison County Inland lakes Onondaga County* Oneida, Otisco, Onondaga and Skaneateles Lakes, Seneca and Oneida Rivers	Cayuga County Harvesting Madison County Harvesting Expand research and implementation of biocontrol methods Onondaga County Education, Citizen monitoring and rapid response	Cayuga County $32,500 FLLOWPA + County share Madison County Fl-LOWPA (~$25,000/yr) Onondaga County* $30-$40,000 (EPA, FLWOPA, NFWF, Onondaga County + others)
European frog-bit	Madison County Oneida L. near Oneida Co. border Onondaga County Oneida, Otisco, Onondaga and Skaneateles Lakes, Seneca and Oneida Rivers	Madison County Educate homeowners Onondaga County Education, Citizen monitoring and rapid response	Madison County ? Onondaga County* $30-$40,000 (EPA, FLWOPA, NFWF, Onondaga County + others)
Muskgrass	Onondaga County Tully Lake	Onondaga County Mechanical harvesting	Onondaga County $10,000 (Cortland SWCD, lake assoc, Onon FLLOWPA)
Curly leaf pondweed, hydrilla, Brazilian waterweed, starry stonewort, Fanwort, parrot feather, frogbit	Onondaga County* Oneida, Otisco, Onondaga and Skaneateles Lakes, Seneca and Oneida Rivers	Onondaga County Education, Citizen monitoring and rapid response	Onondaga County* $30-$40,000 (EPA, FLWOPA, NFWF, Onondaga County + others)

* Funding will be used to address all invasive species concerns in Onondaga County.

The last part of the CNYRPDB survey provided the participants with an opportunity to include additional information about invasive species control and management in Upstate New York. Almost all of the participants had at least one additional comment including the following:

- There needs to be an "Authority" created or designated that will be charged with maintaining control of aquatic species in New York State, especially the Barge Canal. A new entity doesn't need to be created if an existing agency/organization is willing to assume the additional role and responsibility.

- There needs to be a bio-control program for water chestnut. Funds need to be provided to continue researching for a viable biological control. This should be a federal initiative, but certainly could involve state funding. The Invasive Species Grants program is a start, but it

is under funded and large sized problems such as water chestnut cannot be addressed by groups having to constantly submit competitive grant applications.

- There needs to be far more involvement and financial commitment from the Canal Corporation.

Conclusion

Aquatic invasive species continue to spread throughout Upstate New York, the Great Lakes and throughout the US. Researchers, educators, and managers need to continue to work together to engage the public in helping to fight the spread of non-native, aquatic plants and animals. To date, populations of water chestnut have been reduced in Upstate New York. At the same time, satellite populations have been identified in new locations. The persistence of the sea lamprey, the hardiness of the Eurasian watermilfoil, and the tenacity of the round goby continue to challenge scientists, educators, and managers throughout Upstate New York.

Despite all of the time and money spent in Upstate New York, non-native aquatic species continue to threaten the health and biodiversity of lakes, rivers, and streams. This report highlights the billions of dollars that are spent, throughout the country, to monitor, prevent and remove invasive species on the land and in the water. The CNYRPDB's survey indicates that additional money, equipment, and staff are needed to conduct the various education, harvesting, hand pulling, and herbicide treatment programs that are essential to the control of invasive species. In addition, the survey identifies the need for a central agency to be designated that will be charged with the responsibility of coordinating preventative measures for the control of aquatic invasive species in Upstate New York. This report also recommends that a central clearinghouse be established for the sharing of research, treatment options, and control costs. The clearinghouse would allow scientists, managers, and interested citizens an opportunity to discover what is being done throughout the country to manage aquatic habitats and prevent aquatic species introductions. In that same way, scientists, managers, and interested citizens would learn about research, chemical control options, cost estimates, funding sources, and contact information from others who are facing similar challenges. By sharing this information and making it readily available, aquatic invasive species control and management programs can be streamlined and operate more efficiently.

Federal, state, and local agencies and organizations, private institutions, lake associations and others need to continue to work together to combat aquatic species infestations in Upstate New York. By combining resources and sharing information, these agencies and organizations will improve the efficiency of local control efforts by eliminating duplicative efforts and uniting complimentary programs. In turn, key partners in research, regulation, education and funding, along with the general public, will be able to establish both rapid response programs and coordinated long term eradication efforts.

Contact Information for Key Partners

Cayuga Lake Watershed Network
8408 Main Street
P.O. Box 303
Interlaken, New York 14847
(607) 532-4101
http://www.cayugalake.org

Central New York Regional Planning and Development Board
126 N. Salina Street
Syracuse, New York 13202
(315) 422-8276
http://www.cnyrpdb.org

Cornell Cooperative Extension of Onondaga County
220 Herald Place, 2nd Floor
Syracuse, New York 13202
(315) 424-9485
http://counties.cce.cornell.edu/onondaga

Cornell University
122E Fernow Hall
Cornell University
Ithaca, New York 14853
(607) 255-5314
http://www.dnr.cornell.edu

Madison County Planning Department
P.O. Box 606
Wampsville, New York 13163
(315) 366-2498
http://www.madisoncounty.org/plan/IndexA.html

Onondaga County Department of Health
421 Montgomery Street, 12 Floor
Syracuse, New York 13202
(315) 435-6600
http://www.ongov.net/Health

Oswego County Soil and Water Conservation District
3095 State Route 3
Fulton, New York 13069
(315) 592-9663
http://oswegosoilandwater.com/