

Harmful Exotic Species of Aquatic Plants and Wild Animals in Minnesota

**Annual
Report
2003**

*for the year
ending December 31*



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Submitted to

**Environment and Natural Resources Committees
of the Minnesota House and Senate**

This report should be cited as follows:

Exotic Species Program. 2004. Harmful Exotic Species of Aquatic Plants and Wild Animals in Minnesota: Annual Report for 2003. Minnesota Department of Natural Resources, St. Paul, MN.

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Preface

Each year, by January 15, the DNR is required to prepare a report for the Legislature that summarizes the status of management efforts for harmful exotic species (aquatic plants and wild animals) under its jurisdiction. Minnesota Statutes, Chapter 84D.02, Subd. 3, specify the type of information this report must include: expenditures; progress in, and the effectiveness of, management activities conducted in the state, including educational efforts and watercraft inspections; information on the participation of others in control efforts; management efforts in other states; and an assessment of future management needs. Additional sections have been added to this report to provide a thorough account of DNR's Exotic Species Program activities and other activities related to invasive species of aquatic plants and wild animals.

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Harmful Exotic Species of Aquatic Plants and Wild Animals in Minnesota: Annual Report for 2003 Summary

Status of Aquatic Exotics in Minnesota

Bighead Carp found in Lake Pepin

The DNR is working with state and federal agency representatives to keep bighead carp and other exotic carp species from establishing reproducing populations in Minnesota waters of the Mississippi River.

In October 2003, a commercial fisherman netted a 23-pound bighead carp (*Hypophthalmichthys nobilis*) near the south end of Lake Pepin, a widening of the Mississippi River near Lake City and 100 miles upstream of any previous discovery of the fish. Bighead, which can weigh up to 100 pounds, are known to leap 6 to 10 feet out of the water when disturbed by boat engine noise and have injured unsuspecting boaters. Bighead carp are moving up the Mississippi River from the south, where they escaped or were released from aquaculture operations in the southern U.S. The bighead carp directly competes with native fishes and mussels, threatening filter feeding species such as bigmouth buffalo, the threatened paddlefish, young of year fish species, freshwater mussels, and other wildlife.

Although one bighead carp was confirmed in Lake Pepin, there's no evidence the fish are reproducing in Minnesota waters of the Mississippi. Among the options that state and federal agencies are exploring are electric and acoustic barriers across the river to prevent new carp species from moving further into the state.

Zebra mussels found in Lake Ossawinnamakee

In 2003, zebra mussels were discovered for the first time in central Minnesota in Lake Ossawinnamakee. A commercial dock hauler reported finding zebra mussels attached to a boat lift in the lake. DNR field staff confirmed that zebra mussels were in many areas of the lake and a short distance downstream in the outlet brook. Lake Ossawinnamakee is only the second inland water body to be confirmed as infested with zebra mussels in the state. The discovery of zebra mussels hundreds of miles from other populations and in the heart of the lakes region creates new challenges in preventing further spread to more Minnesota lakes and rivers.

In response, DNR staff including fisheries biologists, field staff, and the department's aquatic invertebrate biologist, are drafting a plan to deal with zebra mussels in Lake Ossawinnamakee. In early 2004, DNR staff will discuss options with lake residents and others interested in stopping the spread of zebra mussels.

Lakeshore residents throughout the state continue to monitor for zebra mussels. Over the past two years, approximately 225 people annually have participated in the Volunteer Zebra Mussel Monitoring Program, providing a much more extensive examination of Minnesota waters for zebra mussels than could be conducted by the DNR Exotic Species Program alone (Figure 1). Inland lake infestations in Minnesota

(Zumbro and Ossawinnamakee) were both reported by members of the public, indicating the importance and value of volunteer and public awareness efforts.

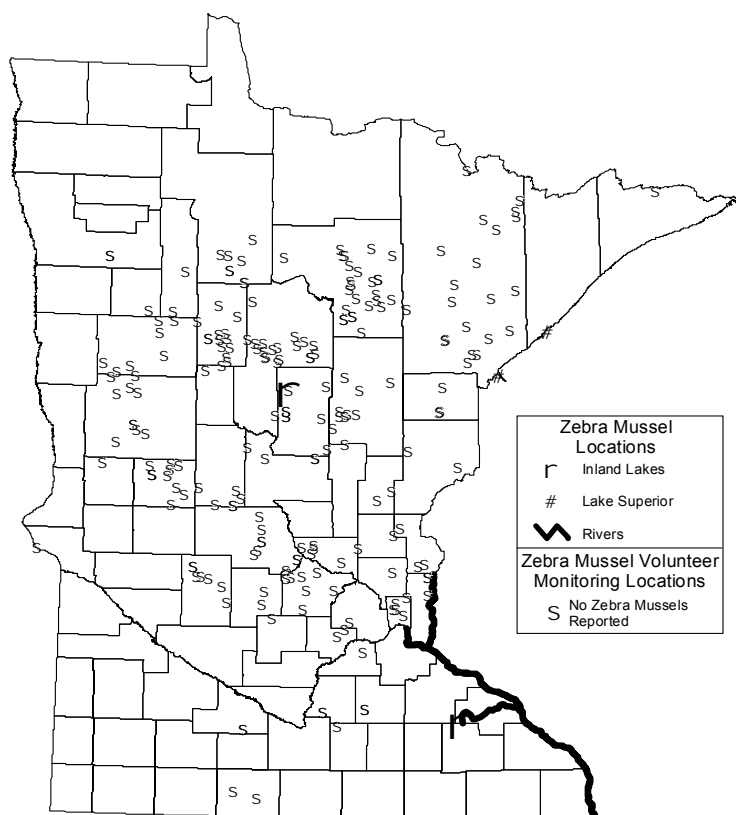


Figure 1. Zebra mussel and volunteer zebra mussel monitoring locations in Minnesota as of November 2003.

Status of other species in Minnesota

- Eurasian watermilfoil was found in 11 new water bodies in 2003, bringing the total number of infestations to 152.
- Spiny water flea was found in Lake Saganaga in Cook County. This is the third inland lake reported in the state.
- Saltcedar, an invasive shrub of riparian areas and wetlands, was found for the first time in the wild near Hibbing. All 50 plants found were cut and treated with an herbicide.
- *Daphnia lumholtzi*, an exotic cladoceran (aquatic crustacean) native to the subtropical regions of Africa and Asia, were first found in Lake Pepin in 1999, but it was not until September 2003 that evidence of a reproducing population was reported.
- Flowering rush, an invasive aquatic plant, is currently found in 16 lakes in Minnesota. The most problematic area of the state is near Detroit Lakes where management efforts are ongoing by the Pelican River Watershed District.

The Problem

The aquatic exotic species mentioned in this summary have the potential to cause serious problems in Minnesota. For example, Eurasian watermilfoil, purple loosestrife, and flowering rush have displaced native plants, degraded valuable habitat for fish and wildlife, and limited water recreation in many lakes and wetlands in Minnesota. Now Asian carp species threaten our rivers by displacing native fishes and altering food sources for fish and wildlife.

The Response

To address the problems caused by harmful exotic species, the 1991 Minnesota Legislature directed the Department of Natural Resources (DNR) to establish the Exotic Species Program. The Program is responsible for monitoring and management of harmful exotic species of aquatic plants and wild animals.

The three primary goals of the Exotic Species Program are:

1. Prevent introductions of new harmful exotic species into Minnesota;
2. Prevent the spread of harmful exotic species within Minnesota;
3. Reduce the impacts caused by harmful exotic species to Minnesota's ecology, society, and economy.

1. Prevent introductions of new harmful exotic species into Minnesota

The best way to manage a harmful exotic is to prevent its establishment, when possible. Prevention methods include risk assessment, education, regulation and enforcement. Risk assessment involves efforts to determine the problems that an exotic might cause if it were to become established in Minnesota and the pathways by which the exotic might reach our state. Education involves outreach intended to explain the risk and steps that people can take to prevent new introductions. Lastly, regulations have been established and enforced to prevent activities or practices that carry a high risk of introduction of harmful exotics.

In 2003, Exotic Species staff revised and widely distributed two publications aimed at slowing the movement of harmful exotic species through the horticultural trade: *Harmful Exotic Species: What every water gardener and shoreline restorer should know*, and *Harmful Exotic Species: What every aquatic plant seller should know*. These publications give aquatic plant buyers and sellers the information they need to be able to prevent the introduction of harmful exotic species into Minnesota waters.

The Minnesota Invasive Species Advisory Council (MISAC), an interagency group working on invasive species issues, convened a series of expert panel meetings to assess the risks posed by various exotic species. The outcome of these evaluations will be a list of species with their associated risks to Minnesota. The information contained in these lists will be used to prioritize management, monitoring, and educational activities, and to help formulate public policy.

2. Prevent the spread of harmful exotic species within Minnesota

Efforts to prevent the spread of harmful exotic species within Minnesota are focused on people and their habits. The primary means of spread for harmful exotics, such as Eurasian watermilfoil and zebra mussels, is unintentional transport on trailered watercraft. In response, each year the DNR has hired up to 40 seasonal watercraft

inspectors to work at public water accesses, primarily on infested water bodies, where they inspect boats and inform owners about the problems caused by exotics and actions that boaters can take to prevent spread. In 2003, the DNR inspected 42,000 watercraft during the open water season from late April through November 15. More than 90% of the inspections were conducted on waters infested with exotic species. The percent of watercraft users who said they were aware of the exotic species laws for the state was 96%.

The DNR worked cooperatively with the Lake Minnetonka Conservation District and Big Mantrap Lake Association to increase inspection hours and education on these two lakes by sharing costs for additional watercraft inspectors.



In 2003, conservation officers spent more than 1,900 hours carrying out inspections and other efforts to prevent further spread of harmful exotics. Regulations prohibiting the transport of aquatic vegetation or taking bait or water from infested waters, are enforced by conservation officers in the Division of Enforcement.

3. Reduce the impacts caused by harmful exotic species

To reduce the harmful effects of exotic species, the Exotic Species Program focused primarily on the management of aquatic plants.

Eurasian watermilfoil. To reduce the problems caused by Eurasian watermilfoil, the Exotic Species Program works closely with owners of lakeshore, lake associations, local units of government, and others. Much of this management involves use of herbicides and mechanical harvesting. In 2003, cooperators on 23 lakes with Eurasian watermilfoil received \$76,000 in state funds from the DNR as reimbursement for at least part of the costs of control of this invasive plant. On eight lakes with milfoil, the DNR treated areas adjacent to public water accesses to reduce the risk of spread of milfoil from the lake and improve access to the lake at a cost of \$11,000. On an additional three lakes with milfoil, the DNR undertook control at a cost of \$9,000.

Purple loosestrife. The Exotic Species Program uses both herbicides and biological control (the use of insects that eat purple loosestrife) to manage purple loosestrife. Since 1992, more than eight million leaf-eating beetles have been released in 800 purple loosestrife infestations statewide. Severe defoliation of the exotic plant by the beetles was observed on more than 20% of sites monitored in 2003. These efforts have been supported in large measure with funding appropriated by the Minnesota Legislature as recommended by the Legislative Commission on Minnesota Resources (LCMR) and cooperation from local and county governments to rear and release the beetles statewide.



Curly-leaf pondweed. In 2003, Exotic Species Program staff provided information to the public on best management practices for curly-leaf pondweed control by attending meetings and providing technical assistance to local units of government and lake associations. To improve management techniques, the DNR supported research efforts on curly-leaf pondweed. Researchers at Minnesota State University-Mankato (MSU)

completed a study examining the best time of year to manage curly-leaf pondweed. DNR also continued to assist the U.S. Army Corps of Engineers in research to improve control of this harmful exotic by early-season treatment with herbicides.

Coordination among groups that manage harmful exotic species

Much of the success of the Exotic Species Program in dealing with harmful exotic species results from cooperation among various organizations. Management of Eurasian watermilfoil and purple loosestrife involves cooperation with local lake associations and local units of government as described above. Efforts to prevent introductions of new exotics into Minnesota often involve the participation of Exotic Species Program staff in state and regional groups such as Minnesota Invasive Species Advisory Council and the Mississippi River Basin Panel on Aquatic Nuisance Species. Involvement with these groups promotes partnerships, develops uniform messages in educational products, and ensures sharing of information about new and existing harmful exotic species.

Revenue and expenditures

Base funding for the Exotic Species Program is derived from a \$5 surcharge on the registration of watercraft in Minnesota, which generates approximately \$1.2 million per year. In 2003, an additional \$380,000 was appropriated to the program to expand efforts to prevent and manage aquatic exotic species in the state. Additional short-term revenue is received from federal sources such as the U.S. Fish and Wildlife Service and the U.S. Environmental Protection Agency, and from the Minnesota Legislature as recommended by the LCMR. Most of the funding (~70%) is spent on watercraft inspections, enforcement, management/control and research (Figure 2).

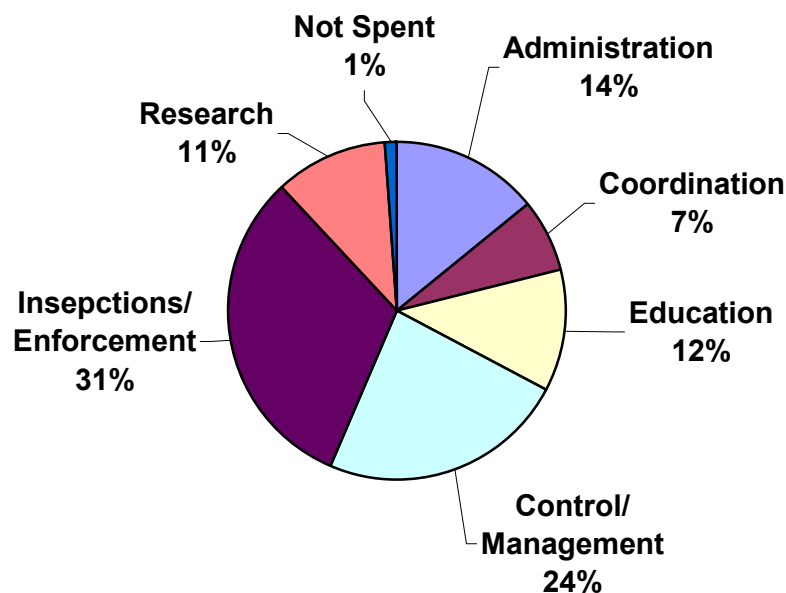


Figure 2. Exotic Species Program spending in FY03 by major categories.

Plans for the future

Protecting Minnesota's natural resources from future damage due to harmful exotic species is paramount. With the significant increase in funding, efforts will be made to expand and enhance prevention and management efforts in Minnesota. The new funding will be used to:

- substantially expand education efforts
- maintain the level of watercraft inspections occurring statewide at 20,000 hours
- increase the amount of time conservation officers spend on exotic species enforcement
- increase the grant funding to cooperators who are managing milfoil on infested lakes
- expand control efforts and technical assistance to local groups by adding one additional staff
- provide grants to improve curly-leaf pondweed management
- fund research to improve control efforts

Although this is not a complete list, it highlights actions that are needed to protect Minnesota's natural resources from harmful exotics now and into the future.

Introduction

Administration of State Harmful Exotic Species Control Programs

The Minnesota Department of Natural Resources (DNR) and the Minnesota Department of Agriculture (MDA) administer prevention and control programs for harmful exotic species (invasive species) in Minnesota. The DNR's Exotic Species Program within the Division of Ecological Services is responsible for programs covering exotic aquatic plant and wild animal species. DNR's Division of Forestry, working in cooperation with the MDA, is charged with surveying and controlling forest pests, including exotic organisms such as the gypsy moth and several bark beetles. A separate annual report is prepared by the DNR Forest Health Protection Team. MDA is responsible for the state's noxious weed and seed regulations that apply primarily to terrestrial plants, although as of 2003 the implementation of the noxious weed law is the responsibility of local agencies. Information about control, prevention, and regulatory programs for several terrestrial invasive species, plant pests, and noxious weeds may be obtained from the MDA. University of Minnesota Sea Grant Extension has an Exotic Species Information Center in Duluth. The Center promotes education and outreach to prevent the spread of exotic aquatic species in the state.

Overview of DNR's Exotic Species Program

Minnesota's Exotic Species Program was established in 1991 and was the first program of its kind in the nation. This comprehensive exotic species program was preceded by single species programs. In 1987, the DNR was designated the lead agency for control of purple loosestrife, an invasive plant of particular concern for the state's wetlands. In 1989, the DNR was officially assigned a coordinating role for Eurasian watermilfoil control (Minnesota Statutes 84D.02, Subd. 2).

Many species fall under the DNR's current statewide responsibility to develop and coordinate a statewide program to prevent the spread of *harmful exotic species of wild animals and aquatic plants*. Examples include harmful exotic species that are present in Minnesota, such as Eurasian watermilfoil, purple loosestrife, zebra mussel, and ruffe (see Table 1). The DNR Exotic Species Program also attempts to prevent the introductions of harmful species that have the potential to move into Minnesota such as hydrilla, water chestnut, and Asian carp. To do so, the program identifies potentially harmful species in other areas of North America and the world, predicts pathways of spread, and develops and implements solutions that reduce the potential for introduction and spread. Prevention efforts are often undertaken with other states or agencies with similar concerns.

Program Staff and Other DNR Support

Most activities of the Exotic Species Program are conducted or directed by a nine-person staff from DNR's Division of Ecological Services. Up to 40 seasonal intern watercraft inspectors are hired each year to inspect boats at public water accesses. Current program staff, their principal areas of responsibility and activity, and their phone numbers are listed in Appendix A. Staff from the DNR Sections of Fisheries and Wildlife, Division of Enforcement, as well as the Bureau of Information and Education contribute significantly to the implementation and coordination of exotic species activities.

Table 1. DNR's Exotic Species Program efforts that address specific harmful exotic species.

Exotic Species of Aquatic Plants and Wild Animals in Minnesota	Efforts of DNR's Exotic Species Program						
	A = Public information and education B = Watercraft inspections to prevent spread C = Population surveys and monitoring D = Control to reduce nuisance E = Control to reduce populations/escapes F = Research on biology and management G = Regulations						
	A	B	C	D	E	F	G
Aquatic Plants							
Flowering rush (<i>Butomus umbellatus</i>)	X	X	X	X	X	X	X
Purple loosestrife (<i>Lythrum salicaria</i>)	X		X		X	X	X
Eurasian watermilfoil (<i>Myriophyllum spicatum</i>)	X	X	X	X	X	X	X
Other Non-native aquatic plants	X		X		X	X	X
Curly-leaf pondweed (<i>Potamogeton crispus</i>)	X	X	F	APM		X	X
Animals							
Common carp (<i>Cyprinus carpio</i>)			F		F/W	W	X
Ruffe (<i>Gymnocephalus cernuus</i>)	X	X	F/O		NIF	X	X
Round goby (<i>Neogobius melanostomus</i>)	X	X	F/O		NIF		X
Spiny waterflea (<i>Bythotrephes longimanus</i>)	X	X	F				X
Zebra mussel (<i>Dreissena polymorpha</i>)	X	X	X			X	X
Rusty crayfish (<i>Orconetes nusticus</i>)	X						X
Mute swan (<i>Cygnus olor</i>)			X		X		X

- APM - Individuals or groups apply for aquatic plant management permits
 F - DNR Section of Fisheries monitors this species
 F/O - DNR Section of Fisheries and other agencies monitor this species
 F/W - DNR Section of Fisheries and/or Section of Wildlife occasionally manage this species at priority sites
 NIF - Inland waters will be addressed as outlined in a Nonindigenous Fish (NIF) plan
 W - DNR Section of Wildlife is involved with research on this species

Divisions of Ecological Services and Fish and Wildlife

Pesticide enforcement specialists from Ecological Services and Aquatic Plant Management Specialists in the Section of Fisheries assist with the management of various exotic plants including purple loosestrife, Eurasian watermilfoil, and flowering rush. In addition to these staff, other individuals from the Division of Fish and Wildlife

contribute by providing biological expertise, assisting with control efforts, conducting inventory and public awareness activities, and providing additional avenues for public input.

Division of Enforcement

Conservation officers are responsible for enforcing the state regulations regarding harmful exotic species. A regional enforcement supervisor acts as exotic species enforcement coordinator within the Division of Enforcement to assist in scheduling, executing, and reporting on enforcement activities related to harmful exotic species. A chapter describing enforcement activities is included in this report (see Enforcement).

Bureau of Information and Education

Susan Balgie and other staff from the Bureau of Information and Education provide support for the Exotic Species Program's public awareness activities (see Education and Public Awareness).

Participation in Statewide, Regional, and National Groups

The DNR Exotic Species Program and other agencies in the state participate in statewide groups such as the Minnesota Invasive Species Advisory Council, the Noxious Weed Potential Evaluation Committee, and the Weed Integrated Pest Management Group.

The DNR Exotic Species Program and others in the state participate in regional and federal activities regarding harmful exotic species. The increasing number of national and regional entities and activities related to invasive species have made it much more difficult to represent Minnesota's interests at the regional and national level.

Minnesota's representative to the Great Lakes Panel on Aquatic Nuisance Species is Jay Rendall, the Exotic Species Program Coordinator. Doug Jensen from Minnesota Sea Grant is the alternate member and represented the state at Great Lakes Panel meetings in 2003. Participation on this regional panel helps keep Minnesota informed of regional and federal efforts regarding harmful exotic species and provides a voice for Minnesota interests. The Mississippi Interstate Cooperative Resources Association (MICRA) convened a Mississippi River Basin Panel on aquatic nuisance species. Jay Rendall was selected by MICRA to chair the new panel during its initial year. The panel held its first meeting in Minneapolis during July 2003. Jay also represented the Mississippi River Basin Panel and the state at meetings of the national Aquatic Nuisance Species Task Force meeting in Arlington, Virginia in November 2003.

Program staff are also involved with the following statewide or regional groups: Gary Montz and Jay Rendall - the St. Croix River Zebra Mussel Task Force (see Appendix B); Luke Skinner - garlic mustard biocontrol working group.

Expenditures

Funding Sources

Funding for activities conducted by the Exotic Species Program comes from a variety of state, federal, and local sources.

State Funds

The primary funding source is derived from a \$5 surcharge on the registration of watercraft in Minnesota. Surcharge receipts are deposited in the "Water Recreation Account" and appropriated by the Legislature. Surcharge receipts currently generate sufficient funds to allow an annual appropriation of approximately \$1,200,000 (Table 2). The 2003 Legislature appropriated an additional \$380,000 to the Exotic Species Program from the "Water Recreation Account." This funding was from the "regular" watercraft license receipts.

Table 2. State and local funding (in thousands of dollars) received by the Exotic Species Program, fiscal years 2003 and 2004.

Fiscal Year	Water Recreation Account		Legislative Commission on Minnesota Resources ¹	Local Contributions	Total
	Surcharge	Regular			
2003	1,191	0	45	11	1,247
2004	1,202	380	55	19	1,656

¹ Environment and Natural Resources Trust Fund or the Minnesota Resources Fund or both.

Over the last decade, significant support for exotic species research has been appropriated by the Minnesota Legislature from the Environment and Natural Resources Trust Fund and the Minnesota Resources Fund as recommended by the Legislative Commission on Minnesota Resources (LCMR). Recommendations by the LCMR are based on results of a competitive process. During the FY02/03 biennium, the DNR Exotic Species Program received \$90,000 from this source for a project entitled, "Biological control of Eurasian watermilfoil and purple loosestrife - continuation." LCMR recommended funding for a new project during the FY04/05 biennium focused on European buckthorn and spotted knapweed, high priority terrestrial invasive plants. This project is a joint effort by DNR and MDA.

Federal Funds

The DNR seeks funding from federal sources for a variety of program activities. Recent projects that have been funded are shown in Table 3. For example, funds from the U.S. Fish and Wildlife Service (USFWS) support the implementation of the St. Croix Interstate Management Plan for aquatic nuisance species. A portion of DNR's public awareness efforts and zebra mussel monitoring dives on the St. Croix River are paid from these funds. Two grants have been approved by the U.S. Environmental Protection Agency to support research on the biological control of European buckthorn. Funding from the U.S. Forest Service was also obtained to initiate a garlic mustard biological control project. These federally-funded projects often operate on timelines that are different from the state's fiscal year.

Table 3. Recent proposals submitted by the Exotic Species Program that received federal funding.

Federal Grant		Grant Amount (thousands of \$)	Source	Purpose
Federal Fiscal Year	Calendar Year(s) Used			
1998	1999	20	USFWS	Implement St. Croix management plan for aquatic nuisance species
1999	2000	19	USFWS	Implement St. Croix management plan for aquatic nuisance species
2000	2001	85	USFWS	Implement St. Croix management plan for aquatic nuisance species
2001	2002	85	USFWS	Implement St. Croix management plan for aquatic nuisance species
2001	2002-03	75	USEPA	Research on biological control of European buckthorn
2002	2003	80	USFWS	Implement St. Croix management plan for aquatic nuisance species
2003	2004-05	50	USEPA	Research on biological control of European buckthorn
2003	2004-06	105	USFS	Research on biological control of garlic mustard
2003	2004	60	USFWS	Implement St. Croix management plan for aquatic nuisance species

* The federal fiscal year begins on October 1 and ends on September 30.

Local Funds

Local entities work with the DNR to manage harmful exotic species and, in some cases, provide funds to expand planned efforts. During 2003, the Big Mantrap Lake Association and the Lake Minnetonka Conservation District provided funding so that the planned level of watercraft inspections at area lakes could be increased.

Timeframe

This report covers activities in calendar year 2003, which includes the last half of the Minnesota fiscal year 2003 (FY03; Jan. 1 - June 30, 2002) and the first half of fiscal year 2004 (FY04; July 1 - Dec. 31, 2003). To provide a comprehensive review of expenditures that occurred during calendar year 2003, we report both expenditures that were incurred in FY03 and those planned in FY04 (Table 4).

Cost Accounting

The DNR has a detailed cost accounting system that is used to track how funds are spent. All staff time and expenditures are coded. The coding allows us to sort work/expenditures by the type of activity being undertaken (e.g., management activities, public awareness efforts) and/or by what exotic species the work is focused on.

Minnesota Statute (M.S. 84D.02 Subd. 6) identifies five expenditure categories that must be reported. Those categories are Administration, Education/Public Awareness, Management/Control, Inspections/Enforcement, and Research. A sixth category,

Coordination, has been added to cover a variety of program-wide or “big-picture” activities that do not fit easily into the reporting categories required by statute. Expenditures within each category are subdivided to reflect the program activities described on the following pages.

Administration

Administration includes the amount assessed by the Division of Ecological Services (about 7% of the base budget) to cover administrative services, general office expenses, clerical staff time, telephones, postage, office rent, workers comp, and a prorated portion of the salary of division staff that serve on regional management teams. Also included as an administrative expense is staff time spent on activities that are not related directly to exotic species program work, e.g., training or professional development and assisting with other division or department projects. Finally, all staff time used for holidays, sickness, or vacations (about 5% of the base budget) is included as an administrative expense.

Coordination

Coordination includes a variety of activities and expenditures. They include:

Program coordination: Staff time spent on the general oversight and planning of program activities.

State coordination: Preparation of state plans and reports, and attendance at public hearings. Meeting with groups such as the Minnesota Lakes Association (MLA) and Lake Minnetonka Conservation District (LMCD) to discuss state activities and coordination with other groups. Involvement in state coordinating groups such as the Minnesota Invasive Species Advisory Council is included. Expenditures primarily represent staff time spent on these activities.

Regional and federal coordination: Staff time and out-of-state travel expenses to work with regional and federal partners on harmful exotic species issues. Examples from 2003 include: the Great Lakes and Mississippi River Basin panels on Aquatic Nuisance Species (ANS), the Mississippi Interstate Cooperative Resources Association’s ANS Committee, the Council of Great Lakes Governors’ ANS Initiative, and the Natural Areas Association’s Invasive Species Workshop.

Equipment and Services: Purchase and repair of boats, trailers, computers, and similar items, and computer support services.

Education/Public Awareness

Expenditures in this category include staff time, in-state travel expenses, fleet charges, mailings, supplies, printing and advertising costs, and radio and TV time to increase public awareness of harmful exotic species. The costs of developing and producing pamphlets, public service announcements, videos, and similar material are included, as are the costs of developing and maintaining harmful exotic species information on the DNR’s website.

Management

Expenditures in this category include staff time, in-state travel expenses, fleet charges, commercial applicator contracts, and supplies to survey the distribution of harmful exotic species in Minnesota and to prepare for, conduct, supervise, and evaluate control activities. When the management activity is focused on a specific harmful exotic species, e.g., Eurasian watermilfoil, purple loosestrife, zebra mussels, detailed expenditure information is shown. Funds provided to local government units and organizations to offset the cost of Eurasian watermilfoil management efforts are also included.

Inspections

Expenditures in this category include the costs that conservation officers incur enforcing harmful exotic species rules and laws, the costs of implementing watercraft inspections at public water accesses, and staff time and expenses associated with promulgation of rules, development of legislation, conducting risk assessments, and other efforts to prevent the introduction of additional exotic species into Minnesota.

Research

Expenditures in this category include staff time, travel expenses, fleet charges, supplies, and contracts with the University of Minnesota and other research organizations to conduct research studies. These studies include efforts to develop new or improved existing control methods, better understanding of the ecology of harmful exotic species, develop better risk assessment tools, and evaluate program success. When research is focused on a specific harmful exotic species, e.g., Eurasian watermilfoil, purple loosestrife, curly-leaf pondweed, detailed expenditure information is shown.

Not Spent

Funds in this category include work that was planned in FY03 and was either not done or for which the final bill has not yet been received. FY03 funds that were not spent were returned to the "Water Recreation Account."

Fiscal Year 2003 (FY03)

Expenditures on exotic species activities during FY03 (July 1, 2002 - June 30, 2003) totaled \$1,315,000 (Table 4). Expenditures from the Water Recreation "Surcharge" Account, the primary source of funding, are listed along with spending from other accounts. The Exotic Species Program manages "Other Program Accounts" that support program activities. An example is revenue from the sale of public awareness material, which is deposited in a "Publications Account" and can be used to fund future public awareness efforts. Grants received from other state or federal funding sources, e.g., LCMR recommended appropriations and the U.S. Fish and Wildlife Service, are also included in this category. In FY03, \$127,000 was spent from these accounts. Expenditures from "Other Department Accounts" primarily reflect work by staff in the divisions of Ecological Services or Fish and Wildlife who are not hired as exotic species specialists, but who occasionally work on exotic species issues as part of their DNR positions. In FY03, about \$2,000 of exotic species work was coded to the Game and Fish Fund and about \$5,000 was coded to the General Fund. This summary may not reflect the contribution of all DNR staff who provide assistance to manage harmful exotic species.

The \$1,181,000 of “Water Recreation Account” expenditures by the Exotic Species Program during FY03 (Table 4) was less than the \$1,191,000 available (Table 2). All funds were not spent (about 1% of the total remained at the end of 2003). Unspent funds are returned to the “Water Recreation Account.”

FY03 expenditures by major category (Figure 3 and Table 4) were similar to spending levels in recent years. Some year-to-year variation in expenditures is expected and reflects changes in program needs and/or the level of assistance provided by various partners. The portion of the budget spent on public awareness/education activities showed the greatest change in the last year, increasing from 7% in FY02 to 12% in FY03. The activities conducted with those additional funds are outlined in the Education and Public Awareness chapter.

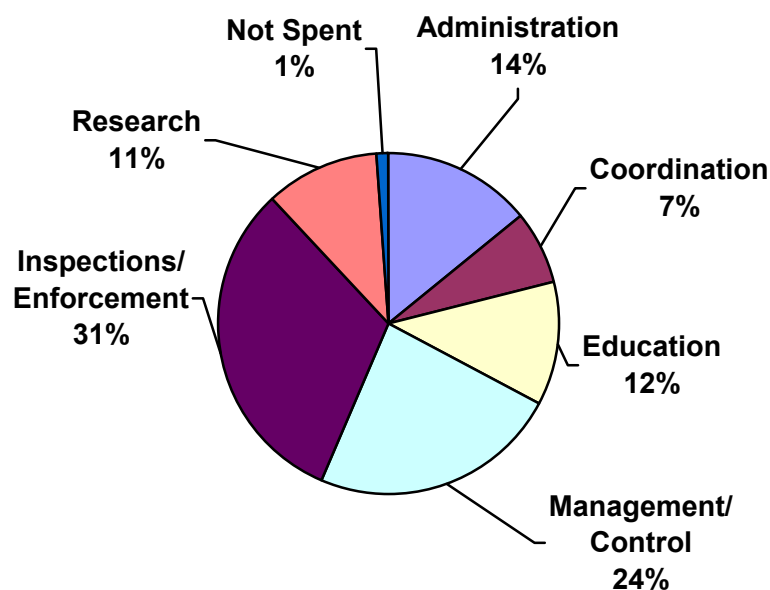


Figure 3. Exotic Species Program spending in FY03 by major categories.

Fiscal Year 2004 (FY04)

Since this report is due in the middle of FY04, planned expenditures for this year are also reported (Table 4). Expenditures in most categories will increase substantially because of the new funding from the “Water Recreation Account” (see Table 2). The Exotic Species Program advocated that FY03 funding levels were not adequate to meet the expanding threats to Minnesota waters. For example, since 1994 the number of lakes infested with Eurasian watermilfoil has doubled (from 76 to 153), as has the number of counties with infestations (from 13 to 24). As a result, the need for technical assistance and control has expanded; the number of waters where watercraft inspectors are contacting boaters has doubled. Over the past decade, new harmful exotic species threats have emerged. Eurasian watermilfoil and zebra mussels have gradually spread, the impacts caused by curly-leaf pondweed have become more apparent, round gobies have arrived, and new species, such as Asian carp, are on the verge of entering the

state. Costs to provide mandated or targeted levels of services have increased. The need for significant additional investment was recognized and funding was expanded in each of the primary focus areas: education/public awareness, management/control, inspections/enforcement, and research.

The following chapters describe in detail the activities that were conducted during 2003 with FY03 and FY04 funds.

Table 4. Harmful exotic species related expenditures in fiscal year 2003 (FY03) and projected expenditures in fiscal year 2004 (FY04) (in thousands of dollars).

Categories of Expenditures	Water Recreation Account			Other Program Accounts		Other Dept. Accounts		Totals	
	Surcharge FY03	Surcharge FY04	Regular	FY03	FY04	FY03	FY04	FY03	FY04
Administration			13					170	194
Rent, Phones, Postage, Office Supplies	30	30							
Staff Time and Regional Representation	33	40							
Staff Personal leave (Vacation, Holiday, Sick)	63	65							
Clerical	14	15							
Div./Dept. Administrative Support	30	31							
Coordination								87	90
State coordination	61	65				5	5		
Support regional/federal activities	10	10				-	-		
Equipment and services	11	10				-	-		
Education			72		55			139	221
Communications plan, workshops, presentations, radio spots, TV, website development	139	94							
Management/Control			140					287	507
General	31	30				2	2		
Eurasian watermilfoil	149	190							
Purple loosestrife	81	85							
Zebra mussel	16	20			5				
Curly-leaf pondweed	2	30							
Flowering rush	4	4							
Non-native fish	-	1							
Buckthorn	1								
Inspections/Enforcement			40					377	537
Watercraft inspections	314	345				<1	<1		
Enforcement - access checks	55	55							
Prevention-development rules/laws/risk assessments	8	42	45						
Research			70					255	175
General	3	12		-	-				
Eurasian watermilfoil	74	14		34	-				
Purple loosestrife	26	4		21	-				
Zebra mussel	-	-		-	-				
Curly-leaf pondweed	17	10		-	-				
Other exotic plants	2	-		-	-				
Non-native fish	-	-		-	-				
European buckthorn	6			72	50				
Garlic mustard				-	25				
Total	1,181	1,202	380	127	135	7	7	1,315	1,724

Emerging Issues

Introduction

There are many aspects of managing harmful exotic species: responding to new species, understanding new threats, monitoring expanding populations, and developing improved tools for control of harmful exotics that are established in Minnesota. In this chapter we describe issues in these areas that attracted attention in 2003.

New Species Reported in Minnesota

Bighead Carp

A new species of exotic fish has been reported in Minnesota in 2003. A commercial fisherman caught a bighead carp (*Hypophthalmichthys nobilis*) near the south end of Lake Pepin. Lake Pepin is a widening of the Mississippi River near Lake City. A carp specimen captured in 1996 by a commercial fisherman was identified as a bighead carp in late 2003. That bighead was caught somewhere in the southern half of the St. Croix River. No other bighead carp were found in 2003 despite DNR efforts to survey for the fish in the fall.

Since the bighead carp were first discovered in the Mississippi and Ohio rivers they have made their way north and south into such nearby states as Illinois, Iowa, South Dakota, and Missouri. Bighead carp are native to China, and have established in other portions of the world. These fish have been used in the aquaculture industry in other states since 1972 as a specialty food item that can be raised along with catfish as well as to improve water quality in rearing ponds. The bighead carp is not allowed for use in Minnesota.

Description

The bighead carp are planktivorous (they eat microscopic organisms). They prefer zooplankton (microscopic animals), but will supplement their diet with phytoplankton (microscopic plants) and detritus. They can get quite large, with individuals reaching over 30 inches in length and weighing 60 pounds. Females can produce on average 660,000 to 872,000 eggs annually.

The unique feature that distinguishes the bighead carp from our native fishes is the placement of the eyes, which are located below the mouth. This gives the appearance of the fish looking down. The head and mouth of the bighead carp are large; tiny scales cover the body. It is gray in color with blotches of black that are mainly found on the lateral side of the fish. The juvenile fish do not have fin spines, but as they age they will develop non-serrated spines at the origin of the dorsal and anal fins.

Potential Impacts

The bighead carp feeds on the same food items as many of our native fishes and mussels. They will directly compete with such filter feeders as the commercially harvested bigmouth buffalo, the threatened paddlefish, young of year fish species, and freshwater mussels. It is also hypothesized that if bighead carp over harvest plankton, the result could be an increase in algae. The bighead carp is also known to jump out of the water in response to the disturbance of a boat motor. The bighead carp may not

jump as often or as high as the silver carp, but it does have the potential to injure unsuspecting boaters.

Saltcedar

In 2003, the first recorded wild population of saltcedar (*Tamarix ramosissima*) was found near Hibbing, Minnesota. Saltcedar, a deciduous shrub native to Asia, was introduced to the western U.S. as an ornamental shrub in the early 1800s. Saltcedar has become established on more than a million acres of floodplains, riparian areas, wetlands, and lake margins in the western United States (Figure 4). Saltcedar can crowd out native stands of riparian and wetland vegetation; increase the salinity of surface soil rendering the soil inhospitable to native plant species; degrade wildlife habitat; and can cause springs, wetlands, riparian areas, and small streams to dry up by lowering surface water tables.

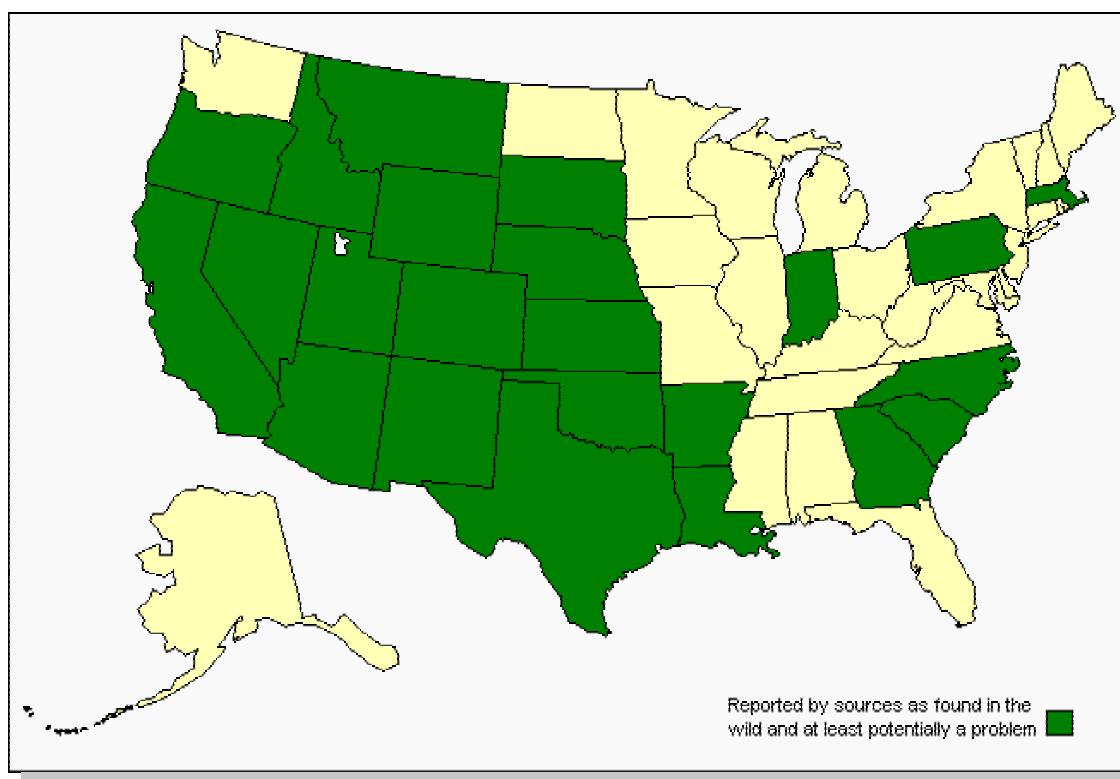


Figure 4. Saltcedar distribution in the United States prior to discovery in Minnesota. (Source: <http://www.nps.gov/plants/alien/map/tama1.htm>)

The saltcedar population in Minnesota was discovered by staff of DNR's Lands and Minerals Division in a mining tailings basin west of Hibbing. After confirmation by DNR botanists, a decision was made to attempt to eradicate the saltcedar population. On September 17, 2003, Exotic Species Program and Lands and Minerals Division staff cut and treated with herbicides all the saltcedar plants at the site. Approximately 40 mature plants (4-7 feet tall) were cut and the stumps treated with triclopyr, while the numerous young plants (less than 3 feet tall) were treated with glyphosate. The site will be revisited in 2004 to evaluate control effectiveness and control any surviving plants.

The saltcedar was thought to have arrived at this tailings basin in hay that was brought in to settle the dust prior to re-vegetation. Other tailings basins in the area will be surveyed for saltcedar in 2004. It is unknown how much saltcedar is used in landscape plantings in Minnesota or what impact it may have here.

Approaching Threats

Asian carp species

In addition to bighead carp, which was found in the state in 2003, three other species of carp native to Asia could threaten state aquatic resources: silver (*Hypophthalmichthys molitrix*), grass (*Ctenopharyngodon idella*), and black carp (*Mylopharyngodon piceus*). Similar to the bighead carp, silver and grass carp have escaped from captivity and have established populations in North American waters. The black carp is used in the aquaculture industry and has escaped from aquaculture ponds in the past, but is not known to have naturalized in North America. Each of these species pose different threats to fish and other aquatic species. Bighead, silver, and grass carp populations are moving toward or into Minnesota waters of the Mississippi River. There is also concern about these carp entering the Great Lakes through the Illinois waterways that connect the Mississippi River basin with the Great Lakes.

Silver carp

The silver carp is present in large numbers in the Mississippi River south of Minnesota and unless impeded by a fish barrier, is likely to move into state waters of the Mississippi River soon. The fish was first found in natural waters in Arkansas about 1980, likely the result of escapes from aquaculture facilities. In large numbers, the fish has the potential to cause considerable damage to native species because it feeds on plankton required by larval fish and native mussels. The silver carp has also attracted attention because of its habit of jumping several feet out of the water, hitting boaters, or landing in boats. The United States Fish and Wildlife Service (USFWS) began a process in 2003 to determine if it will list silver carp as an injurious wildlife species (see Regulations and Proposed Changes).

Grass carp

Grass carp are present in many natural waters in the United States. According to fisheries biologists in Midwest states, they are reproducing in tributaries of the Mississippi River. Individual grass carp have been found in a few locations in Minnesota; nevertheless there has not been evidence of reproducing populations in the state.

Black carp

Black carp are already present in, or are proposed for use in, aquaculture ponds in at least three southern states. Their escape would pose a significant risk to the mollusk and fisheries resources throughout the Mississippi River and its tributaries. The USFWS is continuing a process to determine if it will list black carp as an injurious wildlife species. If they were listed, they would be illegal to import into the country and to ship between states (see Regulations and Proposed Changes).

Response to Asian Carp

In the summer of 2003, the DNR initiated efforts to curb the spread of bighead, silver, and grass carp that are moving up the Mississippi River toward Minnesota waters. The following actions were initiated and completed according to a timetable established in summer.

- Public awareness materials about Asian carp, including a briefing sheet and a power point presentation, were prepared and distributed or presented to several Mississippi River groups.
- Exotic Species Program staff toured the Mississippi River along the southern Minnesota/Wisconsin border and met with fish barrier experts from Smith-Root, other Minnesota DNR staff, and representatives from the Wisconsin DNR, the National Park Service, and the USFWS. They discussed potential opportunities to install a fish barrier in the Mississippi River and arranged for Smith-Root to prepare a preliminary report which was completed in October, 2003.
- An interagency advisory team of experts was assembled from the Minnesota DNR, Wisconsin DNR, the U.S. Army Corps of Engineers (USACE), the USFWS, the National Park Service, and other entities to discuss the need for, and components of, a potential feasibility study. The team also will assist in gathering information for the study.
- An interagency meeting was held in St. Paul in October, 2003, to review the Asian carp threats, potential options for preventing within river spread, what the next steps should be, and who should be involved.
- Exotic Species Program and other DNR staff met with USACE representatives to discuss potential cooperative studies and projects to address spread of Asian carp.
- DNR staff conducted surveys in the Mississippi River to help determine the northernmost extent of the Asian carp species.
- In December, the DNR selected a contractor in cooperation with the USFWS to conduct a feasibility study by March 1, 2004. The feasibility study will address the following topics: options to prevent/slow invaders, evaluation of potential impacts of options; projection of risk if the Asian carp were to become established (including effects on river ecosystem, effects on river recreation, and economic effects); effects of options to prevent/slow invaders (including potential construction impacts, effects of operation and maintenance, effects on future rates and areas of invasion by non-indigenous species, adverse effects that could be avoided, and projected costs); and ranking of the prevention options and effects of those options. Once the study has been completed, future actions will be determined.

New Zealand Mudsnail

The New Zealand mudsnail is another future threat for the state's waters. This tiny snail from New Zealand, can reach densities of over 100,000 per square meter in suitable

river bottoms. It is currently found in Montana, Idaho, California, and Thunder Bay, Ontario (personal communication, Doug Jensen, Minnesota Sea Grant). Experts on this species suggest that recreational anglers, biologists, and others who enter or place equipment in infested streams could spread the snail to other locations.

New Management Techniques: Biocontrol for Buckthorn

Common buckthorn (*Rhamnus cathartica*) and glossy buckthorn (*R. frangula*) are European woody species that invade a number of habitat types in the northeast and north-central regions of the United States and Canada. Both species are very adaptable, forming dense thickets that inhibit the growth of native forbs, shrubs, and tree seedlings. Both species have long been established and are found throughout Minnesota, especially causing problems in the central and southern portions of the state.

Land managers have spent considerable time and money trying to control this invasive shrub using conventional techniques. Their success has been limited and short-term. We believe the best hope for a long-term management strategy may be release of a biological control agent. The DNR has initiated a research project on biological control of European buckthorn, conducted by the Center for Applied Bioscience International in Switzerland (CABI). In 2001, the DNR received a two-year grant from the United States Environmental Protection Agency-Great Lakes National Program Office (EPA-GLNPO) and several other contributors to initiate this research. In 2003, the DNR received \$109,000 in funding from the Minnesota legislature as recommended by the Legislative Commission on Minnesota Resources (LCMR), from the Environmental Trust Fund to continue this research. This funding was matched by EPA-GLNPO with an additional \$50,000. This funding will allow the research to continue through 2005.

Initial research suggests that a dozen species of insects show some potential as control agents. Researchers carried out field surveys for potential control agents in 2002 and 2003. Surveys and collection trips were carried out by CABI researchers in Germany, Italy, Switzerland, Austria, and Yugoslavia. In total, over 60 buckthorn sites were discovered and sampled. To date, some 270 arthropod samples have been collected, 184 on *Rhamnus catharticus* and 70 on *R. frangula*. Beginning in 2004, researchers will rear potential control agents and test whether they feed and/or reproduce on non-target native plants that are closely related to buckthorn. This research is expected to take eight to ten years to complete. If a successful biocontrol agent is discovered, we expect buckthorn populations will be suppressed by: 1) killing buckthorn shrubs outright, 2) stressing or weakening buckthorn plants so that native plant and shrub species can gain a competitive advantage, and/or 3) reducing seed production. In many cases, control or suppression of the pest plant can be long-term.

Luke Skinner of the Exotic Species Program visited CABI Research Center, June 14-21. Several field sites were visited in Germany and Switzerland. The project was reviewed in detail and priorities established for 2004-2005. In 2004, preliminary screening tests will be carried out with *Philereme vetulata*, *Sorhagenia janiszewskae*, and *Trichoderma walkeri*. New emphasis will be put on field surveys of flower- and fruit/seed-feeding insects as well as on *Oberea pedemontana*, a stem-mining beetle. Flower- and fruit/seed feeding insects had not been prioritized in the initial phase of the project because test plants would need to be synchronized at the flowering stage. Now that a

smaller subset of potential agents is proposed for further consideration and a few plant species are growing well in the Center's garden, it has been decided to include flower- and fruit/seed-feeding insects in the study for the next two years. It was also agreed that additional test plants need to be collected and sent to Switzerland before the end of 2003. Finally, priority will be given to the biological control of *R. cathartica*, and no detailed work will be planned for biological control of *F. alnus* at this time.

New Management Techniques: Biocontrol for Garlic Mustard

Garlic mustard, *Alliaria petiolata*, is currently one of the most serious invaders of forested areas in southern Ontario and the northeastern and mid-western United States. This biennial exotic plant can cover large areas where it displaces the native woodland ground flora such as spring ephemerals. Few infested sites were known to exist in the state until recently. In 2001 and 2002, the numbers and sizes of infestations increased significantly. It has become an increasing problem in Minnesota during the past two years. University of Minnesota herbarium records, and reports from citizens and biologists received during 2002, indicate that infestations exist in at least 14 counties: Anoka, Brown, Carver, Cass, Clay, Dakota, Hennepin, Kandiyohi, Nicollet, Pine, Ramsey, Scott, Washington, and Wright. Distribution of garlic mustard is likely more widespread than currently known.

Control of large infestations is difficult and land managers are seeking better control tools. In 1998, a project to search for natural enemies of garlic mustard was initiated at Cornell University. Funding was provided by the Departments of Natural Resources in Minnesota, Illinois, Indiana, and Kentucky; Hoosier National Forest; Native Plant Societies of Illinois and Indiana; U.S. Department of Defense and others. In 2002, the DNR and the United States Forest Service-Forest Health Technology Enterprise Team, in cooperation with representatives from many of the initial funding agencies, organized an informal working group to write a 3-5 year plan for continuing the project to develop a biological control program for garlic mustard. In 2002 and 2003, the consortium has cooperatively provided technical and financial assistance to continue the host range testing in Europe, establish laboratory colonies of promising agents in a quarantine facility in the U.S., and establish permanent evaluation plots in several states. This effort will pave the way for the introduction of garlic mustard biocontrol agents in the near future. To date, several species of insects show promise as control agents against garlic mustard.

To complete host specificity testing of potential control agents, the United States Forest Service-Forest Health Technology Enterprise Team has provided funding to the DNR to help complete testing in quarantine at the University of Minnesota. One insect species was brought into quarantine in the fall of 2003. Native plant species were collected in fall 2003 from field sites in Minnesota. Tests will be carried out to make sure the potential control agents do not feed on native plant species. Once the testing is complete, the insects must be approved for release into the United States by the United States Department of Agriculture (USDA). The earliest this may take place is 2005.

Education and Public Awareness

Introduction

Issue

Public awareness of harmful exotic species is one of the key strategies used to limit their introduction and spread. Since 1992, the DNR's Exotic Species Program has made substantial efforts to create and maintain a high level of public awareness and understanding about harmful exotic species. An annual communications plan is developed by the Exotic Species Program to identify activities and priorities.

Goals

Public awareness efforts in Minnesota are designed to:

- Make the public and certain businesses aware of the negative environmental impacts caused by some exotics;
- Help these groups identify and report findings of specific exotic species;
- Outline actions that boaters, anglers, seaplane pilots, waterfowl hunters, water gardeners, riparian landowners, bait dealers, and others must do to reduce the spread of these exotics; and
- Enhance understanding of management options.

Progress in Public Awareness – 2003

Key components of this year's communication efforts included radio and television advertising, public service announcements, printed materials, press releases, media contacts, information on DNR's website, staffing at sports shows and other major events, informational signs at public water accesses, and training.

Radio

Radio was used in 2003 to reach boaters and anglers in several ways. Paid advertising was used on major stations in the Twin Cities and Brainerd during the weeks preceding the Fishing Opener, Memorial Day, and Fourth of July. The stations were selected for their listener profiles which correspond with those of boat owners. Paid advertising was also used on Minnesota News Network (MNN), reaching an additional 73 affiliate stations throughout Minnesota. In late summer, a special effort was made in the Duluth market and southeastern Minnesota (Rochester and Winona) where there are zebra mussel infestations.

In addition, public service announcements (PSAs) were made available to Minnesota radio stations along with a cover memo, encouraging program managers to play these announcements. The PSAs are available in two audio formats from the DNR's website which makes them readily accessible to station managers at any time and eliminates the need to mail tapes each year (www.dnr.state.mn.us/news/psas/index.html).

A new PSA featuring Minnesota Twins' manager Ron Gardenhire was produced this year. The spot was placed on radio stations during major holiday weekends throughout the summer to maximize the number of listeners reached.

Television, video, and informational materials

Paid television advertising was used this year in the Duluth market during July and August (WDIO-TV, an ABC-affiliate station) to remind viewers of the continuing concerns about zebra mussels in the area. Two spots aired during morning and evening newscasts leading into popular outdoors segments including “Sportsman’s Notebook,” “Gone Fishing’,” “Up North,” and “Pro’s Pointers.”

In addition, spots concerning zebra mussels and Eurasian watermilfoil were aired on metro area cable stations to coincide with outdoor programs and Twins baseball coverage.

The “2003 Minnesota Fishing Regulations” included a section on harmful exotic aquatic species. Descriptions and illustrations of these harmful exotics were provided along with a summary of exotic species laws, a list of infested waters, and information about how to stop the spread of exotics. More than one million copies of the fishing regulations were printed and distributed.

The “Minnesota Boating Guide” also included a page of information on how to prevent the accidental transport of harmful exotic plants and animals. The guide is updated annually and was distributed this year to an estimated 320,000 boaters.

“Contain those Crawlers,” a poster and postcard about the harmful effects of earthworms on Minnesota’s forest floors and “Harmful Exotic Plants,” fact sheets designed for aquatic plant sellers and water gardeners were distributed through a variety of channels including the Northwest Sports Show and the Minnesota State Fair. In addition, a “Contain those Crawlers” poster was mailed to all minnow dealers in Minnesota. The earthworm materials were developed and/or distributed by DNR the Native Plant Society, and other partners.

Information about harmful exotic species was included in the 2003 edition of the “Explore Minnesota Fishing Guide,” a publication of the Minnesota Office of Tourism. The guide targets anglers traveling to Minnesota and is widely distributed throughout the Midwest at major outdoor sports shows including those held in Chicago, Milwaukee, Kansas City, Omaha, Des Moines, Sioux Falls, and Fargo. It is also distributed at travel information centers across Minnesota and some Minnesota outdoor retailers.

News releases

News releases alerting the public about harmful exotic species in the state were distributed throughout the year to all major media outlets in Minnesota. In addition, several interviews with Minnesota media resulted in expanded television, radio, and print coverage this year, helping to raise awareness about these issues. Major daily and weekly newspapers ran articles generated from the news releases and several of these articles were syndicated to other newspapers around the country. Of special note was a *Wall Street Journal* article on earthworms and a two-part series about harmful exotics that was published by the *St. Paul Pioneer Press*.

The DNR also produced and distributed several video news releases (VNRs) about harmful exotics to television stations in greater Minnesota.

DNR website

The DNR's website pages covering harmful exotic species issues were expanded (www.dnr.state.mn.us/ecological_services/exotics.html). The site includes an overview of the Exotic Species Program as well as information on individual programs and staff. A summary of Minnesota's exotic species laws, as well as lists of harmful exotic species and infested waters, and field guides to aquatic plants and aquatic exotic plants and animals are available online. The site also provides a list of publications and resource materials in addition to links to related web pages and sites for other partnering agencies.

Shows and fairs

DNR Exotic Species Program staff participated in the Northwest Sports Show and the Minnesota State Fair to distribute literature and information. Additional display elements at the Sports Show and an expanded staffing schedule at the State Fair provided for a greater presence at these two venues this year. An estimated 750,000 people visit the DNR's exhibits at the Northwest Sports Show and the Minnesota State Fair each year.

Public water accesses

DNR watercraft inspectors completed 19,466 hours of inspection (see Watercraft Inspections and Awareness Events) providing boaters with information and tips on ways to reduce the spread of exotic species. Signs are also posted at public water accesses. The DNR attempts to place "Help Prevent the Spread" and "Stop and Remove" signs at all public water accesses. Additionally, "Exotic Species Alert" signs are placed at accesses to infested waters.

Presentations

Presentations were given to a variety of audiences including: university classes, high schools, conferences, annual meetings, training sessions, service and professional organizations, and lake associations.

Effectiveness of Public Awareness Efforts**Background**

The DNR and Minnesota Sea Grant have conducted several surveys to help assess the effectiveness of public awareness efforts conducted in Minnesota. In 1994, Minnesota Sea Grant conducted a survey of boaters in Minnesota, Wisconsin, and Ohio to evaluate and compare regional differences in educational and awareness programs.

A report (Minnesota Sea Grant, 1994) summarizing the survey results said, "More effort has been expended and a greater variety of techniques have been used in getting the exotic species message out in Minnesota than in the other two states surveyed. Survey results indicate Minnesota boaters are more knowledgeable about exotic species issues and have already changed their behavior to a greater extent (to prevent the spread of exotics) than boaters in the other two states. This suggests that educational programs are effective."

In 1996, the DNR funded a follow-up survey of boaters in the Minneapolis/St. Paul metro area (DNR, 1996). Also in 1998, a survey of boaters in the Brainerd area was conducted (DNR, 1999). Both these surveys indicate that awareness about exotics has

continued to increase. Watercraft inspectors (see Watercraft Inspections and Awareness Events) also continue to find high levels of public awareness of exotics throughout Minnesota. Information from past surveys was used to guide development of annual public awareness efforts and maximize their effectiveness.

Effectiveness and boater survey results

A 2000-2001 mail survey coordinated by Minnesota Sea Grant, with cooperation from the DNR Exotic Species Program and conducted through the University of Minnesota Research Center, was sent to 4,000 boaters in five states: Minnesota, Vermont, Ohio, Kansas, and California. Results from Minnesota show that signs at water accesses, information in fishing and boating regulation booklets, articles in newspapers, and news stories on TV, as well as regulations and enforcement efforts, are the most effective methods to inform boaters and to encourage them to take precautions. The survey results show that messages are translating into action. Ninety percent of Minnesota boaters responding to the question in the 2000-2001 survey said they took action (Armson, 2001), an increase over a similar Sea Grant survey in 1994 when 70% of Minnesota boaters said they took action. The survey also showed considerable differences in the percent of boaters who took action in other states: 82% in Vermont; 46% in Ohio; 40% in California; and 30% in Kansas. These differences are proportional to the level of boater public awareness efforts and the variety of methods used in those states. Comparatively, Minnesota has invested more in public awareness regarding harmful exotic species and results show that this investment is resulting in significant increases in public awareness and preventative actions taken. In another 2000-2001 survey question, 99% of Minnesota boaters said they were very likely or somewhat likely to take precautions.

Angler survey

Minnesota Sea Grant conducted a separate survey of Minnesota anglers (Doug Jensen, Minnesota Sea Grant). The survey found that nearly 97% of Minnesotans believe it is important to prevent the spread of aquatic nuisance species. Yet, while awareness is very high, Minnesota anglers still represent a significant risk for the spread of harmful exotic species – 29% of surveyed anglers dump unwanted live bait into the lake or river after fishing and 25% of anglers who put bait buckets in the water, reuse those minnows on other waters.

Participation of Others in Public Awareness Activities

National “Stop Aquatic Hitchhikers!” Campaign

The national Aquatic Nuisance Species (ANS) Task Force, the U.S. Fish and Wildlife Service, and the U.S. Coast Guard are the primary sponsors of the “Stop Aquatic Hitchhikers!” campaign. The national campaign was developed in 2001 and implemented in 2002. The campaign includes a variety of marketing tools such as public service announcements, stickers, posters, magazine and newspaper articles, television, and radio programs to make the public aware of this issue. Most materials and announcements include a website address (www.protectyourwaters.net) to direct individuals to visit and learn about how they can become part of the solution in stopping the transport and spread of harmful aquatic hitchhikers. Beginning in 2003, the DNR began to use a national “Stop Aquatic Hitchhikers!” brand in its informational materials.

Minnesota partners

Other agencies and organizations in Minnesota have been cooperatively involved with public awareness activities in the state for more than a decade and continue to conduct public awareness efforts throughout the state.

Originally released in 1996, educational “traveling trunks” designed for hands-on learning by youth about harmful aquatic invasive species (AIS) are used by teachers and are available from several organizations in the state in addition to the DNR: University of Minnesota Sea Grant, Bell Museum of Natural History, Great Lakes Aquarium, and National Park Service (for more information, see www.seagrant.umn.edu/education/ttea.html). DNR’s Exotic Species and MinnAqua programs are currently working with Minnesota Sea Grant and the Bell Museum to update the trunks in 2004.

The University of Minnesota Sea Grant Extension Program’s Aquatic Invasive Species Information Center conducts research, outreach, and education programming often in collaboration with the DNR.

Since 1991, the Center has served as a key resource on harmful AIS for the public, agencies, organizations, teachers, students, and water-related businesses. Center staff regularly communicate with DNR Exotic Species Program staff to help identify program priorities and unmet needs, coordinate activities, leverage funds and resources, and share information and publications.

2003 Highlights of Minnesota Sea Grant’s educational activities related to harmful aquatic invasive species in Minnesota:

- Minnesota Sea Grant worked with DNR staff on a national effort to evaluate differences in boater awareness and behavior in Minnesota and four other states. A mail survey demonstrated that AIS public education can significantly change boater behavior to prevent and slow the spread of AIS. This finding has helped states, provinces, and task forces to justify spending for AIS boater education. Minnesota Sea Grant plans to publish a technical report and fact sheet on the survey results in 2004.
- Minnesota Sea Grant worked with DNR staff on a regional effort to evaluate angler awareness and education related to harmful AIS in Minnesota and four other Great Lakes states. Sea Grant plans to publish a technical report and fact sheet on the survey results in 2004.
- Minnesota Sea Grant continues to promote youth education programming about harmful AIS. Youth education traveling trunks, *Aquatic Exotics*, new lesson plans, and youth community stewardship project booklets were distributed to Minnesota teachers and students. Three Sea Grant-sponsored teacher training workshops were held to promote use of a new resource, *Exotic Species Compendium of Activities to Protect the Ecosystem* or *ESCAPE*. Sea Grant also partnered with the Newspaper in Education (NIE) program affiliated with the *St. Paul Pioneer Press* to sponsor an essay contest in fall 2003, which helped high school students incorporate AIS learning into their education.

- An award-winning compact disc (CD), *Exotics to Go!*, continues to be distributed by Minnesota Sea Grant to lake and recreational associations and others to promote awareness, prevent and contain the spread, and mitigate the impacts of harmful AIS.
- Center staff provided 51 presentations about harmful AIS at conferences, workshops, meetings and festivals in Minnesota, including a presentation, *Aliens in Minnesota*, on the University of Minnesota Stage at the 2003 Minnesota State Fair in August.
- Minnesota Sea Grant and DNR collaborated to produce new Spiny and Fishhook Waterflea, Rusty Crayfish, and European Frogbit *WATCH* identification cards. These cards augment those developed and updated in 2002 for Eurasian ruffe, round goby, Eurasian watermilfoil, and purple loosestrife. Each card provides identification features, helps prevent the spread, and encourages public reports of new infestations. From over 3.2 million cards produced for the Great Lakes region, over 260,000 cards were produced for distribution in Minnesota. Of these, nearly 40,000 cards were distributed in 2003 by Sea Grant to bait shops, convenience stores that sell fishing licenses, and agency offices along the North Shore of Lake Superior to Grand Portage as well as across Minnesota.
- Sea Grant, DNR, University of Minnesota Extension Service, and the St. Louis River Citizen Action Committee continue to promote youth community stewardship. Copies of the Biological Control of Purple Loosestrife 4-H project manuals and leader guides, *Biological Control of Purple Loosestrife: A Guide for Rearing Leaf-Eating Beetles* as well as *WATCH* identification cards continue to be distributed to youth and adults involved with the biocontrol program effort in the Duluth area. Since 2000, volunteers have reared and released nearly one million purple loosestrife-eating beetles (*Galerucella californiensis*) in 16 infested wetlands, mostly in the St. Louis River.
- Minnesota Sea Grant was awarded funding for two new AIS outreach projects for 2003-2005 from the National Sea Grant College Program based on a national competition. Both are collaborative efforts with the DNR.
 - 1) To prevent the accidental spread of AIS by aquarium hobbyists, Sea Grant is working in collaboration with the Pet Industry Point Advisory Council, U.S. Fish and Wildlife Service, International Association of Fish and Wildlife Agencies, and Great Lakes Sea Grant Network.
 - 2) To prevent the spread of invasive aquatic plants from water gardens and shoreland restoration activities, Minnesota and Michigan Sea Grant programs are working collaboratively with the Wisconsin and Minnesota DNRs, nursery and landscaping industry representatives, water garden enthusiasts, and shoreland property owners.
- Center staff participate on state, regional, and national task forces including the Minnesota Invasive Species Advisory Council's Communication and Education Committee (chair), Great Lakes Panel on AIS's Information and Education

Committee (chair), St. Croix River Zebra Mussel Task Force, ANS Task Force's Recreational Activities Committee (National Sea Grant College Program representative), and the ANS Task Force's Communication, Outreach, and Education Committee.

Future needs for public awareness in Minnesota

- Maintain spending on paid public awareness radio/TV spots to reinforce high awareness of exotic species by watercraft users.
- Continue to make public awareness of zebra mussels in Minnesota near Brainerd, Lake Superior, the Mississippi, Zumbro, and St. Croix rivers a priority.
- Work cooperatively with specific industry groups to develop targeted public awareness efforts such as the aquaculture industry, live bait dealers, water garden and horticulture industry, and aquarium trade.
- Use the Minnesota Invasive Species Advisory Council (MISAC) and other multi-entity groups to enhance interagency communication on the status and progress of exotic species management efforts.
- Expand public awareness activities that are cooperative ventures with lake communities outside the metro area.
- Increase information about harmful exotic species available through the various communication channels such as the DNR website, publications, and media outlets.
- Continue to work collaboratively with Minnesota Sea Grant staff to pursue research and outreach funding through National Sea Grant and other sources.

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Enforcement

Introduction

Issue

In 1991, the Legislature directed the DNR Commissioner to establish a two-year program designed to check trailered boats. Roadchecks were initially designed to inspect boats and trailers for the presence of Eurasian watermilfoil fragments and to educate and inform boaters. As additional harmful exotic species (e.g., zebra mussels) have become established in Minnesota, roadchecks and boat inspections were expanded to detect illegal transportation of those organisms, as well as other aquatic plants.

The DNR supported changes in statute passed during the 1996 legislative session that prohibited the transport of all aquatic vegetation (rather than Eurasian watermilfoil exclusively). This change in law made enforcement less complicated. Instead of having to identify Eurasian watermilfoil, which can be difficult, officers and watercraft users only had to ensure that all vegetation was removed before transporting boats and equipment.

In 1999, the Division of Enforcement took steps to better focus enforcement efforts. An Exotic Species Enforcement Plan that allocated hours and prioritized exotic species enforcement needs in each district was initiated. Activities in the statewide Exotic Species Enforcement Plan were included as a specific component of the FY02-FY03 annual work plans for all Division of Enforcement activities. These annual work plans describe in detail each enforcement district's responsibilities in meeting various responsibilities, including exotic species, and ensures that appropriate work activities and levels are accomplished.

Goals

One of the department's goals related to enforcement is to prevent the spread of exotic species within Minnesota. Part of this goal is to lower the percentage of trailered boats transporting prohibited exotic species, aquatic vegetation, and infested water within the state. The second part is to respond quickly when reports are received that harmful exotic wild animals have escaped from captivity.

Progress in Enforcement Efforts – 2003

Several types of enforcement activities have occurred to limit the introduction and spread of harmful exotic species including: educational work and presentations, with checks of trailered boats at water accesses, monitoring commercial bait harvest equipment, and follow up on illegally-released exotic animals. In 2003, conservation officers spent 1,941 hours enforcing the exotic species laws and rules. Statewide, there were a total of four civil citations and 19 written warnings issued to individuals for violations of exotic species laws and rules. Officers spent many hours educating the public on the regulations.

The following paragraphs summarize some of the key enforcement initiatives that have been used to meet the goals listed above.

Roadchecks of trailered boats were not conducted in 2003 (Table 5). Beginning in mid-summer of 2002 roadchecks were suspended. The reasons for suspending roadchecks are described below.

In 1994, the Minnesota Supreme Court decided the case of *Ascher v. Commissioner of Public Safety*. *Ascher* held that the police could not conduct sobriety checkpoints. The Court's reasoning was that these checkpoints constituted an unlawful invasion of privacy. The court held that law enforcement officials must have reasonable suspicion of a violation before stopping a motorist.

In the years between 1994 and 2002, the Division of Enforcement maintained that the needs for resource protection outweighed individual privacy interests in the roadcheck scenario. Accordingly, we supported the use of game and fish roadchecks and exotic species roadchecks.

Developments in our state's appellate courts during 2002 signaled that natural resource enforcement measures must comply with the same constitutional rules that govern general police "searches and seizures." These decisions clearly signal that the *Ascher* case applies to Enforcement's work as well.

The Division of Enforcement discontinued the use of game and fish roadchecks and exotics roadchecks as a result. Enforcement is hopeful that further litigation or legislative changes will help resolve this situation for the benefit of our natural resources.

Enforcement at water accesses

Enforcement near the Mississippi River

Conservation officers conducted exotic species enforcement activities along the Mississippi River, focusing on the transportation of zebra mussels and infested water. Boaters using the Mississippi River south of the Twin Cities must empty bilges, live wells, and bait buckets so that they do not transport zebra mussel infested water from the Mississippi. During the summer of 2003, officers spent numerous hours of access enforcement time along the Mississippi and St. Croix rivers (including accesses near Hastings, Red Wing, Lake City, Kellogg, Winona, and LaCrescent).

In addition to individual officer access checks, work crews were utilized. In one case, a district work crew focused enforcement efforts throughout Chisago County at numerous access sites. Efforts also focused on educating the public on the laws relating to transporting water from the St. Croix River in live wells and bait buckets. Zebra mussel awareness cards were handed out to the public again this year.

Table 5. Summary of trailered watercraft inspected by the DNR during roadchecks conducted between 1991 and 2002.

Year	Number of Roadchecks	Number of Watercraft Inspected	Number of Watercraft with Aquatic Plants	Number of Warnings ¹	Number of Written Citations
2003	Discontinued	N/A	N/A	N/A	N/A
2002	1	48	15 (31%)	10 (20.8%)	1 (2.0%)
2001	4	429	68 (15.9%)	66 (15.4%)	1 (0.002%)
2000	4	410	71 (17%)	69 (16.8%)	2 (0.5%)
1999	4	491	101 (21%)	95 (19.3%)	7 (1.4%)
1998	5	645	127 (20%)	117 (18.1%)	3 (0.5%)
1997	7	638	161 (25%)	152 (23.8%)	2 (0.3%)
1996	3	595	138 (23%)	152 (23.8%)	2 (0.3%)
1995	3	202	N/A	9 (4.5%)	-
1994	7	775	N/A	35 (4.5%)	-
1993	37	982	N/A	63 (6.4%)	9 (0.9%)
1992	7	1412	N/A	14 (1.0%)	12 (0.8%)
1991	8	818	N/A	9 (1.1%)	5 (0.6%)
Total	90	7445	681	791	44

¹ Made assumption that between 1994 and 1996 all offenders were issued warnings

Enforcement during the waterfowl hunting season

Conservation officers conducted exotics enforcement activities during the waterfowl hunting season to inform hunters about the laws prohibiting transportation of aquatic vegetation. Hunters must remove vegetation from their boats, decoys, and anchors before leaving the water access. There is an exception for the transport of shooting blinds, and emergent vegetation cut above the water line can be transported.

Conservation officers contacted hunters during the waterfowl hunting season at the following accesses along the Mississippi River: Verchota (Winona County), North Lake (Goodhue County), Dresbach (Houston County), Wilcox and Halfmoon (Wabasha County). Additional time was spent in Freeborn County, Otter Tail County, Beltrami County, and Mille Lacs County at several lakes frequented by waterfowl hunters. Statewide, additional efforts were made by officers to contact waterfowl hunters at their traditional access points.

Responding to escaped exotic animals

In 2003, the DNR changed its procedures and did not respond to reported escapes of mute swans. This modification reflects changes in federal regulation (see Management of Mute Swans). There were a few reports to conservation officers of escapes of exotic deer or other exotic wild animals.

In the Twin Cities metro area, conservation officers have visited several ethnic food markets to evaluate the possible trade in exotic species. As a result of the information gathered in these visits, an educational initiative is underway with exotic species program staff and other DNR personnel to provide resource materials to the communities in their respective languages.

Goals for 2004

The DNR believes that enforcement plays a critical role in reducing the spread of harmful exotic species, however, it is only part of the larger prevention effort. In order for the regulations on harmful exotic species to be effective in reducing their spread, there must be: a balanced mix of public education and awareness efforts, voluntary compliance from the general public, and enforcement of the regulations. One measure of the effectiveness of enforcement efforts targeting trailered boats would be a long-term decrease in the percentage of boats carrying vegetation.

Participation of Others

The Exotic Species Program is interested in increasing the participation of other peace officers to help look for violations and to enforce the state laws related to transport of prohibited exotic species on public roads. Recognition of exotic species, as well as being well versed in the laws that relate to them, aids in the enforcement efforts to stop the spread of exotic species.

Regulations and Proposed Changes

Introduction

Issue

Minnesota's regulations related to harmful exotic species currently in Minnesota Statutes and Minnesota Rules are generally considered to be comprehensive and some parts are unique. The state statutes related to harmful exotic species are found in Minnesota Statutes, Chapter 84D. The administrative rules related to harmful exotic species are found in Minnesota Rules, Chapter 6216. Current versions of both statutes and rules are available at www.revisor.leg.state.mn.us/. Summaries of annual changes in the regulations can be found in past DNR annual reports on harmful exotic species.

The DNR is assigned responsibility for designating *infested waters* (see M.S. 84D.03). Water bodies are designated infested if they contain specific harmful exotic species such as Eurasian watermilfoil, zebra mussels, ruffe, round goby, white perch, and spiny waterfleas. The current *infested waters* lists are found in Minnesota Rules, Chapter 6216 at www.revisor.leg.state.mn.us/.

The DNR is also required to adopt rules (per Minnesota Statutes 84D.12) that place exotic species into various regulatory classifications and prescribe how exotic species permits will be issued (per Minnesota Rules 6216.0265). The DNR is authorized to adopt other rules regarding harmful exotic species and infested waters.

Goals

The future needs identified in the 2002 report, included:

- Continue to support efforts to integrate and improve the comprehensiveness, enforceability, and responsiveness of federal laws regarding noxious weeds, injurious wildlife, and other designations related to harmful exotic species. Specifically seek reauthorization of the National Invasive Species Act (NISA) and designations of injurious wildlife such as the black carp.
- Continue to adopt rules that designate additional prohibited, regulated, and unregulated exotic species.

Progress in Regulations – 2003

Federal

At the national level, activity occurred in the following key areas: 1) related to reauthorization of the National Invasive Species Act (NISA), 2) national ballast water regulations, and 3) USFWS potential designation of injurious wildlife.

Reauthorization of NISA

On March 5, 2003, Senator Carl Levin (D-Mich.) and Senator Susan Collins (R-Maine) introduced The National Aquatic Invasive Species Act (NAISA) of 2003 (S. 525). In the House, Reps. Vern Ehlers (R-Mich.), Pete Hoekstra (R-Mich.), Wayne Gilchrest (R-Maryland), Brian Baird (D-Wash.), and Solomon Ortiz (D-Texas) introduced complementary legislation (H.R.1080) as part of a coordinated bipartisan, bicameral effort to address the threat from aquatic invasive species. Numerous other House and

Senate members co-sponsored the bill. The legislation contains provisions to: regulate ballast discharge from commercial vessels; prevent invasive species introductions from other pathways; support state management plans; conduct ecological surveys for early detection of invasive species; authorize rapid response funds; create education and outreach programs; conduct research on invasion pathways and prevention and control technologies; and authorize funds for state and regional grants. On March 17, 2003, HR1080 was referred to the Subcommittee on Fisheries Conservation, Wildlife, and Oceans. On Tuesday, June 17, 2003, the Senate Environment and Public Works Subcommittee on Fisheries, Wildlife, and Water held a hearing centered around S. 525 on legislation regarding nonindigenous invasive aquatic species. There was no congressional floor action taken on NAISA before the end of 2003.

Congressional authors of the bill have indicated they will reintroduce the act again early in the 2004 session. Minnesota DNR reviewed and supported a letter from the Council of Great Lakes Governors to congressional members encouraging them to support NAISA in the next session of Congress.

National Ballast Water Regulations

- Voluntary Program Becoming Mandatory - As detailed in a June 2002 Report to Congress (Report to Congress on the effectiveness of the voluntary BWM program, June 3, 2002, <http://www.uscg.mil/hq/g-m/mso/HotIssue6-02.pdf>), the Coast Guard has seen only a 30% compliance with the required submission of ballast water reporting forms, however, NISA does give the Coast Guard the authority to establish a mandatory ballast water management program and penalties for non-compliance if compliance with the voluntary guidelines and submission of ballast water reporting forms was too low to allow for an accurate assessment. Therefore, the Coast Guard is moving to establish a mandatory program with penalties. This program will require ships operating outside the Exclusive Economic Zone to either: 1) conduct a mid-ocean exchange, 2) retain ballast water on board, 3) use an approved ballast water management method, and/or 4) discharge to an approved facility. The most common method will likely be the mid-ocean exchange because it is the most practical method given current limitations in technology. Ships that are not able to conduct a mid-ocean exchange because of safety, or because their route does not take them far enough off shore, (for example, a transit from Chile to California), will not be required to comply with the requirement.
- Ballast water standard - The Coast Guard announced in the *Federal Register* on September 26, 2003, that it intends to prepare and circulate a Programmatic Environmental Impact Statement for the proposed regulatory action to establish a ballast water discharge standard. To determine whether ballast water management methods are effective, the Coast Guard is working on identifying a measurable standard that will clearly establish when the ballast water no longer contains quantities of species that pose a significant risk. In addition, the Coast Guard is examining the potential impacts on the environment of various possible methods for reaching that standard.

Designation of injurious wildlife

- The USFWS announced in the *Federal Register* on June 4, 2003, that they were seeking additional information related to a proposal to designate black carp as an injurious wildlife species under the Lacey Act. The USFWS had not designated black carp as injurious as of December 31, 2003.
- The USFWS announced in the *Federal Register* on July 23, 2003, that it was seeking comments regarding the possible designation of the silver carp as an injurious wildlife species under the Lacey Act. The USFWS had not designated bighead carp as injurious as of December 31, 2003.
- The USFWS announced in the *Federal Register* on September 17, 2003, that it was seeking comments regarding the possible designation of the bighead carp as an injurious wildlife species under the Lacey Act. The USFWS had not designated bighead carp as injurious as of December 31, 2003.

Injurious wildlife can only be imported by permit for scientific, medical, educational, or zoological purposes, or without a permit by federal agencies solely for their own use; permits are also required for the interstate transportation of injurious wildlife currently held in the United States for scientific, medical, educational, or zoological purposes. Designation of injurious wildlife prohibits interstate transportation of those species currently held in the United States for purposes not listed above. Violations could bring a \$5,000 fine or six months in jail.

State statute changes

Cervidae

During 2003, there were changes to Minnesota Statutes, Chapter 17.452 related to farmed Cervidae and game farms. Most of the changes become effective on January 1, 2004. The changes were primarily for purposes of addressing chronic wasting disease, but they also affect the possession, tagging, fencing, and control of exotic deer. These changes, and those made in 2002, eliminated some conflicting time requirements and tagging issues that made responses to escaped exotic and native Cervidae species difficult. Under the 2003 legislation, all captive Cervidae must be possessed as “farmed Cervidae” and may no longer be possessed under DNR game farm regulations or as pets. Captive farmed Cervidae are not subject to the harmful exotic species regulations, however, exotic species of Cervidae that are free roaming for longer than 48 hours are subject to both the Cervidae regulations and harmful exotic species statutes.

Harmful Exotic Species

The DNR may propose statutory changes for consideration during the 2004 Legislative Session. The proposed changes may include modifications of definitions, additions and increases in civil and criminal penalties, revision of the mandate to conduct 20,000 hours of watercraft inspections of watercraft leaving waters of the state, and changes in restrictions related to use of nets in infested waters.

Permanent rulemaking

On November 24, 2003, the department completed the rulemaking process to designate additional exotic aquatic plants that could threaten Minnesota's resources as prohibited exotic species or regulated exotic species. The changes to Minnesota Rules are the underlined portions below.

6216.0250 PROHIBITED EXOTIC SPECIES.

[For Subp. 1 and 2, see MR]

Subpart 2A. Federal noxious weed list. For the purpose of this part, the aquatic plants listed in the Code of Federal Regulations, title 7, section 360.200 are also designated as prohibited exotic species.

6216.0260 REGULATED EXOTIC SPECIES.

[For Subp. 1, see MR]

Subp. 2. Aquatic plants. The following aquatic plants are designated as regulated exotic species:

[For items A-C, see MR]

D. Yellow iris or yellow flag (*Iris pseudacoris*) Linnaeus.

New rules will be proposed in 2004 to designate infested waters that have been designated in emergency rule, but have not yet been designated in permanent rules. Northern snakehead fish (*Channa argus*), exotic earthworms, and other exotic animal and aquatic plant species will be assessed, classified, and proposed as additional prohibited and regulated exotic species in 2004.

Emergency rulemaking

DNR has begun to draft emergency rules to designate waters found to have Eurasian watermilfoil, zebra mussels, and spiny waterflea for the first time in 2003 as infested waters, as well as redesignate infested waters for which the designation in emergency rule have expired. Designation of some species as regulated or prohibited exotic species may be included in the same emergency rule.

Watercraft Inspections and Awareness Events

Introduction

Issue

The potential for boaters to accidentally move aquatic exotic species from one lake to another is a clear threat to Minnesota's aquatic ecosystems. For this reason, the 1991 Minnesota Legislature mandated that DNR conservation officers conduct inspections of trailered boats on Minnesota highways. The purpose of these inspections was to look for Eurasian watermilfoil, issue citations to violators, and inform the public about the potential spread of harmful aquatic exotic species.

In 1992, the DNR, Minnesota Lakes Association, and angling groups proposed and supported legislation (adopted as M.S. 18.317, Subd. 3A, and recodified as 84D.02 subd. 4) requiring 10,000 hours of inspections of watercraft leaving infested water bodies containing harmful aquatic exotic species such as Eurasian watermilfoil, spiny waterfleas, and zebra mussels. Subsequently, a watercraft inspection program was established by the DNR in 1992 to accomplish this mandate. In 1993, legislation was passed increasing the number of inspection hours to 20,000 starting with the 1994 boating season. In 1999, this statute was amended to allow inspections on both infested and uninfested water bodies to fulfill the 20,000 hour requirement.

Goals

Watercraft inspections help meet the goal of preventing the spread of harmful exotic species within Minnesota. The inspections also help to:

- Complete 20,000 hours of watercraft inspection as required in state statutes and target about 10% of that effort at uninfested waters;
- Increase public awareness about exotic species and the potential for boaters to transport exotics between water bodies;
- Reduce the percentage of trailered boats carrying harmful exotic species;
- Increase educational efforts with citizen groups.

Progress in Watercraft Inspections – 2003

Complete required hours of watercraft inspection

In 2003, approximately 37 inspectors worked through the summer providing information to the public on watercraft inspections and exotic species. Inspections began in late April and continued through November 15. Within this 27-week period, watercraft inspectors logged 19,466 inspection hours and an estimated 550 hours of inspection time was accomplished by Enforcement. A total of 41,640 watercraft/trailers were inspected.

During the inspection season, inspections were conducted at six fishing tournaments and continued through October in order to reach waterfowl hunters. Inspectors also distributed more than 5,200 Exotic Alert Tags on vehicles with trailers at access points on infested waters. Inspectors also worked to clear aquatic plant fragments from the public water accesses at which they were stationed.

Inspection efforts were conducted across the state in rough proportion to the number of public water accesses (PWAs) on infested water bodies, with some inclusion of high-use accesses on uninfested water bodies (Table 6 and Figure 5). The actual distribution of time reflects both the number of PWAs and the level of public use at those accesses. In 2000, the program was broadened to include many uninfested water bodies in an effort to reach more boaters in non-metro locations. The percent of time that the program is spending in each region has stayed relatively stable from 2000 to 2003 with a slight decrease in time in Region 4 and a slight increase in time in Region 2 (Figure 6). This change could be attributed to the increase in infestations in greater Minnesota in the past years. The necessity of having inspectors on infested water bodies in greater Minnesota has enabled the program to spend time on surrounding uninfested water bodies as well.

Table 6. Number of watercraft inspections conducted by watercraft inspectors in 2000, 2001, 2002, and 2003. (Totals are rounded values).

Year	DNR Region				Total
	1	2	3	4	
2000	2,300	4,200	35,200	9,000	51,000
2001	1,700	4,000	27,200	5,800	39,000
2002	660	3,100	32,300	7,700	44,000
2003	760	5,600	29,684	5,500	42,000

The watercraft inspection program has primarily focused on water bodies with infestations of harmful exotic species. This approach was used because there were relatively few infested water bodies and so it was very efficient. While it is important to contact boaters leaving water bodies infested with harmful exotic species, we feel it is also important to inform boaters on other popular recreation lakes in Minnesota. To allow more flexibility in the program, state statute was amended to include watercraft inspections on uninfested water bodies in order to meet the department's 20,000-hour mandate (M.S. 84D.02, Subd. 4). During 2003, inspections on uninfested waters represented about 9% of the total inspections (3,543 inspections) and approximately 9% of the inspection hours (1,736 hours).

To determine which uninfested waters to visit, we used three criteria: 1) lakes or areas with a high level of boater activity, 2) lakes identified on program surveys as frequent destinations for boaters leaving infested water bodies, and 3) lakes with lake associations that desired to hold "Exotic Awareness Events."

Although the program has broadened to include inspections at uninfested waters, the majority of the inspections are still done at infested water bodies. The St. Croix River is of special concern because the lower 25 miles are infested with zebra mussels, discovered in 2000 (see Management of Zebra Mussels). Since this is a relatively new infestation, it has been very important that watercraft users on the river are aware of the infestation and become educated on how to reduce the risk of transporting zebra mussels to other water bodies. In 2003, almost 1,000 (849.25) inspection hours were spent on the St. Croix River and more than 2,000 watercraft were inspected.

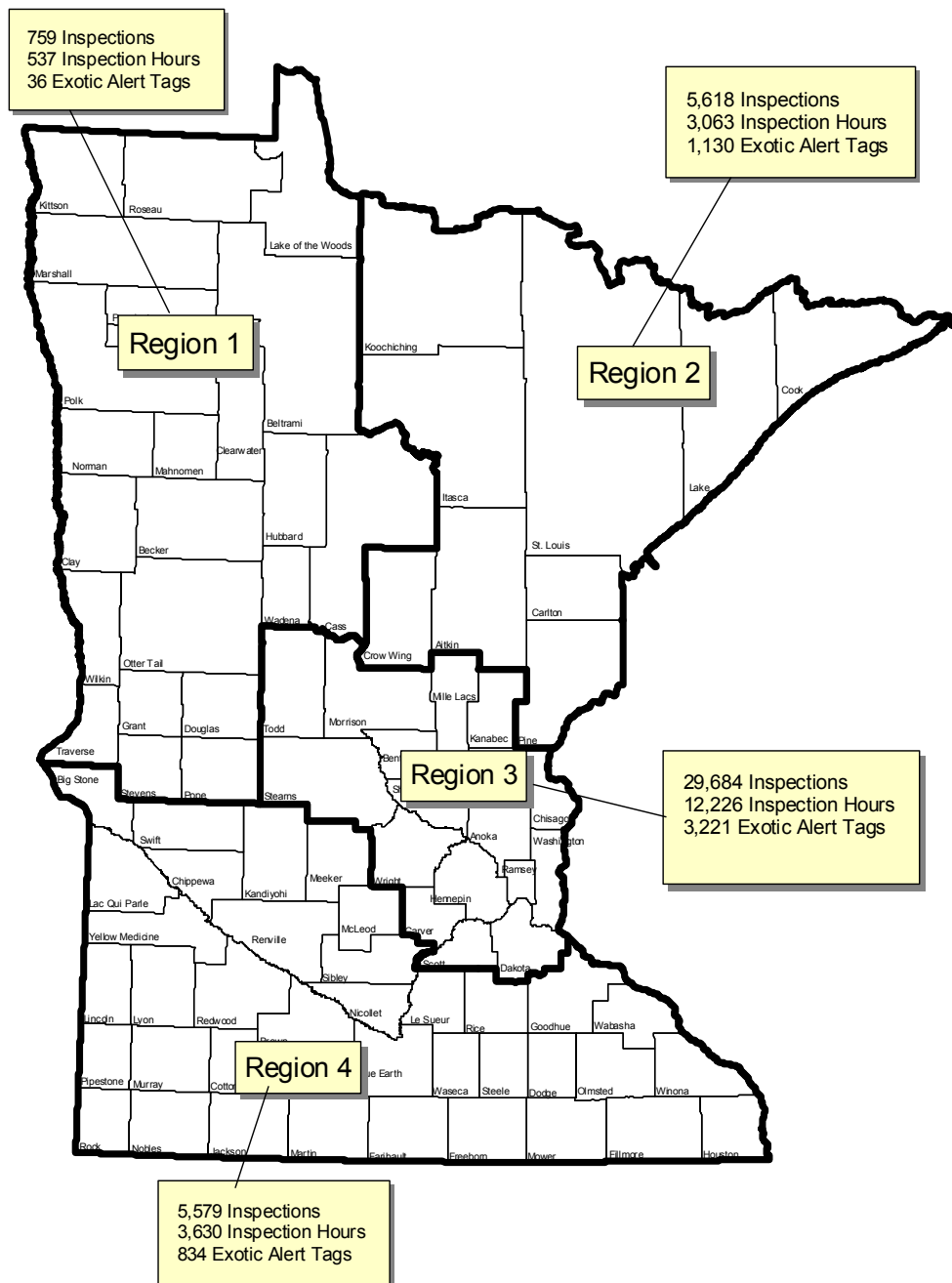


Figure 5. DNR watercraft inspections at public water accesses in 2003.

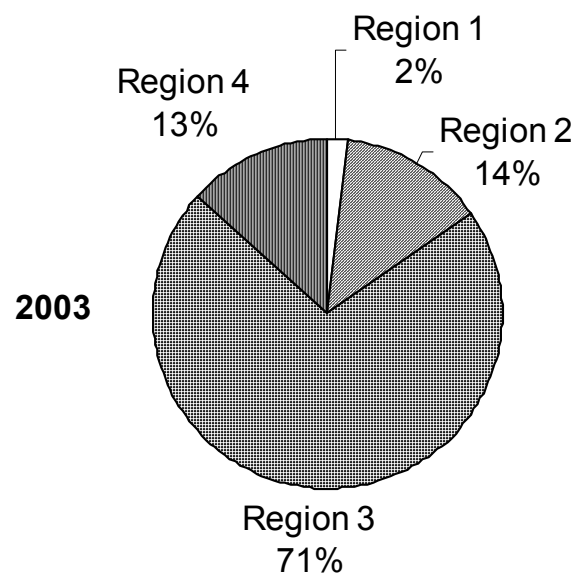
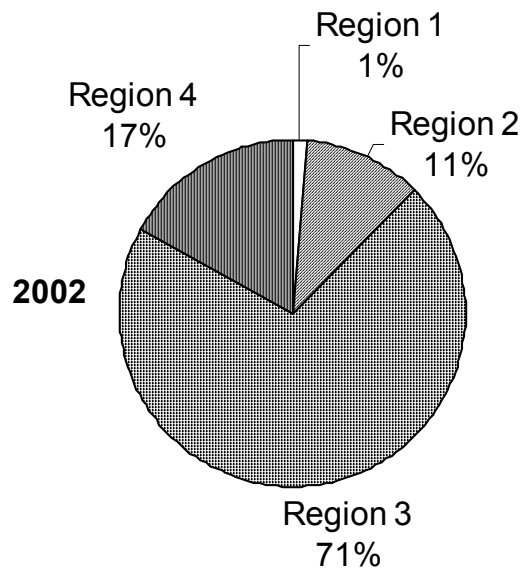
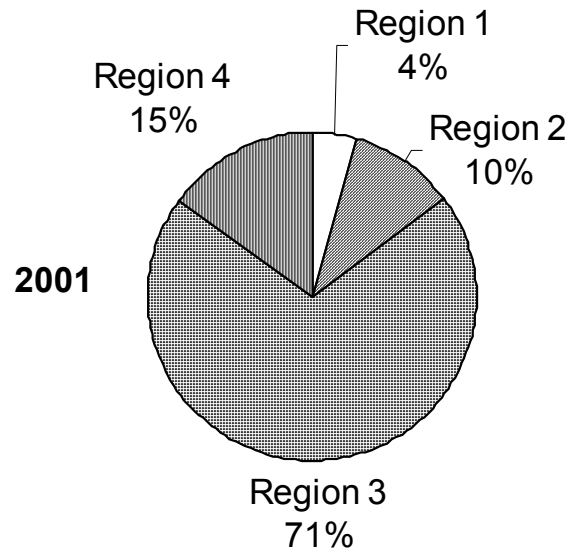
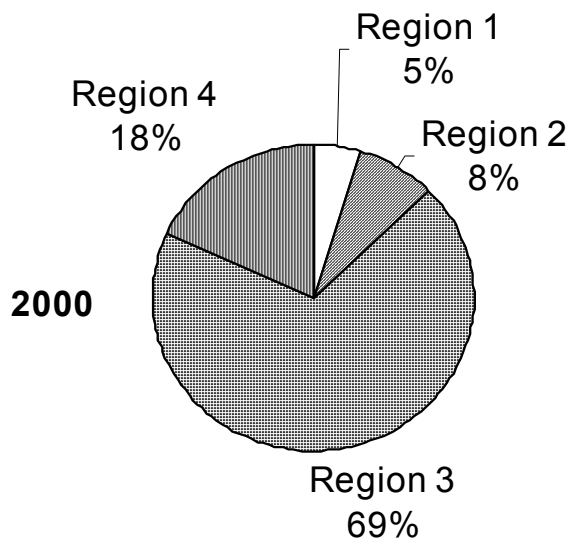


Figure 6. Percent of the state's total watercraft inspection hours spent in each region in 2000, 2001, 2002, and 2003.

Increase public awareness

Surveys conducted by watercraft inspectors provide important information on the public's awareness of exotic species laws and help identify high risk areas (i.e., accesses where many watercraft pick up plant fragments). According to survey information collected by watercraft inspectors, awareness of exotic species laws remains very high among Minnesota boaters. The percent of watercraft users who responded "yes" when asked if they were aware of the exotic species laws for the state was 96%, up 3% from 2002. Boaters from other states using Minnesota water bodies had a slightly lower response at 90%. The range of percentages for each Minnesota county where at least 100 inspections had been done varied from 82% (in Rice County) to 100% (in Lake County). Of those who said they were not familiar with the laws, just over 3% (26 out of 836) had vegetation on their watercraft when they entered the access. In contrast, fewer than 2% (295 out of 19,417) of the people who said that they were familiar with the laws entered the access with vegetation.

Decals are given to boaters (see Decal Program for Trailered Watercraft) which signify that they have talked with a watercraft inspector. Of those with no decal, 7% said they were not familiar with the exotics laws. In contrast, of those with a year 2003 decal, 0.003% said they were not familiar with the laws. This suggests that the Watercraft Inspection Program is successful at educating boaters about the exotics laws.

Reduce the percentage of trailered boats carrying exotic species

In 2003, the Watercraft Inspection Program and the Division of Enforcement conducted one access check. The inspection program has been unable to assist with roadchecks due to changes in the law that prevent the department from conducting them (see Enforcement).

Increase educational efforts with citizen groups

In 2003, the Watercraft Inspection Program participated in many public awareness activities and worked with several citizen groups in order to educate the public about harmful exotic species. Inspectors answered questions both at the exotic species display at the Minnesota State Fair and at an informational booth for the Shoreland Volunteer group at the Wright County Fair. The Watercraft Inspection Program was also able to work with several citizen groups throughout the season. Inspectors worked side by side with lake association members during two awareness events: one at Lake Frances in Le Sueur County and one at Lake Ossawinnamakee in Crow Wing County.

The Big Mantrap Lake Association also worked cooperatively with the DNR to increase inspection hours on its lake. The Big Mantrap Lake Association funded 90 hours of its inspection at its access. The DNR provided training, equipment, and supervision while the Big Mantrap Lake Association paid for salary and travel for one individual who completed 90 inspection hours.

The Watercraft Inspection Program worked cooperatively with the Lake Minnetonka Conservation District (LMCD) for the second year to increase inspection hours on Lake Minnetonka. Inspectors spent an additional 1,600 hours on four Lake Minnetonka accesses because of the funding provided by the LMCD. The DNR trained, equipped, and supervised inspectors hired with LMCD funding.

Estimate of Risk from Trailered Boats

The percentage of boats/trailers carrying vegetation as they were trailered out of a lake or river varied widely by county (Figure 7). These variations may be caused by several variables including the amount and type of vegetation in the water body, its proximity to the public water access, and the amount of recreational boating traffic. An average of 17% of the watercraft checked by watercraft inspectors were found with vegetation (3,447 watercraft) as they trailered out of the water. This rate demonstrates a clear risk that boaters will transport aquatic vegetation (and harmful exotics) from lake to lake if boats are not properly cleaned. The percentage of boats and trailers carrying vegetation as they enter public accesses on infested waters was 1.6%. This is a good indication that the majority of boaters using infested waters are inspecting and cleaning their boats and trailers. Enforcement of exotic species laws continues in an effort to reduce the transportation of vegetation and harmful exotics (see Enforcement).

Transportation of Other Exotic Species

There were no zebra mussels found on boats being launched into Minnesota waters. Zebra mussels were found on 32 watercraft exiting Minnesota waters. This demonstrates a clear risk of zebra mussels being moved on boat hulls or on plants caught on trailers if boats are not properly cleaned. Anglers who “catch” zebra mussels off the bottom and discard them in the bottom of their boats can also move them.

Decal Program for Trailered Watercraft

During the 1994 boating season, several boaters expressed frustration over being approached by inspectors several times each week throughout the summer. To respond to their concerns and to reduce the duplication of education efforts, a decal was developed and distributed to boaters whose watercraft had been inspected for exotic species (Figure 8). Boaters are instructed to voluntarily affix the decal to the winch post of their trailer. This allows inspectors to identify the boaters who have already spoken with inspectors during the summer. Boaters with a decal are given a brief reminder to drain water and remove vegetation from their boats. The decals have been used for eight years now and have been well received by the public. The 28,500 decals distributed during the 2003 boating season also remind boaters to inspect their boats when inspectors are not present.

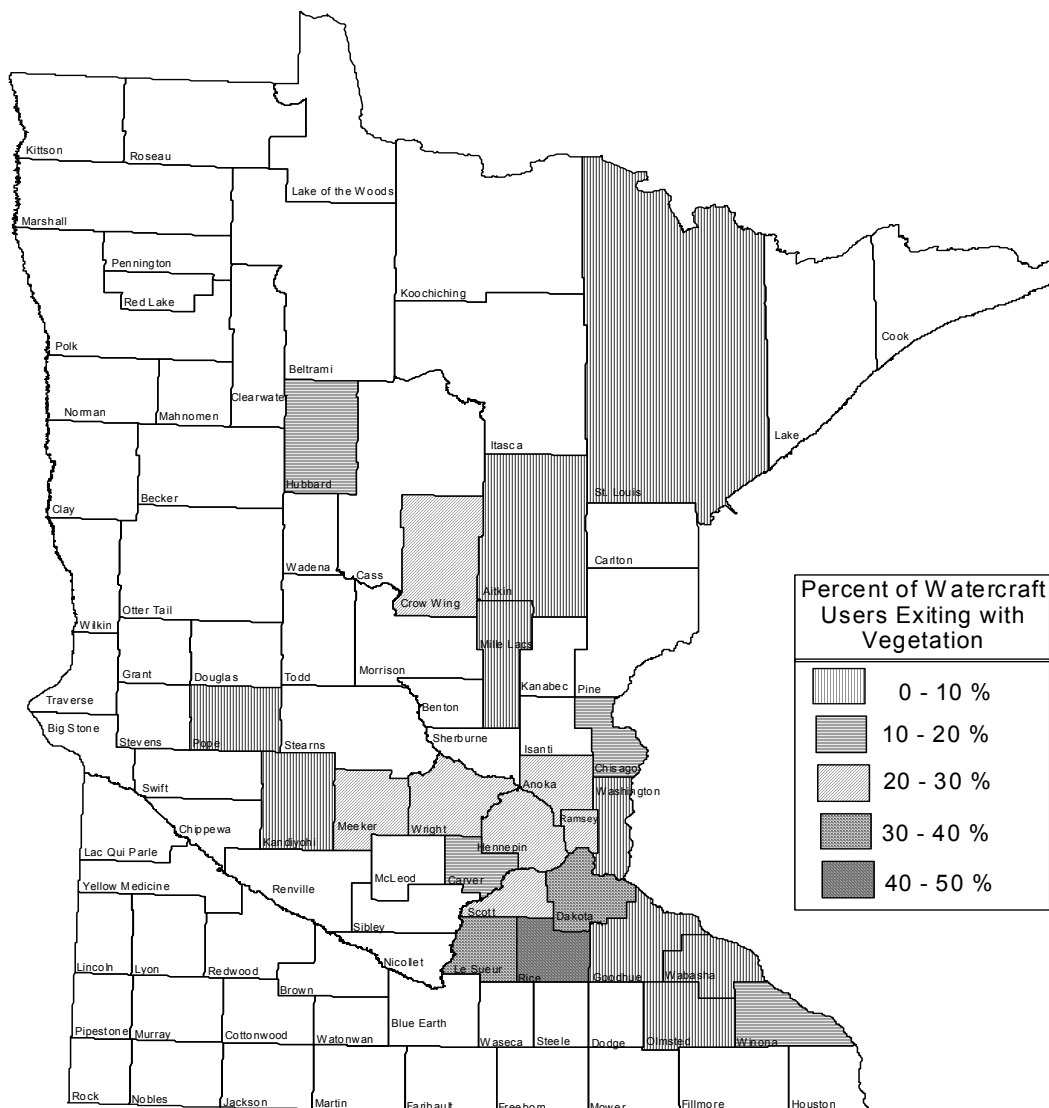


Figure 7. Percentage of exiting watercraft with attached vegetation prior to cleaning (in counties where more than 90 boats were inspected upon leaving an access).

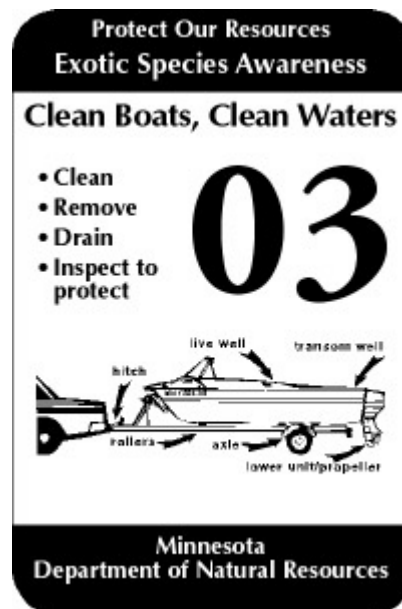


Figure 8. Decal provided to boaters by DNR watercraft inspectors in 2003.

Future needs and recommendations for watercraft inspections

- Conduct a minimum of 20,000 hours of inspections during the 2004 boating season and target about 10% of these inspections at high-use uninfested waters.
- Continue to reduce the percentage of watercraft traveling on Minnesota roads carrying vegetation and other exotic species.
- Increase cooperation with citizen groups that would like to help increase awareness in their areas.

Risk Assessment, Risk Management, and Related Research

Introduction

Many harmful exotic species that cause problems in other parts of the United States or other countries do not yet occur in Minnesota. Keeping these species out of Minnesota is a high priority not only for the environment, but also for the state's economy. Failure to interrupt pathways and address high risk species often results in introductions that are costly to manage and may become perpetual problems. In reference to the introduction of the snakehead fish, Walter Courtenay, an ichthyologist and national expert on exotic fish, said: "The biggest mistake this country has made is that we have not been proactive in preventing these kinds of introduction. We've always been reactive. When you look at the cost of trying to eliminate or control something once it is established here, it is just out of sight."

In order to prevent the introduction of new harmful exotic species into Minnesota, it is necessary to determine which species are moving into the state, and how they are getting here. The Exotic Species Program and others perform risk assessments on exotic species which include pathways of spread. The risk assessment projects described in this chapter were conducted or completed in 2003.

Aquatic Plant Sales

Activities such as water gardening, wetland restoration, and shoreline plantings are increasing in popularity. While efforts to restore lakeshores to more natural conditions are recommended, the commercial sale of aquatic plants represents a significant pathway for the introduction of harmful exotic species into Minnesota waters. The risk that harmful exotics will make their way into natural waters either by accidental escape of cultivated plants or by deliberate introduction of aquarium or water garden plants, poses a threat to Minnesota lakes, rivers, and wetlands.

Goals

The goals of the aquatic plant risk assessment, risk management, and related research are to:

- Identify exotic aquatic plant species that may be harmful to Minnesota resources;
- Identify businesses that sell aquatic plants to Minnesotans; and
- Communicate to both buyers and sellers of aquatic plants which species are potentially harmful and how they can prevent the introduction of those species.

Communication

In 2003, Exotic Species staff revised and widely distributed two publications aimed at slowing the movement of harmful exotic species through the horticultural trade: *Harmful Exotic Species: What every water gardener and shoreline restorer should know*, and *Harmful Exotic Species: What every aquatic plant seller should know*. These publications give aquatic plant buyers and sellers the information they need to be able to prevent the introduction of harmful exotic species into Minnesota waters. Exotic Species Program staff made personal contact with nurseries throughout Minnesota, explaining the risks associated with some exotic aquatic plants, the laws which govern the sale and use of those plants, and how they can help prevent new introductions of

harmful exotics into Minnesota. Nursery managers throughout the state were extremely cooperative and offered to pass our two publications along to their customers and staff.

Identify businesses that sell aquatic plants

Minnesota Sea Grant began work on a new initiative "Preventing New Introductions of Invasive Aquatic Plants through Water Gardening and Shoreline Restoration." Staff from the Exotic Species Program are assisting with this effort. This project will examine the potential for the introduction of aquatic nuisance species through the nursery trade both regionally and nationally, develop key messages and materials, evaluate an educational campaign based on those messages; and transfer an outreach program to other states. Sea Grant staff are currently in the process of developing a questionnaire for aquatic plant sellers to assess what is moving and how much they know about the risks posed by aquatic exotic plants.

Risk Assessment of Individual Species

The Minnesota Invasive Species Advisory Council (MISAC) convened a series of expert panel meetings to assess the threats posed by various exotic species. Groups met to discuss insects, terrestrial animals, aquatic plants, terrestrial animals, and aquatic animals. Exotic Species Program staff have been active members of MISAC and helped organize the panels. Exotic Species Program staff contributed to each of the panels.

Each expert panel developed a list of species to evaluate, researched information on those species, and evaluated each species for the severity of problems it could cause in Minnesota. Each panel met three times between July and December 2003. All panels intend to complete their efforts by April, 2004.

The risk assessments were done using the following decision tree:

MISAC Exotic Species Decision Tree, October 18, 2003

1. Is the species native to Minnesota?

Yes - stop. No - go to #2.

Debated/unknown - go to #2.

2. Can the species naturalize in Minnesota?

(MISAC definitions - Naturalize means to establish a self-sustaining population of exotic species in the wild outside of its natural range).

It is naturalized here or in similar climates, do CLIMEX or other programs predict it could naturalize in the state, or can it survive in heated structures or warm water discharges - continue to #3.

No - go to considered, but did not list (#2b)

Unknown - go to further evaluate (#5)

2b. Is it a well-known pest in other areas?

Yes - (go to #8)

No - (go to #7)

3. Is the species *known to be a pest/invasive in Minnesota or similar areas?**

* *known* means it actually causes nuisances, it is not just listed as a pest/invasive species in similar locations.

Yes - continue to #3b

No - go to considered, but did not list (#7)

Maybe - go to watch list (#6)

Unknown - go to (#6)

3b. Is the species naturalized/established in the state?

Yes - continue to #4 and assign ranks for "species established in the state"

No - go to #4 and assign rank for species "not established in the state"

4. Determine the rank for each impacted area the species affects.

If one or more *impacted areas* are known to be affected - Review* the *standards* for the *impacted area(s)* and determine appropriate *category* or categories below:

Severe Threat - in state

Severe Threat - not naturalized/established in state

Moderate Threat - in state

Moderate Threat - not naturalized/established in state

Minimal Threat - in state

Minimal Threat - not naturalized/established in state

If species is not expected to have impacts in Minnesota - go to #6 or #7 depending on uncertainty regarding potential impacts in Minnesota.

- see MISAC's *Categories, Criteria, and Standards for Evaluating Invasive Species* sheets, available from Jay Rendall, DNR Exotic Species Program, 651-296-1464.

5. Further evaluate climate requirements

Evaluate with CLIMEX, CABI software, or other means to compare native range requirements with Minnesota climate. If Yes after evaluation - go to #2; if No - go to considered, but did not list (# 2b); if Maybe - go to watch list (#6).

6. Place on watch/unknown list

Assign this category

(Note: These are species that need to be watched to see if they are becoming invasive in the state. It is not the list of species to watch for because they are known to be invasive.)

7. Place on considered, but not listed list

Assign this category and add to this list with a comment that it is not expected to establish/naturalize in the state.

8. Place on severe pest in other areas list.

A severe pest in other areas but, not expected to naturalize/establish in Minnesota. These species could be a seasonal problem.

Each species which made it to step four in the decision tree was evaluated based on its ease of spread and the severity of impacts it could cause. The severity of its impacts were evaluated for six separate areas: native species/natural communities, agribusiness, human health, recreation/industry, landscaped areas, and structures/stored pests. The outcome of these evaluations will be a list of species with their associated ranks. The information contained in these lists will be used to help provide information and education to the public, prioritize and justify management and monitoring activities, and help formulate public policy. The results of these evaluations should be available in April, 2004.

Future needs for risk assessment, risk management, and related research

Risk assessment

- Continue to identify exotic species that may be likely to enter Minnesota and evaluate their potential to cause problems if they become established in the wild.
- Develop a database and maintain files at the DNR of literature about exotic aquatic plant and wild animal species to guide regulatory classification.
- Continue to identify pathways which could bring harmful exotic species into the state.

Risk management

- Determine and carry out appropriate actions to deal with species determined to be harmful to Minnesota. Actions will include education, monitoring and management, and formulation of public policy.

Research

- Encourage, fund, and support research to predict which exotic species are likely to naturalize and be harmful in Minnesota.

Management of Curly-leaf Pondweed

Introduction

Issue

Curly-leaf pondweed (*Potamogeton crispus* L.) is a perennial, rooted, submersed vascular plant that was first noted in Minnesota about 1910 (Moyle and Hotchkiss 1945). Curly-leaf pondweed is currently known to occur in 65 of the 87 counties in Minnesota (Exotic Species Program 1997), (Figure 9). Unlike most native plants, curly-leaf pondweed plants remain alive, slowly growing even under thick ice and snow cover (Wehrmeister and Stuckey, 1978). Therefore, it is often the first plant to appear after ice-out. There were several reports of curly-leaf pondweed growing more abundantly in the spring of 2003 than in previous years. This may have been due to less snow on the ice, and a shorter duration of ice than in previous winters.



By late spring, curly-leaf pondweed can form dense mats that may interfere with recreation and limit the growth of native aquatic plants (Catling and Dobson 1985). In mid-summer, curly-leaf plants usually die back, which results in rafts of dying plants piling up on shorelines, and often is followed by increases in concentrations of phosphorus (Bouldan et al. 1994) and undesirable algal blooms. Curly-leaf plants usually die back in early summer in response to increasing water temperatures, but they first form vegetative propagules called turions (hardened stem tips). New plants sprout from turions in the fall (Catling and Dobson 1985). Short-term control of dense mats of curly-leaf can be removed using contact herbicides or mechanical harvesting. However, in order to obtain any long-term control of curly-leaf pondweed, the production of turions must be stopped. It is not clear how many years of turion reduction it will take to produce long-term control of curly-leaf.

Goals

The DNR has two goals that apply to curly-leaf pondweed management:

- To prevent the spread of curly-leaf pondweed within Minnesota.
- To reduce the impacts caused by curly-leaf pondweed to Minnesota's ecology, society, and economy.

One strategy to attain the second goal is to support and conduct research to improve the management of curly-leaf pondweed, and to communicate research results to the public.

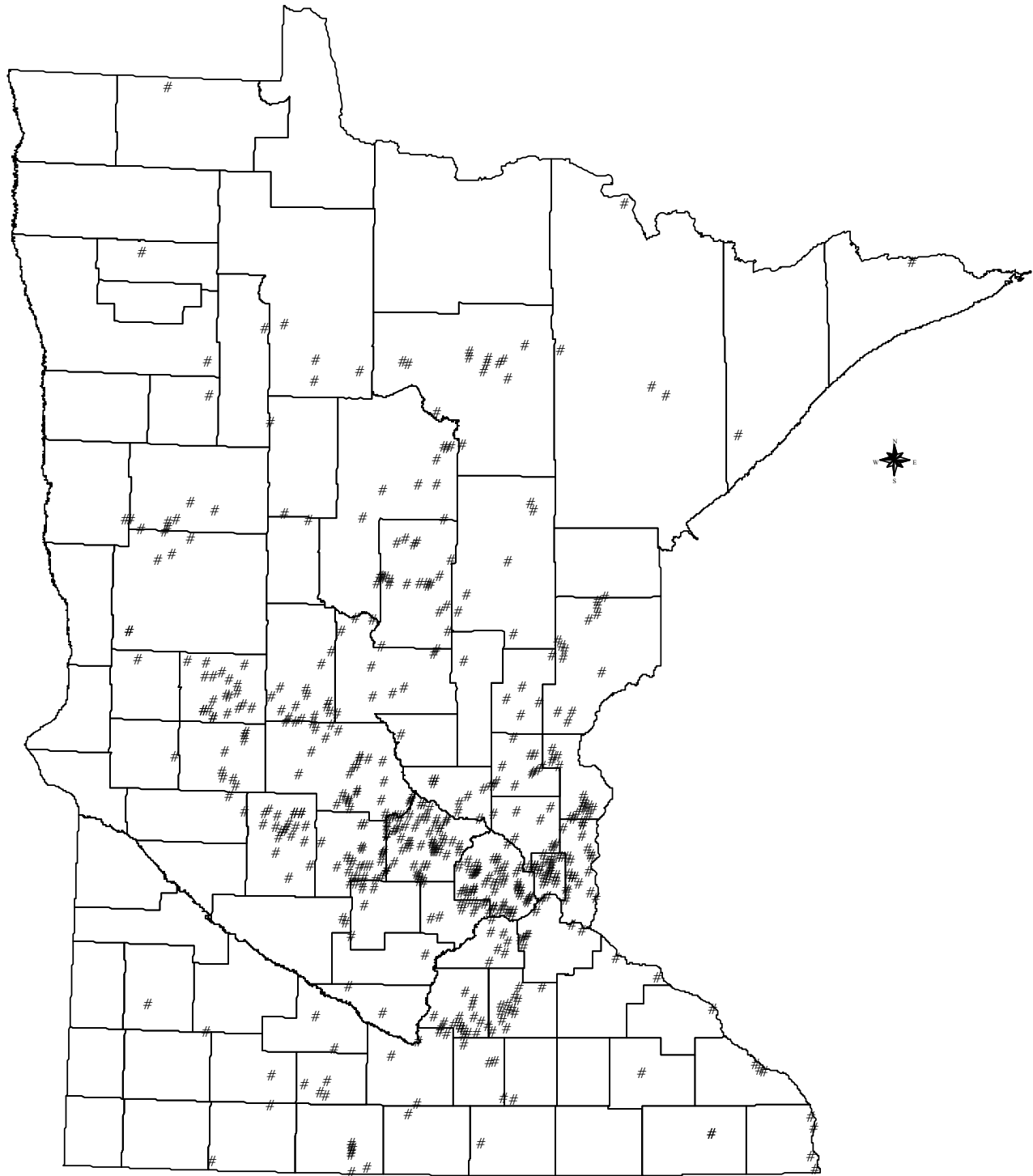


Figure 9. Curly-leaf pondweed locations in Minnesota (compiled using DNR Fisheries surveys).

Progress in Management of Curly-leaf Pondweed – 2003

Prevention of spread

Exotic Species Program staff have worked with the general public, lakeshore residents, and researchers to support our goals for curly-leaf pondweed. The Exotic Species Program continued to use watercraft inspections, informational materials, and public speaking engagements to further our efforts to prevent the accidental spread of curly-leaf pondweed. In particular, access inspectors spent time at several lakes, which are heavily infested with curly-leaf pondweed (See Watercraft Inspections and Awareness Events for a description of their activities).

Support research to improve management

Staff have provided technical assistance and financial support to researchers working on curly-leaf pondweed.

U.S. Army Corps of Engineers (USACE)

Exotic Species Program staff assisted USACE in its continuing study to evaluate the efficacy of contact herbicides to control curly-leaf pondweed at low temperatures and to reduce next summer's growth by reducing turion production (Poovey et al. 2002). USACE has been treating three small lakes in Minnesota every spring since 2000 with endothall, a contact herbicide, to determine whether this approach can provide long-term control of curly-leaf pondweed. It is hypothesized that this approach may deplete the "bank" of turions in the lake sediments and so reduce the growth of the exotic in the following year.

These annual treatments have been successful in controlling curly-leaf pondweed during the year of treatment, encouraging the growth of native plants, and reducing turion production. In April of 2003, coontail and elodea were abundant in two of the treated lakes, Blackhawk and Schwanz, while curly-leaf pondweed was rare. Nevertheless, enough curly-leaf was still present in the those lakes in the spring of 2003 to warrant treatment. In April 2003, Schwanz and Blackhawk, were again treated. Spring surveys in 2004 will determine if further treatments are needed.

In the third treatment lake, the north Bay of Gleason, curly-leaf was also rare in April 2003. In this study, lake the curly-leaf pondweed was not treated in 2003 but instead was monitored to see how dense the curly-leaf would become during June. By the end of June, curly-leaf was abundant in some areas, though there was quite a bit less than before the treatments originally began in 1999. Gleason Lake will be checked again next summer to see how long the reduction in curly-leaf lasts

Based on the USACE research so far, the Exotic Species Program recommends using an endothall-based herbicide, such as Aquathol K when water temperatures are 60° F in the spring. These treatments should successfully kill curly-leaf pondweed, reduce or eliminate turion production in the treated areas, and will have less of a negative impact on native aquatic plants than treatments done later in the summer.

In 2003, the USACE began another study in Minnesota to look at the effectiveness of a combination of a 2,4-D-based herbicide and an endothall-based herbicide to control areas of Eurasian watermilfoil and curly-leaf pondweed. This study will evaluate the effects of large-scale treatments on the target plants, non-target plants, and fish communities. USACE is doing this study in cooperation with Mississippi State University and the DNR with support from CerexAgri, an herbicide manufacturer. In 2003, two Minnesota lakes were chosen to be untreated reference lakes, and two lakes were chosen as treatment lakes. Pre-treatment data was collected on all lakes in 2003.

Effects of fluridone

To evaluate the effects of fluridone on curly-leaf pondweed, MSU collected data on curly-leaf pondweed biomass and turion production in two Minnesota lakes. They collected data from two lakes, a treated lake (Eagle) and an untreated reference lake (Parley) in Carver County. Eagle Lake is part of an evaluation of fluridone herbicide by the DNR (see Management of Eurasian Watermilfoil chapter for more information about this study). Researchers at MSU sampled biomass and turions in Eagle and Parley lakes in early and late June in 2002, and in early May and early June of 2003. These data have been received by the DNR and will be analyzed during the winter of 2003-2004. The project was funded by the Exotic Species Program with \$3,000 of program funds.

Curly-leaf biology

Dr. John Madsen, while at Minnesota State University-Mankato (MSU) and his graduate student Thomas Woolf completed a research study aimed at determining the best time of year to manage curly-leaf pondweed (Woolf and Madsen 2003). They measured the seasonal variations in biomass and carbohydrate allocation in curly-leaf pondweed populations in Minnesota in order to identify low periods of carbohydrate storage. Low periods of carbohydrate storage are the time when curly-leaf pondweed will potentially be most vulnerable to control efforts. Their results showed the low point in carbohydrate storage occurred between January and April. (Woolf and Madsen 2003). This research was funded by the Exotic Species Program with \$53,000 of program funds over two and a half years.

Provide technical assistance

Staff of the Exotic Species Program have continued to provide the public with information on the best management practices for curly-leaf pondweed control. During 2003, staff met with many lake groups to discuss control of curly-leaf pondweed, including the Weaver Lake Conservation District in Hennepin County, Portage Lake Association in Hubbard County, the Lake Orono Improvement Association in Sherburne County, Lake Benton Improvement Association in Lincoln County, Big Swan Lake Association in Todd County, Crow Wing Lake Association in Crow Wing County, and City of Plymouth Aquatic Plant Management Group in Hennepin County.

Exotic Species staff wrote an article for the *Minnesota Lakes Association Reporter* about curly-leaf pondweed and its control which was published in March, 2003 (Crowell 2003). Copies of this article have been given out to many people requesting information on the control of curly-leaf pondweed.

Future needs for management of curly-leaf pondweed

- Participate in symposium organized by the Minnesota Lakes Association to discuss problems caused by curly-leaf pondweed and options for control.
- Review available information on the ecology and management of curly-leaf pondweed to identify possible research projects that might be carried out to improve management of the exotic in Minnesota. Provide funding for identified research needs.
- Support research to determine how the growth and abundance of curly-leaf is affected by the elimination of turion production.
- Continue public awareness efforts focused on containing curly-leaf pondweed to where it is already found. Opportunities include our Watercraft Inspection Program, literature, and public speaking engagements.
- Continue to provide information on the best management practices for curly-leaf pondweed control to the public.
- Continue to provide technical assistance and other support to researchers working on curly-leaf control, and the relationships between curly-leaf populations and lake water quality in Minnesota.

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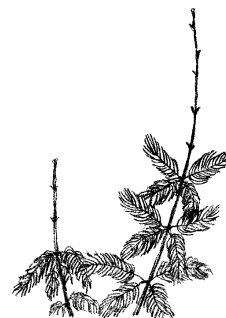
Management of Eurasian Watermilfoil

2003 Highlights

- Eurasian watermilfoil was discovered in 11 additional Minnesota water bodies during 2003. There are now 152 Minnesota lakes, rivers, and streams known to contain the exotic submersed aquatic plant.
- The Exotic Species Program funded management of milfoil on 31 Minnesota lakes.
- New research showed that hybrids between the exotic Eurasian watermilfoil and native northern watermilfoil occur in Minnesota lakes where there has been confusion about the identity of the plants.

Issue

Eurasian watermilfoil (*Myriophyllum spicatum*) is an exotic submerged aquatic plant that was inadvertently introduced to Minnesota. Eurasian watermilfoil, hereafter called milfoil, was first discovered in Lake Minnetonka during the fall of 1987. Milfoil can limit recreational activities on water bodies and alter aquatic ecosystems by displacing native plants. As a result, Minnesota established the Minnesota Department of Natural Resources' (DNR) Exotic Species Program to manage milfoil, as well as certain other harmful exotic species. This report describes the Exotic Species Program's efforts in 2003 to manage milfoil and limit its spread in Minnesota.



Goals

The Exotic Species Program has two primary goals for management of milfoil in Minnesota. They are listed below along with the principal strategies to achieve these goals.

- Prevent spread of milfoil in Minnesota
 - Monitor distribution of milfoil in Minnesota
 - Show boaters how to prevent the spread of milfoil (see Watercraft Inspections and Awareness Events chapter of this report)
- Reduce problems caused by milfoil in Minnesota
 - Provide funding for maintenance management by cooperators
 - Conduct high-intensity management and control at public water accesses
 - Provide technical assistance
 - Support or conduct research on the ecology and management of milfoil

Spread of Eurasian Watermilfoil in Minnesota during 2003

Milfoil was discovered in 11 new lakes during 2003 (Table 7 and Figure 10). Four of these lakes are located in the seven-county metropolitan area. Another four of these lakes are located in Wright County, which is adjacent to the seven-county metropolitan area. Three of these lakes are located 90 to 100 miles from the Twin Cities. In

addition, milfoil was found during 2003 in two counties, Morrison and Pine, where the exotic had not previously been discovered.

Milfoil is now known to occur in 152 water bodies in Minnesota. On a statewide basis, milfoil has been found to occur in about 1% of Minnesota's lakes.

The rate of spread of milfoil in Minnesota as reflected in the annual discovery of new occurrences of the exotic has changed little over the last three to four years (Table 7). This observation is based on the running three-year average for number of lakes in which milfoil was discovered, which appears to be stable after experiencing an increase that began in 1998 and reached a plateau in 2000.

Table 7. Number of lakes or rivers where Eurasian watermilfoil is known to occur in Minnesota as of December 2003.

Year	Number of lakes in which milfoil was discovered	Running three-year average for number of lakes in which milfoil was discovered	Number of rivers in which milfoil was discovered	Cumulative number of water bodies with milfoil	Cumulative number of counties with milfoil
1987	1	--	0	1	1
1988	8	8	0	9	5
1989	14	11	1	24	8
1990	12	13	1	37	10
1991	14	12	0	51	10
1992	10	10	2	63	12
1993	5	5	0	68	12
1994	2	5	0	70	13
1995	7	5	1	78	13
1996	5	5	0	83	14
1997	5	6	0	88	14
1998	9	7	1	98	16
1999	8	10	0	106	19
2000	14	11	1	121	21
2001	12	11	0	133	22
2002	8	10	0	141	24
2003	11	-	0	152	26

Discovery of new occurrences of Eurasian watermilfoil in Minnesota

Characteristics of some newly discovered occurrences of milfoil suggest that there likely are other water bodies in Minnesota with the exotic that have not yet been discovered. In some cases, milfoil is discovered years after the time when it became established in a lake. For example, on Lake Alexander, a well-developed recreational lake in Morrison County, a person from the DNR Section of Fisheries, while fishing off-duty, discovered an area of milfoil that was matted on the water's surface. Subsequent inspection of the lake found milfoil in a number of additional areas of the lake. This suggests that the exotic invaded this lake some years ago. Nevertheless, it was not reported to the DNR by local users of the lake, perhaps because they were unfamiliar with the plant.

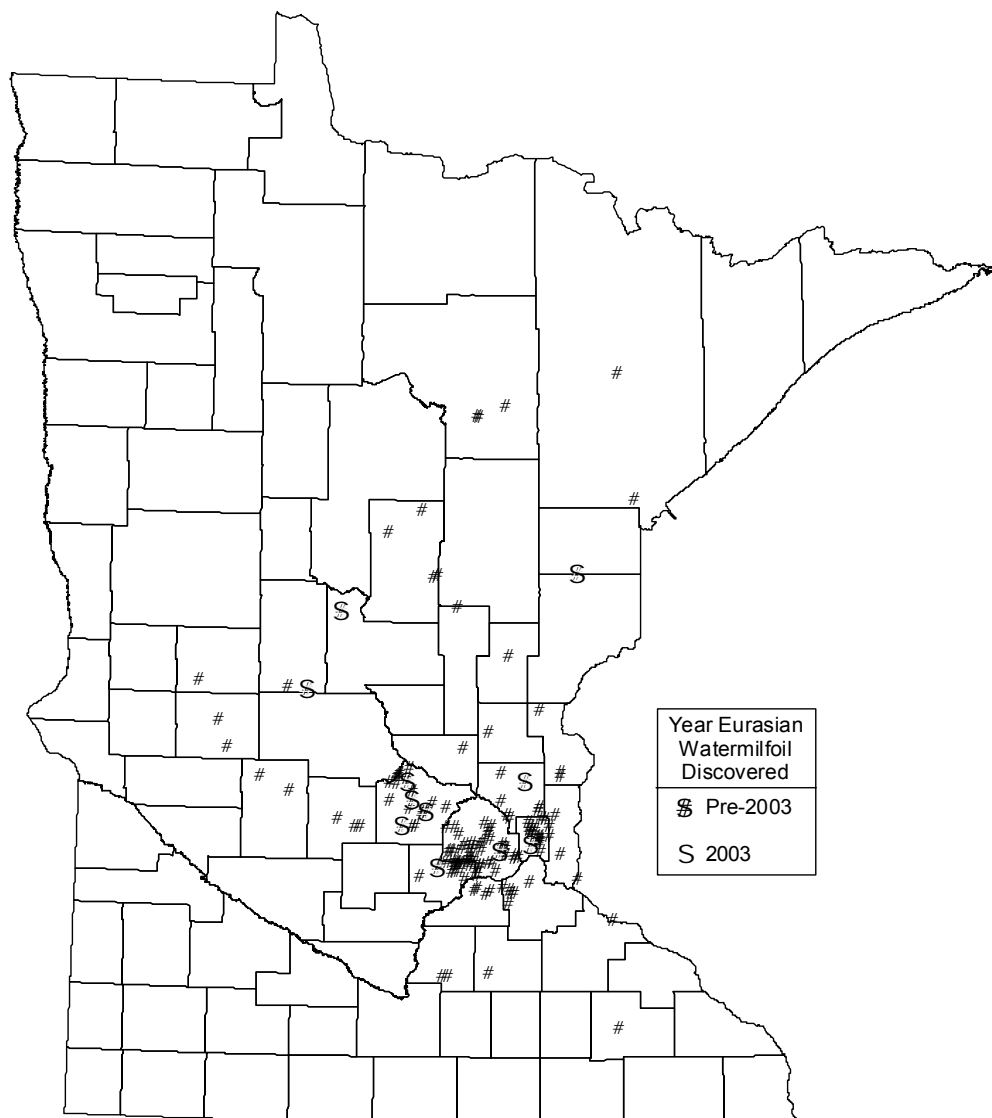


Figure 10. Distribution of water bodies with Eurasian watermilfoil in Minnesota as of November 2003.

In other lakes, milfoil appears to have been discovered before the exotic became abundant or widespread when an unusually knowledgeable person noticed the plant. For example, a new occurrence of milfoil on Coon Lake in Anoka County was reported by an individual who is familiar with the exotic plant, because he is a commercial herbicide applicator and has treated milfoil in other lakes. Other users of the lake would have been much less likely than this applicator to notice this infestation due to the similarity in appearance between milfoil and many native plants. In addition, the milfoil

was not abundant and it was difficult to find among the many native plants in the lake. DNR staff made a number of trips to the lake before they were able to find rooted milfoil.

Many false reports of milfoil result when other species of submersed vegetation, often forming mats, attract the attention of users of Minnesota lakes. These individuals suspect that the abundant vegetation is milfoil and report the occurrence to the Exotic Species Program. During 2003, as in previous years, most of these reports were found to be occurrences of various native aquatic plants. It has been extremely useful for citizens to send the DNR samples of suspected Eurasian watermilfoil so the plants can be quickly identified.

In one unusual case during 2003, a citizen reported dense submersed aquatic vegetation that was interfering with access during July on Sand Lake in Pine County. Examination of a sample showed that the plant was not milfoil, but Canada waterweed (*Elodea canadensis*), which was growing densely in the lake. Less than a month later, the DNR received a second report from the same lake. This time, the plant was milfoil and inspection of the lake by the DNR found that the exotic was widespread in the lake, though not very abundant. The DNR encourages the public to report suspected new occurrences of milfoil to us.

Participation in monitoring the distribution of Eurasian watermilfoil by other state agencies, local units of government, and interested groups

The participation of other divisions of the DNR and outside agencies, citizens, etc. in reporting new occurrences of milfoil remains critical. People in the DNR Section of Fisheries reported more new occurrences than did any other group of observers (Table 8). This assistance is very important because people in the Exotic Species Program are only able to visit a limited number of lakes each year. Efforts by others to search for milfoil and report suspected occurrences of the exotic greatly increase the likelihood that new occurrences are discovered. The program investigates likely reports of new infestations as soon as possible for two reasons. First, it is important to determine whether milfoil actually is present in the lake. Second, if the exotic is present, then it is important to minimize the risk of spread to uninfested waters by notification of the users of the lake. It is hoped that once people who use a lake are aware of the presence of milfoil, they will be especially careful to not transport vegetation from the lake on their boats, trailers, or other equipment.

Table 8. Minnesota lakes where Eurasian watermilfoil was discovered in 2003.

Number	Date reported	Lake and county names	DOW number	Reporter
1	June 4	Coon, Anoka	2.0042	Commercial Herbicide Applicator
2	June 13	Howard, Wright	86.0199	DNR Fisheries
3	July 10	Mink, Wright	86.0088	DNR Exotic Species Program
4	July 15	Alexander, Morrison	49.0079	DNR Fisheries (off duty)
5	July 17	Wolff, Hennepin	27.0664	DNR Fisheries
6	July 21	Indian, Wright	86.0223	DNR Fisheries
7	July 25	Burandt, Carver	10.0084	Citizen
8	August 5	Little Birch, Todd	77.0089	DNR Exotic Species Program (off duty)
9	August 8	Sand, Pine	58.0081	Citizen
10	August 12	Loeb, Ramsey	62.0231	DNR Fisheries
11	September 3	Ramsey, Wright	86.0120	DNR Fisheries

Reports of suspected occurrences of milfoil that turn out to be mistaken also have value. In the course of responding to such reports, people in the Exotic Species Program discuss identification of the exotic Eurasian watermilfoil with the observer and so increase the number of people who in the future are likely to be able to distinguish the exotic from native plant species that are similar in appearance.

Management of Eurasian Watermilfoil in Minnesota during 2003

Classification of water bodies for management of Eurasian watermilfoil

In the spring of 2003, the Exotic Species Program classified the 141 bodies of water known to have milfoil on the basis of information available in 2002 (Table 9). One hundred seven lakes were determined to be eligible for management with state funds because they have public water accesses and are protected waters that are regulated by the state (Minnesota Statute 103G.005, Subd. 15). Lakes eligible for management of milfoil with state funds are divided into two classes: maintenance management and high-intensity management.

For lakes assigned to the maintenance management class, the DNR offered funding to local cooperators, who were expected to take the lead in assessment and control of the milfoil. The goals of maintenance management are to: 1) manage nuisances caused by milfoil, but not necessarily reduce the abundance of the plant lake-wide, and 2) slow the spread of the exotic to other lakes. The most common activity on lakes in the maintenance management class that receive funds from the DNR is application of herbicide, followed by mechanical harvesting and planning.

For lakes assigned to the high-intensity management class, the DNR continued to take the lead in assessment and control of milfoil. The goals of high-intensity management are to: 1) limit the spread of the plant within a lake, 2) reduce the abundance of milfoil within a lake, and 3) slow the spread of the exotic to other lakes. High-intensity

management usually involves efforts to find all milfoil in a lake and treat it with herbicide. High-intensity management usually is undertaken by the Exotic Species Program on a very few lakes that either have small, recently discovered populations of milfoil or are located in areas of Minnesota where there are few if any other lakes with milfoil. In addition, a small number of lake associations also undertook high-intensity management of milfoil during 2003.

Another 27 lakes were determined to be ineligible for management with state funds because they either do not have public water accesses or are not protected waters. Lastly, seven water bodies with milfoil are rivers or streams. In flowing waters such as rivers, control of milfoil or other submersed aquatic plants is not usually attempted because: 1) users of these waters in Minnesota rarely encounter problems caused by milfoil like those found in lakes, and 2) use of herbicides in rivers is less reliable than in lakes.

Seven of the 11 water bodies that were discovered to have milfoil during 2003 were eligible for management with state funds because they have public water accesses (Table 9). All seven were classified for maintenance management because the exotic plant was widespread in these lakes. None was placed in the high-intensity management class because all of the newly discovered lakes had more than a limited amount of milfoil. Four lakes found to have milfoil in 2003 have no public water access and consequently are ineligible for management with state funds.

Table 9. Classification of water bodies in Minnesota with Eurasian watermilfoil during 2003.

Classification	Spring	New in Summer	Fall
Eligible for management with state funds			
Maintenance management	96	7	105
Fluridone evaluation (treated & reference)	6	0	6
High-intensity management	5	0	3
(Subtotal)	(107)	(7)	(114)
Ineligible for management with state funds			
Public water but no public access	22	4	26
Not public water	5	0	5
(Subtotal)	(27)	(4)	(31)
Other			
Rivers or streams	7	0	7
Total	141	11	152

Maintenance management of Eurasian watermilfoil

During 2003, state funding and technical assistance were available from the Exotic Species Program to potential cooperators for management of milfoil on lakes in the maintenance management class (Table 9). The offer of state funding is described in an announcement that is available to potential cooperators (DNR 2003) and briefly

summarized here. These funds are intended to pay for control during spring or early summer of unavoidable nuisances caused by dense and matted milfoil that will benefit a number of homeowners and the general public who use a lake. These funds may not be used for control work that would otherwise be done by private individuals. Typically, control undertaken by private individuals is done immediately adjacent to the owner's shoreline or adjacent to structures such as docks.

During 2002, it was suggested to the DNR that the amount of funding available for control of milfoil on relatively small lakes was too small to encourage potential cooperators to try to obtain this funding. Consequently, the amount of funding available to individual lakes was increased in 2003. In 2003, the maximum amount of funds for which an organization could apply to use for control on an individual lake was determined as follows. Lakes with less than 51 littoral acres were eligible to receive up to \$700. Lakes with 51 to 100 littoral acres were eligible to receive up to \$1,200. Lakes with more than 100 littoral acres were eligible to receive \$1,200 plus \$5 for each littoral acre in addition to the first 100 acres. In 2002, lakes with less than 100 littoral acres were eligible to receive up to \$700. In 2002, lakes with more than 100 littoral acres were eligible to receive \$700 plus \$4 for each littoral acre in addition to the first 100 acres.

The DNR received applications for state funding to control milfoil from potential cooperators on 32 lakes (Table 10). Applications were reviewed by the Exotic Species Program in relation to the standards described in the announcement that is available to potential cooperators (DNR 2003). More than half of the applications were approved as submitted. Questions about the other applications led to inspections of the milfoil in all but one of these lakes by staff of the Exotic Species Program. These inspections revealed that some sites proposed to be treated with herbicide either did not have dense and matted milfoil or did not constitute an unavoidable nuisance for users of the lake. The results of these inspections and recommended modifications of proposed control projects were reported to the potential cooperators and staff in the Aquatic Plant Management Program who issue permits for control. On four lakes, proposals were modified by reducing the size or number of sites to be treated, and subsequently approved. Applications for reimbursement were denied on six lakes. On four of the six lakes there was too little milfoil to justify the proposed control. In one case, an application for reimbursement was denied because sites proposed for control were treated before the application for reimbursement was received by the DNR. In another case, an application for reimbursement was denied because a non-selective herbicide was applied to a site for which treatment with an herbicide selective for milfoil had been required. The requirement for use of a selective herbicide was based on the observation that among and near the milfoil there were native pondweeds that the DNR believed should have been protected, not controlled. Lastly, in three cases applications for reimbursement were not pursued to the point of approval or denial.

Table 10. Number of Minnesota lakes in the maintenance management class where management of Eurasian watermilfoil was supported with state funds in 2003.

Status	Number of lakes
Applications received	32
Applications approved	19
Applications approved after modification	4
Applications denied	6
Applications not pursued	3
Total approved	23

As a result, the DNR expects to reimburse 16 cooperators on 23 lakes for costs of milfoil management during 2003. In addition, the Exotic Species Program initiated treatment of milfoil in the immediate vicinity of public water accesses operated by the DNR on eight lakes in the maintenance management class (Table 11). The purpose of this type of control is to reduce the risk that users of the lake inadvertently transport milfoil from the lake to other bodies of water.

The DNR also received applications for state funding to develop plans for management of milfoil from potential cooperators on four lakes in 2003. The DNR has not decided whether to approve these applications because there is a need to provide guidelines for development of plans in order to improve their utility. The DNR intends to develop guidelines for such plans before spring, 2004.

High-intensity management of Eurasian watermilfoil

During 2003, the Exotic Species Program conducted high-intensity management of milfoil (see description above) on the five lakes in this class (Table 11). High-intensity management began with surveys of the lakes by staff of the Exotic Species Program and was followed by application of herbicides by commercial applicators under contract to the DNR on three lakes: Gilbert Pit, Minnewaska, and McKinney.

Lake McKinney and Ice Lake, which is connected to McKinney, were discovered to have milfoil in 1999. Due to their location in northern Minnesota, in an area with no other known occurrences of milfoil, these two lakes represented a potential source of the exotic that might be spread to many uninfested lakes. To reduce the risk of spread, the DNR subjected these lakes to whole-lake treatment in 1999 with fluridone, the active ingredient in SonarTM herbicide (see Exotic Species Program 2000). Inspection of the lakes by the DNR in 2003 found a small area with milfoil in Lake McKinney, which was treated by the DNR. No milfoil was seen in Ice Lake during 2003, as was the case in the three preceding years. Based on past experience in Minnesota with fluridone treatments on other lakes, it is likely that milfoil will reappear in Ice Lake in the future.

Survey of Lake Minnewaska in 2003 showed a new milfoil area in the open water portion of the lake. This area, along with the marina at Starbuck, was treated with herbicides. Post-treatment survey of Lake Minnewaska showed that the application of herbicide was ineffective against the milfoil in the open water site and that there were

several other large open water milfoil sites in the lake. Subsequently Lake Minnewaska was reclassified as a maintenance management lake.

Results of DNR surveys of the other lake in the high-intensity management class, Lake Ossawinnamakee in Crow Wing County, showed that milfoil was widespread in the lake. Consequently, this lake was reclassified as a maintenance management lake.

Technical assistance to cooperators and other citizens

Technical assistance was provided by the Exotic Species Program to cooperators and other citizens and managers through various means. Staff of the Exotic Species Program attended numerous meetings of lake associations and local units of government to make presentations and participate in discussions of approaches to management of milfoil. During the course of a season, staff of the Exotic Species Program have many conversations with people over the telephone. In addition, staff of the Exotic Species Program exchange correspondence by regular mail and e-mail with people who need assistance in dealing with milfoil.

Table 11. Number of lakes, budgets, and expenditures in different classes of management of Eurasian watermilfoil in Minnesota during 2003.

Year	Number of lakes in class in spring	Funds budgeted in spring	Number of lakes in class where control was done	Funds spent
Maintenance Management				
Control by Cooperators and reimbursed by DNR				
2001	74	149,000	31	71,000
2002	90	80,000	21	43,000
2003	96	105,000	23	76,000
Control by DNR at DNR Public Water Access				
2001	--	--	1	600
2002	--	--	7	11,000
2003	--	15,000	8 ¹	11,000
High-Intensity Management				
2001	16	--	8	34,000
2002	5	15,000	2	9,000
2003	5	15,000	3	9,000
Totals				
2001	90	149,000		105,000
2002	100	95,000		77,000
2003	107	153,000	31	96,000

¹ Three of these lakes also received funding for maintenance management.

Effectiveness of management of Eurasian watermilfoil in Minnesota lakes

Though the number of Minnesota lakes known to have milfoil increased in 2003, the number from which applications were received for DNR funding for maintenance management control projects was the same as in 2002. The number of lakes where cooperators received DNR funding for control of milfoil increased slightly in 2003 by comparison with the previous year. The cost of control by cooperators that was reimbursed by the DNR in 2003 increased by 77% by comparison with 2002. This is attributed to the increase in funds offered to individual lakes by the DNR.

Nevertheless, potential cooperators used only 72% of the funds that were budgeted by the DNR for reimbursement. Possible explanations for this outcome include: 1. lack of nuisances caused by milfoil that met the criteria for funding by the DNR, and 2. lack of awareness of the program among potential cooperators.

In 2003, the growth of milfoil and also the problems caused by the plant in many, but not all, lakes seemed to be somewhat less than levels observed in some previous years. Reduced water clarity in 2003 might have resulted from high levels of precipitation in May followed by near-average levels in June (Figure 11). The high levels of precipitation in turn would create high levels of overland run-off that would carry nutrients like phosphorous into the lakes. These nutrients can promote the growth of algae, both on plants and in the water column, which can suppress the growth of submerged aquatic plants like milfoil. For comparison, precipitation levels in 1988, a year when we experienced drought in spring, were very low (Figure 11) and the growth of milfoil was high.

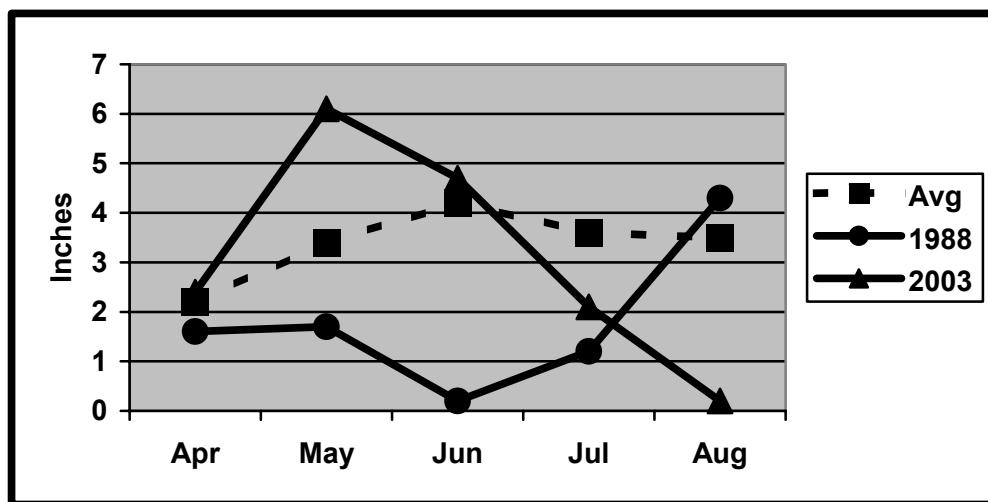


Figure 11. Monthly precipitation in Minneapolis, Minnesota in 2003, 1988, and averaged for the last 112 years.

Participation in control efforts by other state agencies, local units of government, and interested groups

Cooperation between the Exotic Species Program and organizations outside the DNR such as lake associations and various local units of government was critical to the success achieved in management of milfoil and the problems it causes in Minnesota. The Exotic Species Program has also received valuable assistance in management of milfoil from staff from DNR's Section of Fisheries and the DNR's Aquatic Plant Management Program in the Section of Fisheries and the Division of Ecological Services.

Research on Eurasian Watermilfoil and Potential Approaches to Management in Minnesota

The Exotic Species Program has supported or conducted a number of research projects to improve management of milfoil. In this section, we briefly summarize the most important or interesting results of recent efforts by researchers.

Potential for biological control of Eurasian watermilfoil

Efforts to evaluate the potential for biological control of milfoil have been supported since 1992 with funding appropriated by the Minnesota Legislature as recommended by the LCMR. Current research by researchers at the University of Minnesota continues to focus on a weevil (*Euhrychiopsis lecontei*) and has three primary objectives. The first is to attempt to detect additional lake-wide milfoil declines and assess populations of the milfoil weevil in a number of Minnesota lakes. The second objective of this research is to identify and manipulate factors that limit populations of the milfoil weevil. The third primary objective of this research is to identify features of the response of the plant community to milfoil control agents and manipulate factors that may limit the effectiveness of these agents.

The research described above was supported by funding provided through the DNR with an appropriation of \$45,000 for the FY 2002-2004 period made in 2001 by the Legislature as recommended by the LCMR. This appropriation was matched by a commitment of \$50,000 from Exotic Species Program funds, which comes from a surcharge on watercraft licenses (see Overview of DNR's Exotic Species Program, Funding Sources). This follows previous appropriations recommended by the LCMR in 1992, 1993, 1995, 1997, and 1999.

The DNR expects to receive a final report on this research from the University of Minnesota in April 2004. Due to the uncertain potential for providing operational biocontrol of milfoil with weevils or any other insect agent under consideration, the DNR did not submit a proposal to the LCMR in 2002 for continued funding for this effort.

The most recent paper submitted for publication by Ray Newman, the principal investigator for this project at the University of Minnesota, is entitled "Biological control of Eurasian watermilfoil by aquatic insects: basic insights from an applied problem." It is "in press" at Archiv für Hydrobiologie.

Hybrids between the exotic Eurasian and native northern watermilfoil

Since the discovery of milfoil in Minnesota during 1987 when the exotic was first noticed in Lake Minnetonka, there have been many cases where it has been difficult to

distinguish the exotic milfoil from various native milfoil species. Indeed, milfoil most likely became established in Lake Minnetonka some years before 1987, but was overlooked because the plant is very similar in appearance to the native northern watermilfoil (*Myriophyllum sibiricum*). Recently, researchers from the University of Connecticut demonstrated the existence in lakes of hybrids between Eurasian and northern watermilfoil (Moody and Les 2002). One of the hybrid populations was sampled in White Bear Lake, Ramsey County, Minnesota.

In 2002, the Exotic Species Program committed \$4,500 to support research by the University of Connecticut on hybrids between Eurasian and northern watermilfoil in Minnesota. This research had two main objectives. First, determine if hybrid populations identified in Minnesota by use of molecular sequence data could be correlated with unusual genotypes as determined by randomly amplified polymorphic DNA (RAPD) markers. The RAPD marker technique was used by researchers from the University of Minnesota in a previous study supported by the Exotic Species Program (Furnier et al. 1995). In 2002, the Connecticut researchers collected milfoil from five Minnesota lakes that had been sampled in the past by the University of Minnesota and found that there was a correlation between results generated by the two different techniques (Moody 2003). Further, the recent results suggested that earlier collections by the University of Minnesota indicate that hybrid milfoil may occur in at least five additional Minnesota lakes that were not sampled by the Connecticut researchers in 2002.

The second main objective of the current project was to determine if Eurasian watermilfoil and northern watermilfoil co-occur in the Minnesota lakes where the hybrid has been identified. In two of the three lakes where the hybrid was found, Eurasian watermilfoil was not found. In the third lake where the hybrid was found, Eurasian watermilfoil was found, though it appears to be much less frequently encountered than the hybrid. In the last two lakes, Eurasian watermilfoil has been positively identified and the hybrid was not documented. This pattern raises a number of questions about the frequency of hybridization, competitive relationships between the two milfoil species and their hybrid, and possible differences in growth of the different types of milfoil in relation to variation in environmental conditions among lakes.

In addition, the Connecticut researchers found minimal overlap between Eurasian and northern watermilfoil in number of "pinnae" or leaflet pairs per leaf. Eurasian watermilfoil had 12 or more leaflet pairs and northern watermilfoil had 12 or fewer leaflet pairs. In the hybrid, the numbers of leaflet pairs ranged from eight to 19. The number of leaflet pairs per leaf is the principal characteristic used by the DNR and other observers to distinguish between the exotic Eurasian watermilfoil and native species, mainly northern watermilfoil. This finding supports the view that much of the past difficulty in trying to distinguish the exotic plant from natives was in fact due to the presence of hybrids with intermediate numbers of leaflet pairs. This difficulty has practical significance because the presence of the exotic in a lake causes concern among lake residents and results in action by the DNR, whereas the presence of native milfoil does not.

Another result from the Connecticut research was that the genetics of the hybrid watermilfoil suggests the potential for sexual reproduction. This is important because

the hybrid, and possibly Eurasian watermilfoil may then be able to re-establish or spread through recruitment from seed banks and not solely by vegetative means.

Late in the summer of 2003, the Exotic Species Program committed an additional \$5,000 to support further research by the University of Connecticut on hybridization in milfoil. This effort has two main objectives. The first is to determine whether there are differences in growth between Eurasian watermilfoil and the hybrid. This evaluation will be made by growing the two types of plants under controlled and uniform conditions in a greenhouse. The second objective is to determine if different sediments affect growth of the two types of plants. This question also will be addressed by studies conducted in a greenhouse.

Potential to use fluridone herbicide to selectively control Eurasian watermilfoil

The potential use of fluridone herbicide, which is formulated as Sonar™ and AVAST!™, to control milfoil has been the subject of much discussion in Minnesota because the product is usually applied to whole bays or lakes (see Welling et al. 1997, Exotic Species Program 2001). Operational treatment of whole bays or lakes with herbicide is not allowed in Minnesota because this destroys more vegetation than is necessary to give users access to the lake.

In 2000, new information was made available from studies in Michigan which suggested that application of fluridone at low rates of 5 to 6 ppb may provide more selective control than had previously been observed in Minnesota (Getsinger et al. 2001; Madsen et al. 2003). To address questions about possible harm to native plants, the DNR is conducting an evaluation of the potential to use fluridone herbicide to selectively control Eurasian watermilfoil in Minnesota. As part of this evaluation, three Minnesota lakes were subjected to whole-lake treatments with fluridone in 2002. For the 2002 treatments, the target concentrations were 4.6 to 5 ppb fluridone.

The effect of fluridone on the plant community is to be determined by examination of the distribution of individual species in the lakes. The distribution of individual species is estimated by determining their frequency, which is the percentage of sampling sites at which the plant was present. Sampling by the DNR of the three treated lakes and three untreated reference lakes, six in all, began in 2001 and will continue through 2004. Results of sampling done in 2003 will become available before spring, 2004. During 2003, milfoil was not found in any of the three lakes treated in 2002.

At this time, the DNR does not intend to allow additional whole-lake treatments with this herbicide to control milfoil before 2005. This means that we would not review any proposal for such a treatment before 2004, when pre-treatment surveys of the vegetation would need to be done. The reason for this approach is that results of monitoring of plants and water quality to be done during the summer of 2004 by the DNR are necessary to enable the agency to better understand the effects of whole-lake treatments with this herbicide.

An exception to this approach would be a situation like McKinney and Ice lakes in Grand Rapids where milfoil was discovered in 1999. These lakes were subjected to whole-lake treatment with fluridone to prevent the spread of milfoil in a part of

Minnesota with no other known infestations of the exotic. If such a situation were to arise, the DNR would consider use of fluridone.

One interesting observation from monitoring of McKinney and Ice lakes, which has been done by the DNR each year from 1999 through 2003, is that milfoil was discovered in McKinney Lake during 2003. This is the first observation of the exotic in either McKinney or Ice lakes since 1999.

Potential to apply two herbicides at low rates to control both Eurasian watermilfoil and curly-leaf pondweed

In 2003, the U.S. Army Corps of Engineers began a new study in Minnesota. The objective of the study is to determine whether early spring treatment with low rates of endothall and 2,4-D herbicides will control both Eurasian watermilfoil and curly-leaf pondweed. In each treatment lake, all areas with Eurasian watermilfoil or curly-leaf pondweed will be treated with herbicide. The researchers also want to determine whether reductions in milfoil and curly-leaf will produce a more diverse and abundant native plant community. Lastly, the project is intended to determine whether the expected shift in vegetation will affect the fish community. The study will be conducted in cooperation with Mississippi State University and the DNR with support from CerexAgri, an herbicide manufacturer. In 2003, two Minnesota lakes were chosen to be untreated reference lakes, and two lakes were chosen as treatment lakes. Pre-treatment data were collected on all lakes in 2003.

Future plans and needs for management of Eurasian watermilfoil

Priorities for management of milfoil include:

- Keep the public informed about milfoil and the problems it can cause;
- Hold a meeting with lake people, commercial applicators, and other interested parties in late winter or early spring to review management of milfoil in 2003 and plans for 2004;
- Reduce the plant's spread by targeting watercraft inspection and enforcement efforts in areas of the state where milfoil is present;
- Monitor the distribution of milfoil in the state with emphasis on verification of reports of new occurrences of milfoil;
- Revise the DNR's Maintenance Management Program by increasing the amount of funds available to potential cooperators by \$50,000;
- Review information from Minnesota to evaluate the effects of milfoil on native plants and lake ecosystems; and
- Continue the evaluation of fluridone herbicide.

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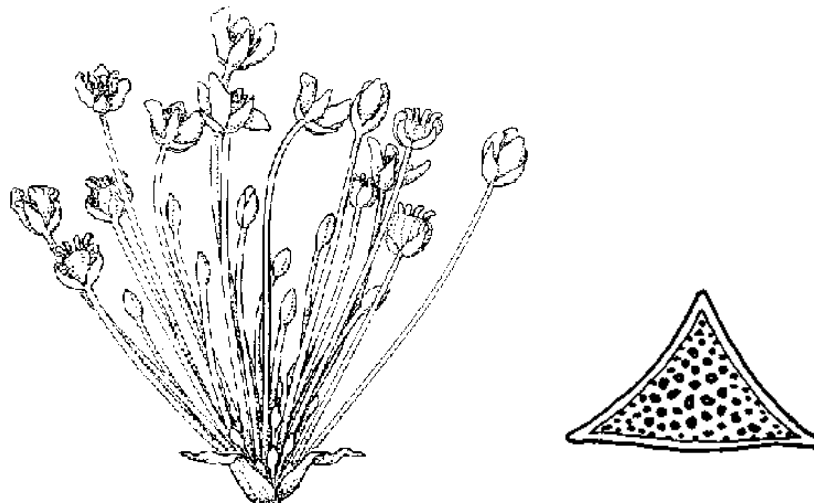
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Management of Flowering Rush

Introduction

Issue

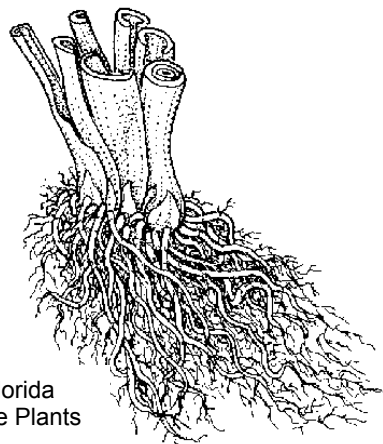
Flowering rush (*Butomus umbellatus* L.) is a perennial aquatic plant, native to Europe and Asia. It grows along lake and river shores as an emergent plant with three, angled fleshy leaves and may produce an umbel-shaped cluster of pink flowers (Figure 12). Flowering rush may also grow as a non-flowering submersed plant with limp, ribbon-like leaves.



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Figure 12. Flowering rush umbel and cross-section of a leaf.

The plant spreads primarily vegetatively from thick rhizomes (Figure 13), from small tubers that break off the rhizome, and from small bulblets that form in the inflorescence. Water currents, ice movement (Haber 1997), and muskrats (Gaiser 1949) can easily move these reproductive structures to new locations within a water body.



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Figure 13. Flowering rush rhizomes.

Flowering rush was likely brought to North America in the late 1800s in ship ballast and has also been repeatedly introduced as an ornamental plant. As early as 1973, resource managers and researchers have expressed concern that flowering rush may grow more aggressively in North America than in its native Europe and may become an aggressive competitor with native wetland vegetation (Anderson et al. 1974, Staniforth and Frego 1980). Given the invasive qualities of flowering rush, it is classified as a prohibited exotic species in Minnesota. A prohibited exotic species is illegal to possess, sell, transport, or release into the wild.

Distribution

Flowering rush was first recorded in Anoka County in 1968 (Moyle 1968) and has since been located in six other counties. Despite its 30-year presence in the state, the distribution of flowering rush is geographically widespread, but not common (Figure 14). New introductions are likely the result of intentional planting from horticultural sales. More information about the distribution of flowering rush in the state can be found in the 2000 Exotic Species Annual Report (Exotic Species Program 2001). There were no new discoveries of flowering rush locations in 2003.

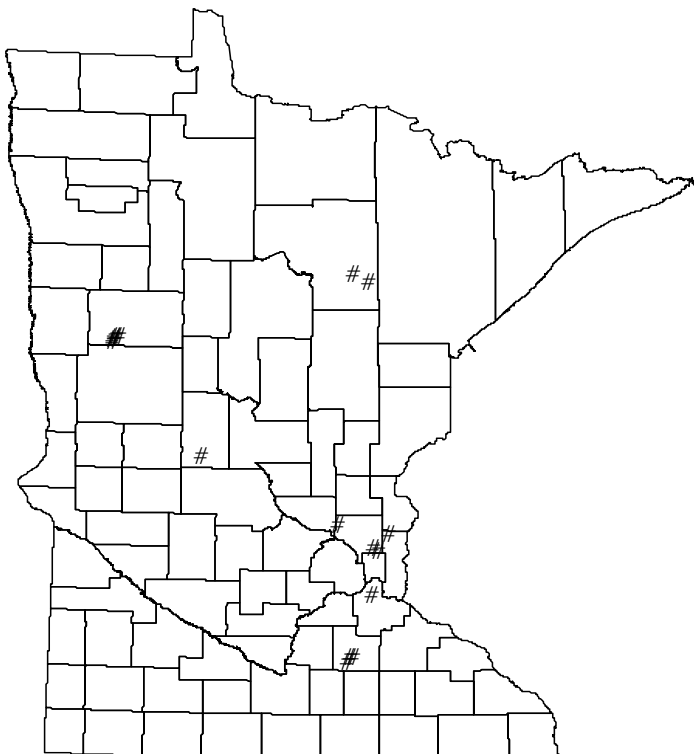


Figure 14. Minnesota flowering rush locations as of December 2003.

Goals

The DNR has two goals that apply to flowering rush management: 1) To prevent the spread of flowering rush within Minnesota; and 2) To reduce the impacts caused by harmful exotic species to Minnesota's ecology, society, and economy. To attain these goals, the following strategies are used:

- Prohibit the sale of flowering rush in Minnesota.
- Monitor current distribution and assess changes.
- Support research to develop and implement better management methods.
- Provide information to concerned citizens on how to best manage flowering rush.

Progress in Management of Flowering Rush – 2003

Prohibit the sale of flowering rush

Flowering rush is a prohibited exotic plant in Minnesota, which means that it is unlawful to possess, purchase, or sell this exotic in Minnesota. Nevertheless, horticultural sales are the most likely means of introducing this plant into a new area. It is sold in catalogs and companies that advertise on the Internet as a hardy, desirable ornamental water garden plant. In Minnesota, the sale of flowering rush in many large discount stores was stopped following contact from the Exotic Species Program in 1999 (Exotic Species Program 2001). In 2003, Exotic Species Program staff contacted several aquatic plant sellers as well as purchasers in order to relay our concerns and educate them on the potential negative impacts of such activities. This effort will continue to expand in 2004.

Monitor current distribution and assess changes

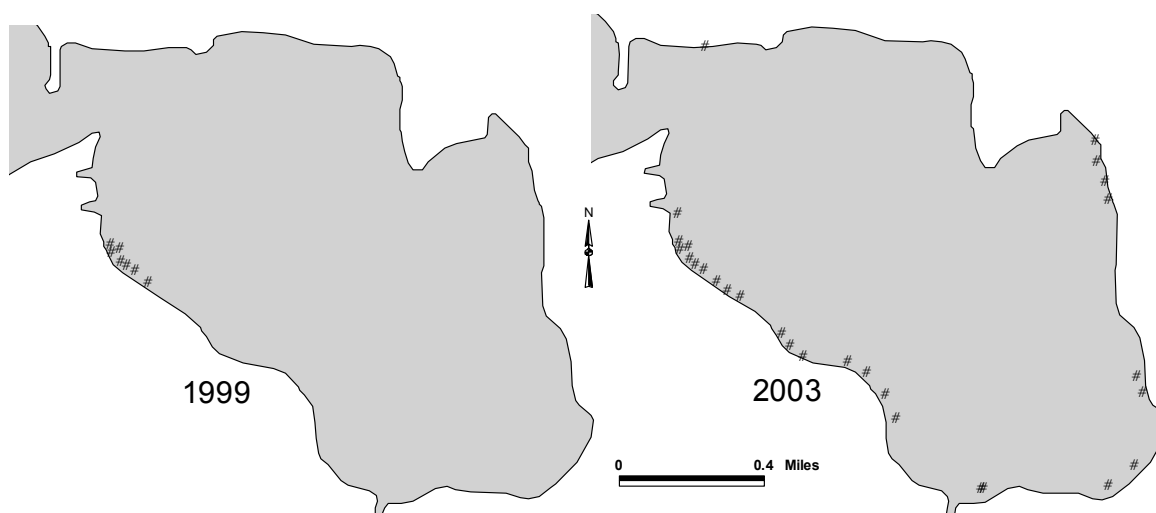
Exotic Species Program staff surveyed flowering rush distribution during peak biomass on Detroit Lake (Becker County) and Forest Lake (Washington County). The goals of these surveys are to document spread of flowering rush and to monitor the effects of management.

In 2002, flowering rush surveys on Detroit Lake took place in the spring and fall. The timing of these surveys missed peak biomass. As a result, in 2003, the survey was moved to July. The results confirm that peak biomass occurred sometime in mid-summer. In the fall 2002 survey, flowering rush was found at 7% of the sites, while in the summer of 2003, flowering rush was found at 18%. DNR's Section of Fisheries has also performed vegetation surveys of Detroit Lake. These surveys have taken place between late July and early August in the following years: 1989, 1992, 1994, and 1999. The flowering rush frequency has fluctuated between 42% and 65% (Table 12). Given the number of sites (transects that start at shore and end near the maximum depth of vegetation) visited (n=40), the difference between years is not significant. It is not possible to directly compare these results with surveys performed by the Exotic Species Program staff because of the different methods and number of sites involved.

Forest Lake (Washington County) was also surveyed to document flowering rush distribution. Informal flowering rush surveys have been performed in Forest Lake for the past four years. During those four years, flowering rush has increased in distribution, but has remained in the "third" or east basin (Figure 15).

Table 12. Flowering rush frequency surveys on Detroit Lake.

Year of Survey – Performed By	Number of Sample Sites	Number of Transects	Frequency of Flowering Rush
1989 - Section of Fisheries	N/A	42	“Abundant”
1992 - Section of Fisheries	N/A	42	48%
1994 - Section of Fisheries	N/A	42	65%
1999 - Section of Fisheries	N/A	42	42%
Spring 2002 - Exotics Program	241	N/A	6%
Fall 2002 - Exotics Program	260	N/A	7%
Summer 2003 - Exotics Program	190	N/A	18%

**Figure 15. Flowering rush locations in Forest Lake in 1999 and 2003.**

Support research to develop and implement better management methods

In 2003, the Pelican River Watershed District (PRWD) contracted with a private herbicide applicator to test different aquatically registered herbicides on small plots of flowering rush. The effectiveness of these applications will not be known until next growing season.

The Forest Lake infestation is the only known location in Minnesota to produce fertile seeds, according to recent studies done by Eckert et al. (1999). These seeds may pose an increased risk of spread to neighboring waters. In an effort to reduce this risk, Exotic Species Program staff removed the umbels (flowers) in late summer.

Provide information to concerned citizens on how to best manage flowering rush

Hand-cutting has been successful at seasonally reducing dense stands of emergent flowering rush. The Exotic Species Program again coordinated and assisted with a flowering rush hand-cutting project at a public swimming beach in Twin Lakes (Itasca County) for a sixth year. Flowering rush impedes fishing and swimming activities at this

beach and fishing pier. This beach was cut in spring of 1998, 1999, and 2002. It was cut twice in 2000, 2001, and 2003. Similar results may be achieved using contact herbicide. In the spring of 2004, contact herbicide will be applied to the Twin Lake flowering rush in the beach area and its effectiveness will be evaluated.

The PRWD annually meets with Exotic Species Program staff to discuss concerns regarding the expansion of flowering rush within and into lakes in the Detroit Lakes area. Currently, the PRWD mechanically harvests flowering rush and other aquatic plants to reduce the nuisances for lake residents and users. The PRWD is interested and continues to research other management tools to complement harvesting activities, such as the herbicide applications to small plots of flowering rush in the fall of 2003.

Effectiveness of Management

Flowering rush often grows in stands with native vegetation, making it difficult to control this exotic without harming the native plants. Mechanical control by cutting appears to be the most effective method of reducing dense stands of flowering rush. Cutting is most effective if done early and repeated several times during the growing season (Hroudova 1989). Disadvantages of cutting include that it is not selective, is labor intensive, and does not eliminate the exotic. Digging flowering rush may increase its spread if the entire rhizome is not removed. Herbicide applications, particularly in water, have been ineffective because herbicide is quickly washed away from the plant. When new herbicides come on the market that are selective for flowering rush, can remain on the targeted plant for adequate contact time, and are registered for aquatic use, they will be reviewed as potential management tools.

Participation by Other Groups

Others involved in flowering rush management in Minnesota in 2003 include: DNR Sections of Fisheries and Wildlife, PRWD, and Greenway Township in Itasca County.

Future needs for management of flowering rush

- Continue efforts to prevent introductions of flowering rush in Minnesota. Inform the public, nursery industry, and other businesses selling flowering rush of the problems associated with this plant and the existing laws against its possession and sale in Minnesota.
- Encourage research on the distribution, reproductive biology, and potential impacts of flowering rush in Minnesota.
- Continue to investigate new methods of controlling flowering rush and to evaluate the results of ongoing flowering rush management within the state.

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Management of Purple Loosestrife

Background

Purple loosestrife (*Lythrum salicaria*, *L. virgatum* and their hybrids) is a wetland plant from Europe and Asia that invades marshes and lakeshores, replacing cattails and other wetland plants. The DNR and other agencies manage purple loosestrife because it harms ecosystems and reduces biodiversity by displacing native plants and habitat for wildlife. The Purple Loosestrife Program was established in the DNR in 1987. State statutes direct the DNR to coordinate a control program to curb the growth of purple loosestrife (M.S. 84D.02, Subd. 2) and a significant amount of progress has been made toward the development of a sound approach to manage this harmful exotic. This management program integrates chemical and biological control approaches and cooperates closely with federal and state agencies, local units of government, and other stakeholder groups involved in purple loosestrife management. The goal of the program is to reduce the impact purple loosestrife is having on our environment. Management efforts include both biological and chemical control methods, monitoring management efforts, and supporting further research.

Statewide Inventory of Purple Loosestrife

In 1987, the DNR began to inventory sites in Minnesota where purple loosestrife was established. DNR area wildlife managers, county agricultural inspectors, local weed inspectors, personnel of the Minnesota Department of Transportation, and the general public report purple loosestrife sites to the DNR. The DNR maintains a computerized list or database of sites that includes the location, type of site, and number of loosestrife plants present (see Figure 16). In 2003, 16 new purple loosestrife infestations were identified in Minnesota. There are now 2,181 purple loosestrife infestations recorded statewide (Table 13). Of those sites, the majority (70%) are lakes, rivers, or wetlands. Inventory totals indicate that Minnesota presently has over 63,000 acres infested with purple loosestrife.

Progress in Management of Purple Loosestrife – 2003

Chemical control of purple loosestrife

Initial attempts by the DNR to control purple loosestrife have relied mainly on the use of herbicides. The most effective herbicide was found to be Rodeo™, a formulation of glyphosate, which is a broad spectrum herbicide that is also toxic to desirable, native plants. To allow maximum survival of native plants, Rodeo™ is applied by backpack sprayer as a “spot-treatment” to individual loosestrife plants. A second herbicide, 2,4-D, or 2,4-dichlorophenoxyacetic acid, is less frequently used. 2,4-D is more selective than Rodeo™ because it affects primarily broad-leaved or dicotyledonous plants but it is less effective than Rodeo™.

Beginning in 1991, a prioritization plan was developed for selecting control sites in public waters and wetlands where herbicide would be used for purple loosestrife control. This was done because there are insufficient resources to apply herbicides to all known purple loosestrife sites in Minnesota. In addition, DNR personnel observed that herbicide treatments do not result in long lasting reductions of loosestrife when applied

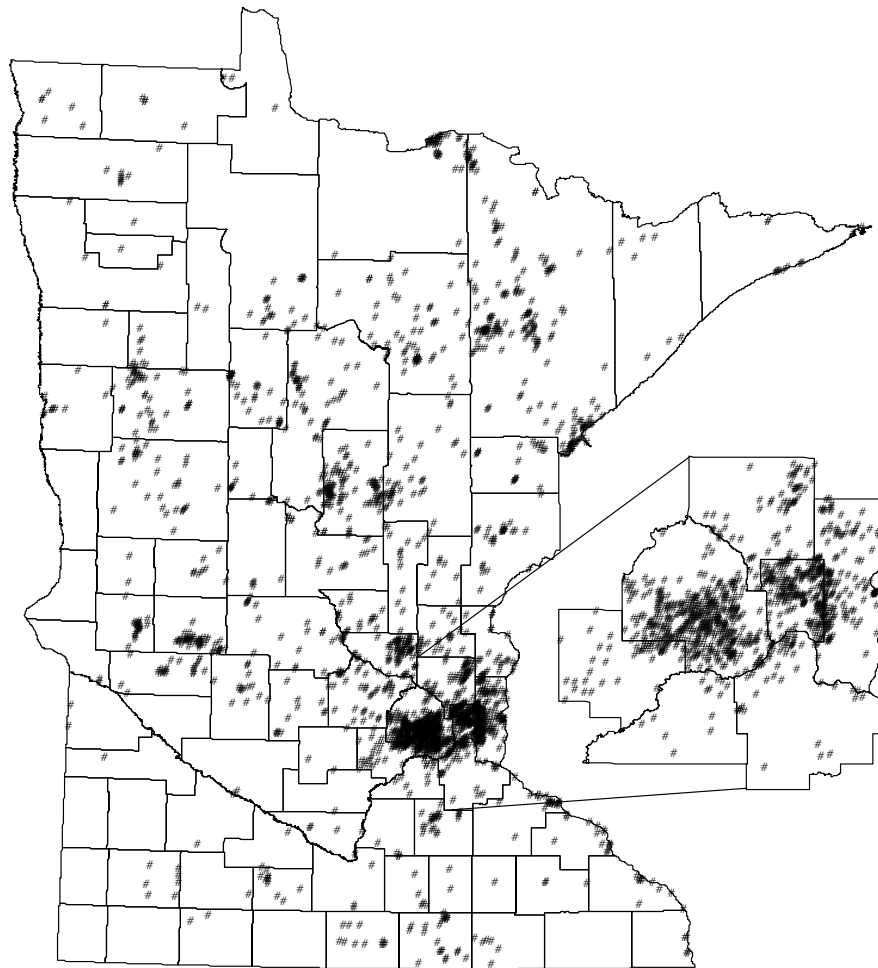


Figure 16. Purple loosestrife infestations in Minnesota as of December 2003.

Table 13. Purple loosestrife infestations in Minnesota recorded by the Minnesota Department of Natural Resources in 2002 and 2003.

Site Type	Total sites 2002	New sites 2003	Total sites 2003
Lake	652	7	659
River	199	3	202
Wetland	685	2	687
Roadsides and ditches	468	3	471
Other ¹	161	1	162
Total	2,165	16	2,181

¹Includes gardens and other miscellaneous sites.

to large populations that have been established for a number of years. This is due in part to the plant's ability to re-establish from an extensive purple loosestrife seed bank. Research done by the University of Minnesota, under contract to the DNR, demonstrated that long-established stands of loosestrife develop very large and persistent seed banks. Herbicide treatments which kill the existing loosestrife population only create space for additional seeds to sprout. Consequently, small and recently established populations of loosestrife, which are likely to have small seed banks, are given the highest priority for treatment. In addition, because seeds of this species are dispersed by water movements, the DNR tries to keep loosestrife from infesting downstream lakes. Sites located in the upper reaches of watersheds with little loosestrife are treated before those located in watersheds with large amounts of loosestrife. Implementation of the prioritization scheme in 1991 resulted in fewer large sites (> 1,000 plants) being treated. Only one site had greater than 1,000 plants and was treated in 2003.

Between 1989 and 2003, the number of sites, number of plants, and total cost of treating purple loosestrife with herbicide has decreased (Table 14). This summary includes applications made by DNR personnel, commercial applicators working under contract to DNR, and various cooperators; it is not a complete listing of all herbicide applications made in Minnesota. During the summer of 2003, the DNR or licensed contractors visited 54 purple loosestrife stands for herbicide control work (Figure 17). At 24 sites, workers found no loosestrife plants to treat. A total of 30 sites were treated with herbicides. Most of the sites were very small: 87% had less than 100 plants. In total, all sites visited used 0.61 gallons of Rodeo™, 0.26 gallons of 2,4-D, took 242.5 worker hours, and cost \$8,180.

Table 14. Historical herbicide applications performed by DNR and applicators contracted by DNR in Minnesota (1989-2003).

Year	Sites visited	Sites with <100 plants treated	Sites with >100 plants treated	No plants located	Total worker hours	Herbicide quantity used	Total treatment costs
1989	166				3,045	471	\$ 102,000
1990	194	74	120	0	3,290	-	\$ 74,900
1991	200	109	58	33	3,420	-	\$ 77,900
1992	227	110	77	40	-	-	-
1993	194	96	79	19	2,300	48	\$ 65,000
1994	188	81	81	26	1,850	30	\$ 52,000
1995	203	102	63	38	2,261	35	\$ 63,000
1996	153	74	56	23	1,396	14	\$ 45,000
1997	132	55	55	22	965	7	\$ 36,000
1998	144	66	51	27	1,193	11	\$ 40,000
1999	131	65	38	28	791	9.5	\$ 26,000
2000	111	38	28	45	518	2.4	\$ 22,800
2001	87	55	17	15	359	1	\$ 19,700
2002	55	32	7	16	305	2.3	\$ 18,800
2003	54	30	7	17	243	0.87	\$ 8,180

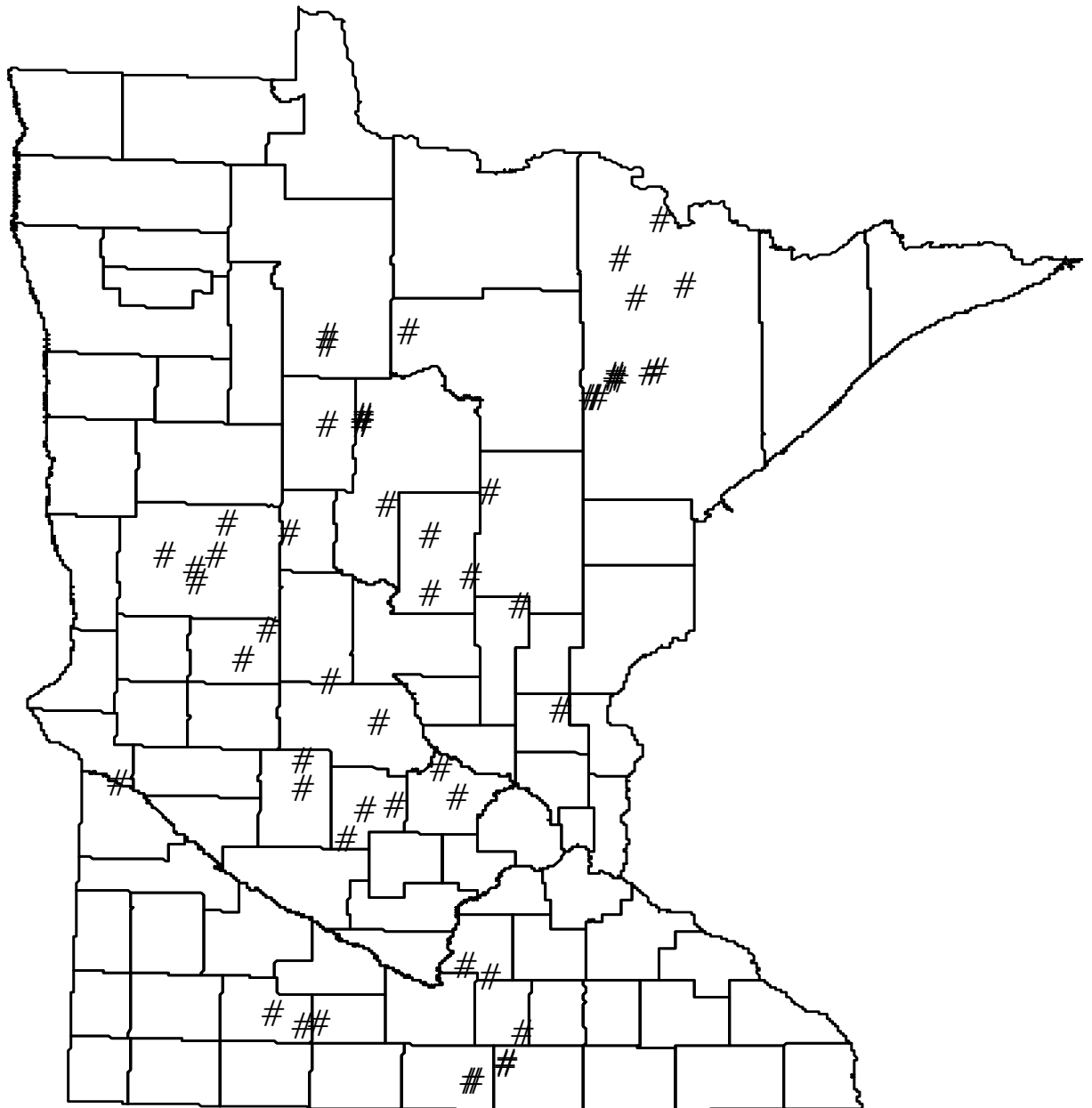


Figure 17. Locations where the Purple Loosestrife Program funded chemical control in 2003.

Effectiveness of chemical control

Effectiveness of control efforts will be based on short-term and long-term objectives. Control or eradication of small infestations statewide with herbicides is the primary short-term objective. Each year, a small number of purple loosestrife infestations (14 in 2003) are eradicated for at least one year with herbicides. This is critical because these infestations are in watersheds that have very few infestations of loosestrife. This effort helps prevent the spread of purple loosestrife into uninfested wetlands and lakeshores.

Biological control of purple loosestrife

Insects for biological control of purple loosestrife were first released at one site by DNR staff in 1992. This initial release occurred after years of testing to make sure the insects were specific to purple loosestrife and would not damage native plants or agricultural crops and approved for release by the United States Department of Agriculture (USDA). To date, four species of insects, two leaf-eating beetles, *Galerucella californiensis* and *G. pusilla*; a root-boring weevil, *Hylobius transversovittatus*; and a flower-feeding weevil, *Nanophyes marmoratus*, have been released as potential biological controls for loosestrife in Minnesota.

Leaf-Eating Beetles: In 1997, the DNR initiated an insect rearing program by providing county agricultural inspectors, MDA field staff, and DNR area wildlife managers with a “starter kit” for rearing their own leaf-eating beetles. From 1997-2003, rearing efforts were increased by recruiting additional partners, such as nature centers, lake associations, schools, 4-H and garden clubs (Table 15). This cooperative effort has had a significant effect on total number of insects released (Figure 18).

Table 15. List of cooperators in Minnesota during 2003 that were participating in purple loosestrife control efforts and the type of participation.

Government/Organization	Type of Cooperation
Counties: Aitkin, Anoka, Becker, Carver, Crow Wing, Dakota, Freeborn, Goodhue, Hennepin, Houston, Isanti, Itasca, Marshall, Mille Lacs, Otter Tail, Ramsey, Scott, Sherburne, St. Louis, Stearns, Wabasha, Wadena, Washington, Wilkin, Wright	Counties where insects were reared and released by county agricultural inspectors, MDA field staff, MnDOT field staff, DNR area wildlife managers, 4-H clubs, lake associations, and schools.
MN Department of Agriculture	Partner with DNR in statewide biological control efforts including releasing and monitoring insects.
University of Minnesota	Partner with DNR in statewide biological control efforts including rearing, releasing, and monitoring insects.
Leech Lake Indian Reservation, Dept. of Resource Management	Partner with DNR in biological control efforts including rearing, releasing, and monitoring insects on or near the Reservation.
USFWS, MN Valley NWR; Sherburne NWR; Upper Mississippi NWR	Partner with DNR in biological control efforts including rearing, releasing, and monitoring insects.

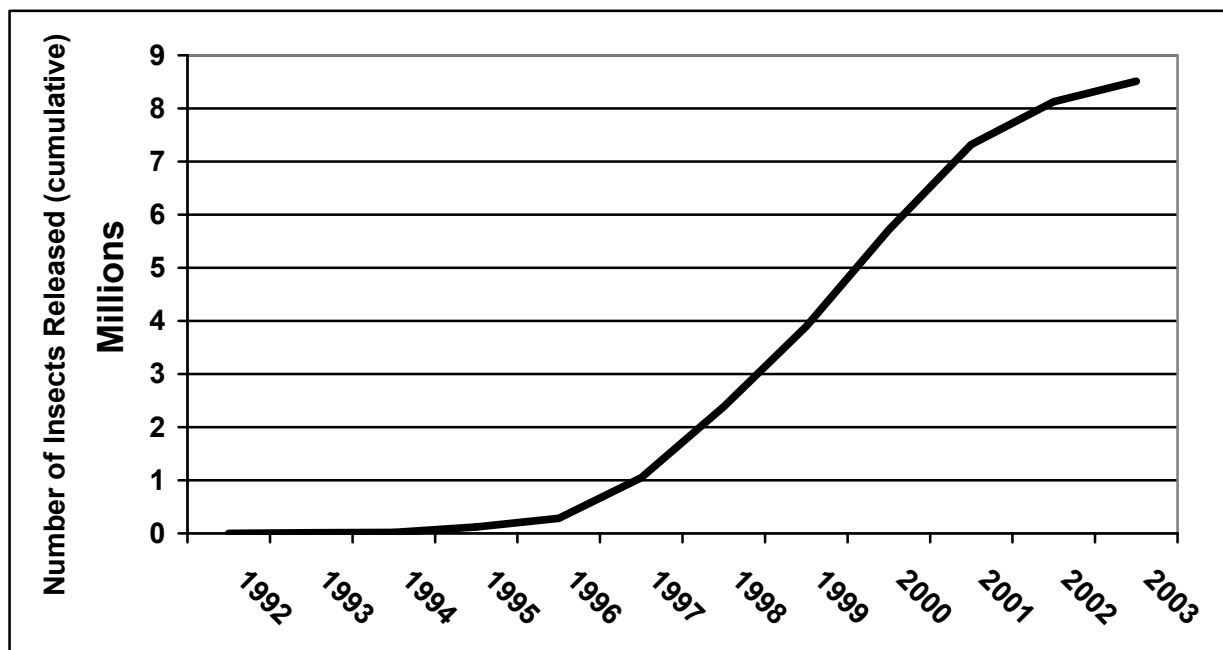


Figure 18. Cumulative number of insects released to control purple loosestrife by year.

A starter kit is composed of pots, potting soil, insect cages, leaf-eating beetles, and other materials necessary to rear 20,000 leaf-eating beetles (*Galerucella* spp.). The insects were then released on high priority areas. All insect rearing was completed outdoors for ease of production and to produce hardier insects. In total, 46 cooperators in 25 counties reared and redistributed an estimated 400,000 leaf-eating beetles and released them on more than 83 sites. As of December 2003, insects have been released at more than 731 sites statewide (see Figure 19, Table 16). The number of release sites is lower than reported in 2002. In 2002, estimations were made for the annual report when cooperator release data was incomplete. 2003 data more accurately reflects actual release sites in the state.

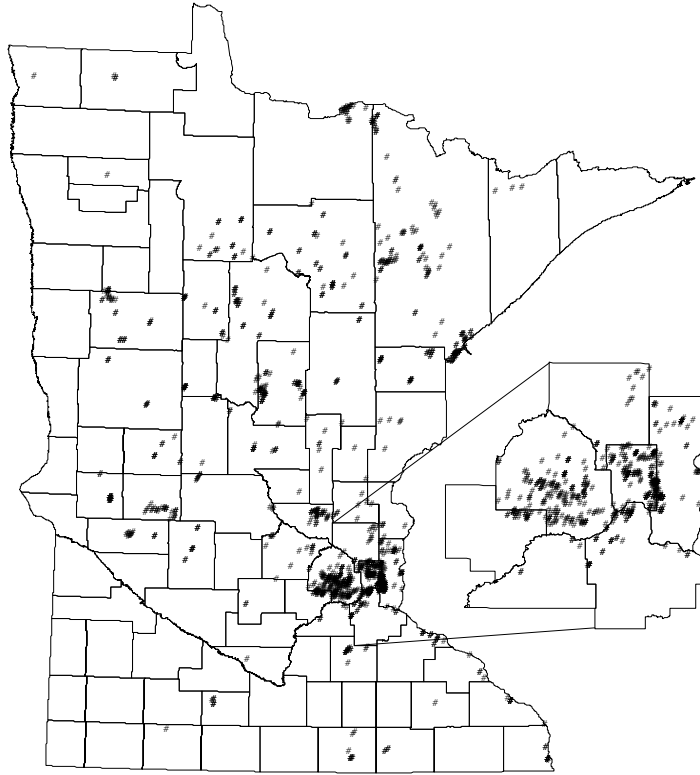


Figure 19. Locations of insects released to control purple loosestrife in Minnesota through 2003.

Table 16. Summary of number of insects released in each region to control purple loosestrife (1992-2003).

Minnesota DNR Regions	Number of Release Sites	Number of Insects Released
1 – Northwest	111	1,300,000
2 – Northeast	184	1,600,000
3 – Central	381	5,000,000
4 – South	55	700,000
Totals	731	8,600,000

Biological control insects released between 1992 and 2002 have established reproducing populations at more than 90% of the sites. Insect populations increased significantly at many locations with pronounced damage to loosestrife plants. In the summer of 2003, 225 insect release sites were visited to assess the insect establishment and level of control achieved. At 34% (77 sites) of the sites surveyed, the insect populations are rapidly increasing and causing significant damage to the loosestrife infestations. At 15% of all visited sites, the loosestrife was severely defoliated (90-100%) (Figure 20).

With success of insect establishment in the field, organized rearing efforts are anticipated to come to an end within the next several years. Resource managers will be able to collect insects from established release sites and redistribute to new infestations. The “collect and move” method will reduce the effort and costs needed to further distribute leaf-eating beetles in Minnesota. In 2000-2003, insects were collected and redistributed to 94 of the locations statewide.

Root-Boring Weevils: Initially, only a small number of root-boring weevils were brought to Minnesota. As of December 2003, there are 12,223 weevils comprising 30 releases, at 23 different sites. In 2003, no weevils were made available for release, but in the future, Minnesota will be receiving additional weevils.

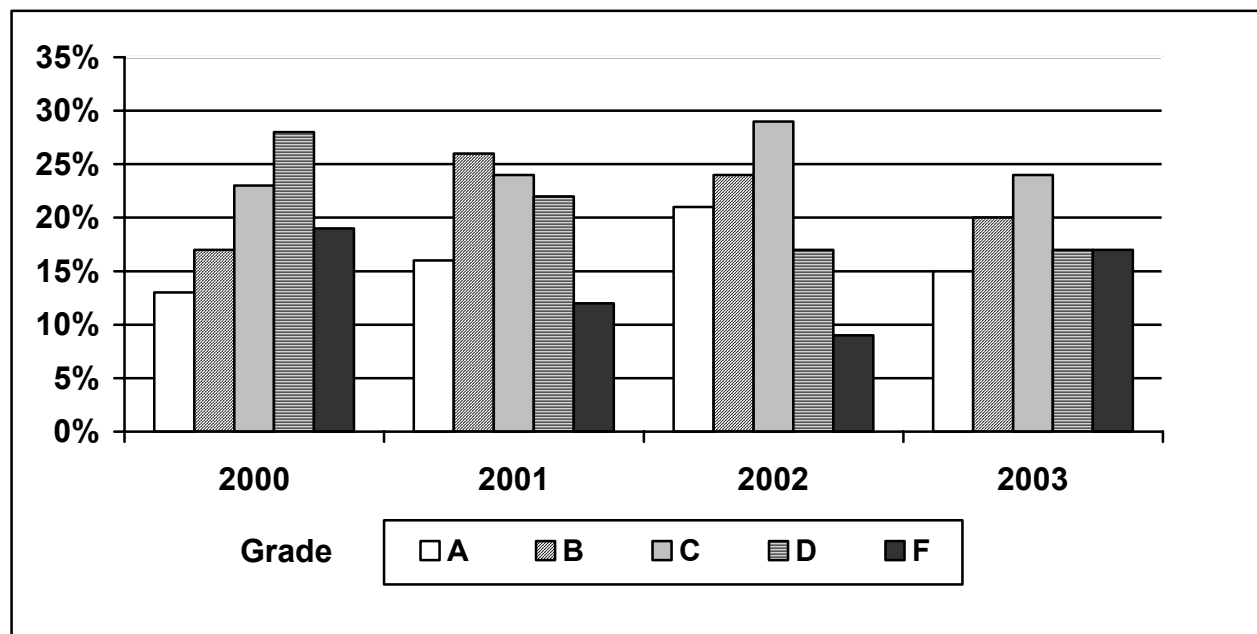


Figure 20. Sites graded for insect establishment and control.

A = 90-100% defoliation, B = 50-89% defoliation, C = damage near release point with insects visible, D = No damage, few insects visible, F = no insects or damage present.

Effectiveness of biological control

A long-term objective is to utilize biological controls to reduce the abundance/impacts of loosestrife in wetland habitats throughout Minnesota. Biological control, if effective, will reduce the impact loosestrife has on wetland flora and fauna. The DNR's goal is to reduce the abundance of loosestrife in wetlands where it is the dominant plant by at least 70% within 15-20 years. Purple loosestrife will not be eradicated from most

wetlands where it presently occurs, but its abundance can be significantly reduced so that it is only a small component of the plant community, and not a dominant one. Assessment efforts in 2003 demonstrated that *Galerucella* introductions have caused severe defoliation of loosestrife populations on less than 20% of sites visited (Figure 20). The DNR will continue to track these wetlands to assess how loosestrife abundance changes over time and to determine what combinations of biological control agents provided the desired level of control.

Research on Insects as Biological Control Agents

During 2001, funding from the Minnesota Legislature, as recommended by the LCMR, was used to monitor impacts to loosestrife populations by the insects used as purple loosestrife biological control agents.

One study was conducted to assess whether *Galerucella* spp. were feeding on non-target species. To test this, a native loosestrife species and purple loosestrife plants were transplanted into wetlands at Circle Lake and Big Marine Lake in the summer of 2001. Both wetlands had active, well-established, *Galerucella* populations. In the summer of 2002, numbers of *Galerucella* spp. egg masses, amount of leaf defoliation caused by adult beetle feeding, and larval beetle feeding were monitored on each transplanted plant. Results were similar for both study sites. The native plants did not survive the transplanting process well. Only three plants survived out of approximately 60 transplants. Of the three native that survived, evidence of *Galerucella* was present with 5% adult and larval defoliation. The surrounding *L. salicaria* had approximately 20% beetle defoliation. Transplanting seedlings into a wetland is not the best method to use for monitoring potential non-target feeding by *Galerucella* spp. in the field. This is demonstrated by the poor survival rates of transplanted *L. alatum* and *D. verticillatus*.

In 2001, a study began monitoring the landscape movements of *Galerucella* spp. The main objectives are to track the beetles within a wetland as well as wetland to wetland movement. Results show that in an average of 2.8 years, mean dispersal distance was 4.7 km from known established release sites to areas where beetles were never released. Maximum dispersal distance from release sites was 20 km. Beetles were found in 85% of the 167 non-release sites visited. From these data we can advise resource managers who wish to maximize redistribution efforts of *Galerucella* spp. to select wetlands that are greater than 5 km from any known release.

Management of Purple Loosestrife in Other States

To date, more than 30 states and four federal agencies (states include: Alabama, California, Connecticut, Delaware, Idaho, Iowa, Illinois, Indiana, Maryland, Maine, Michigan, Minnesota, Montana, Nebraska, New Hampshire, New Jersey, New York, Ohio, Oregon, Pennsylvania, Rhode Island, South Dakota, Tennessee, Utah, Vermont, Washington, and Wisconsin) have implemented biological control against purple loosestrife. In 2002, the United States Department of Agriculture's Animal Plant Health Inspection Service (USDA) reared and distributed 348,000 *Galerucella* spp. beetles to 16 states (Connecticut, Delaware, Iowa, Indiana, Kansas, Kentucky, Massachusetts, Maryland, Maine, Michigan, Missouri, North Dakota, Nebraska, Pennsylvania, South Dakota, and West Virginia). The USDA lab has begun to rear the *Hylobius*, the root-mining weevil, with the hopes of distributing this species to states in the future.

Future needs for purple loosestrife management

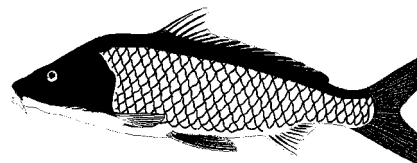
- Continue research on biological control of purple loosestrife, including the development of release strategies. Implementation strategies are needed for actual distribution in the field and subsequent monitoring of the insects.
- Continue DNR funding of herbicide control efforts on small, high-priority infestations.
- Continue to assess effectiveness of management efforts including chemical and biological control.
- Continue to develop new in-state partners (e.g., county agriculture inspectors, MnDOT, DNR area wildlife managers, nature centers) to expand scale of management efforts.

Management of Common Carp

Introduction

Issue

Common carp (*Cyprinus carpio*) were intentionally introduced into Minnesota waters before 1900. They remained relatively unnoticed as a threat to environmental quality until after the drought of the 1930s. The drought had set the stage for an explosion of aquatic vegetation and invertebrates. The early wetland drainage efforts had provided connections into many wetlands and shallow lakes previously inaccessible. With the recovery of precipitation and subsequent increase in water levels in wetlands, lakes, and streams, the common carp found an abundance of food and spawning habitat. As early as the 1940s, carp had noticeably damaged aquatic habitat in famous waterfowl lakes such as Heron Lake in southwestern Minnesota. By the 1960s, common carp were recognized as a major factor in the deterioration of aquatic habitat across southern Minnesota.



The role of common carp in causing habitat deterioration is primarily related to their search for invertebrates in aquatic vegetation and bottom sediments. Their feeding activity disrupts shallowly rooted plants and suspends bottom sediments in the water column. The sediments release phosphorus that increases the growth of phytoplankton. As water clarity is reduced, remaining aquatic plants find it difficult to survive. As the rooted plants disappear, more bottom soils are exposed to wave action and further suspension. The cycle continues until the water body is devoid of rooted aquatic plants and phytoplankton thrives in the suspended nutrients. Habitat for most native game fish and aquatic wildlife such as waterfowl is devastated. Since carp do not require clear water to feed and reproduce, they eliminate competition from fish that do, including those that prey on carp fry and young of the year.

Common carp are a carrier of a new disease in the state, spring viremia of carp. All *Cyprinids* (minnows) and northern pike are susceptible to the disease.

Goals

The DNR has two goals related to management of common carp:

- Prevent the spread of carp into waters within Minnesota where they do not currently exist or have been successfully removed.
- Remove common carp from high-priority waterfowl waters, such as shallow lakes and wetlands where they are present.

Distribution

Carp currently occur in the majority of waters across the southern half of Minnesota (see Figure 21).

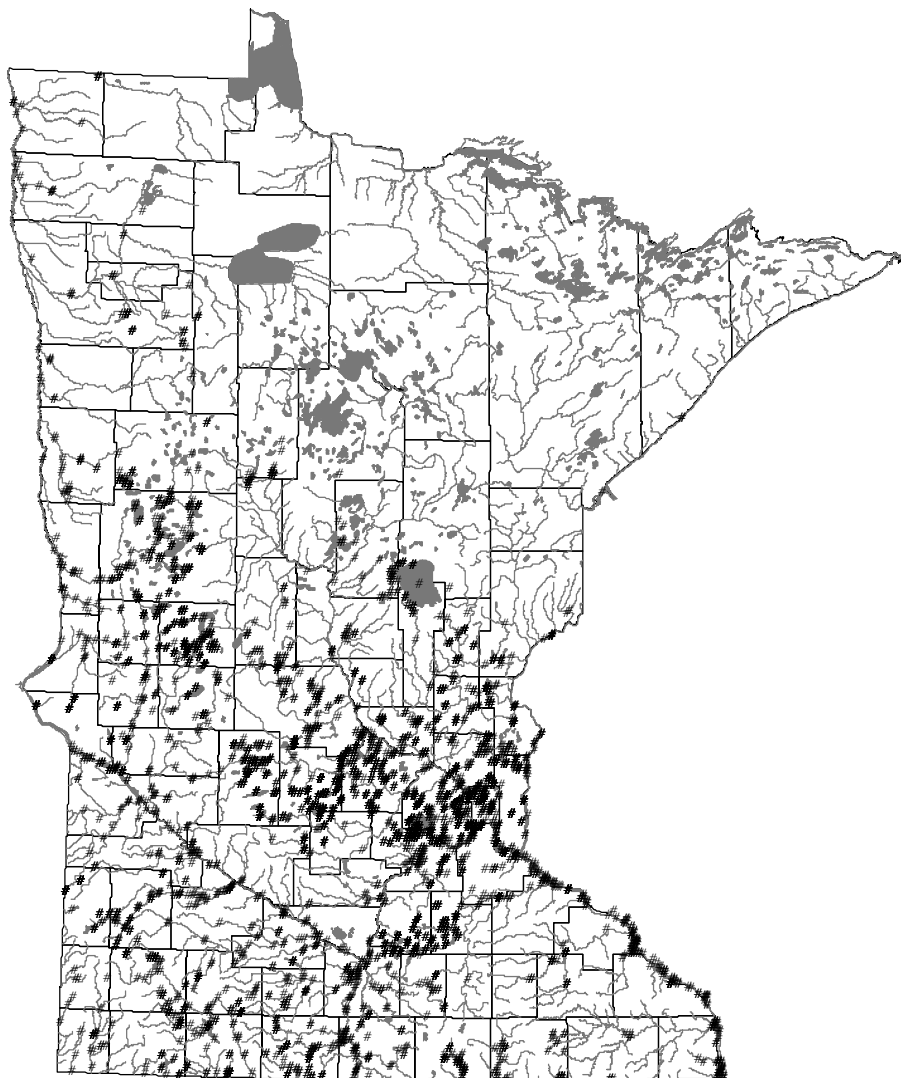


Figure 21. Distribution of common carp in Minnesota as of December 2003.

Progress in Management of Common Carp – 2003

Several activities occur to inventory common carp infested waters, limit their spread, and remove carp from waters where they exist. Those activities (described below) are primarily conducted by staff of the Division of Fish and Wildlife.

Evaluation of habitat conditions on shallow lakes

Habitat evaluation surveys were conducted on 98 shallow lakes by the Section of Wildlife in 2003. These surveys evaluate water clarity, chemistry, and depth along with occurrence and density of rooted aquatic plants.

Evaluation of fish populations

Fish population surveys were proposed at 629 managed fishing lakes by the Section of Fisheries. The results of those surveys will be available in June 2004.

Establish and maintain fish barriers

Fish barriers are used to limit the movement of common carp between connected waters. Fish barriers continued to be constructed, repaired, and maintained by the Section of Wildlife in 2003.

Remove carp from priority lakes

A large project was conducted by the DNR Section of Wildlife at Lake Christina, one of the major waterfowl lakes in the state to remove common carp, bullheads, and other zooplankton-eating fish. The lake was treated with Rotenone on October 21 and 22, 2003, to kill the fish in the lake.

Water level drawdowns were conducted by the DNR Section of Wildlife on several designated wildlife lakes to eliminate carp and restore aquatic vegetation. Examples include: Rice and Minnesota lakes (Faribault County), Bear and Geneva lakes (Freeborn County), and Buffalo Lake (Waseca County).

Research

Research to identify pheromones to attract or repel carp is currently being conducted at the University of Minnesota, with Dr. Peter Sorenson as the project leader, in cooperation with the DNR Section of Wildlife. A proposal entitled "Developing Pheromones for Use in Carp Control" was recommended by the LCMR and funding of \$100,000 was subsequently appropriated by the Legislature to continue this research at the University of Minnesota in FY 2004-2005. The USFWS will also contribute \$75,000 toward the same research project. The findings from the pheromone research will be used to develop an integrated approach to carp management.

Effectiveness

Common carp management has been only moderately effective in all types of waters within Minnesota. Although in shallow waters, where removal of carp has been successful, the aquatic habitat has responded immediately the next spring with improved water clarity and abundant native rooted aquatic plants.

Participation of Others

Participation of others varies depending on the individual management project for common carp. During 2003, participation on common carp management projects included Ducks Unlimited, Minnesota Waterfowl Association, USFWS, USACE, Division of Wildlife, Division of Fisheries, and local lake associations.

Future needs for management of common carp

- Continue support for funding of research related to the application of pheromones, induce winterkill to remove carp, develop and evaluate new fish barrier designs, and make additional refinements of chemical applications to remove common carp.
- Continue to seek and provide funding for management to accelerate the removal and blocking of common carp from high-priority affected waters.
- Monitor the new disease, spring viremia of carp, to determine how widespread it is in Minnesota and consider new limitations on live carp shipments.

Management of Mute Swans

Introduction

Issue

Mute swans (*Cygnus olor*) are native to Europe and Asia and were brought to the United States from the mid-1800s through the early 1900s (Lever 1987, Ciaranca et al. 1997). Ciaranca et al. (1997) reported that all North American populations of mute swans originated from release or escape of individuals from captive flocks.



In Michigan, Ontario, Wisconsin, and eastern states from Maine to South Carolina, mute swan populations have naturalized and are expanding rapidly causing concern for native species and their habitat (Allin et al. 1987; Ciaranca et al. 1997). For example, Lever (1987) reported that around the Chesapeake Bay one or two pairs escaped captivity during a storm in 1962. By 2000, the Maryland mute swan population had grown to about 4,000 individuals.

Some people have been interested in possessing and releasing mute swans to compete with Canada geese, but this management approach has not been proven to work. Others are interested in having mute swans for ornamental purposes. Wild birds may fly into the state from other states and provinces.

Mute swans are currently regulated in part by the Minnesota game farm statutes in Minnesota Statutes 97A.105 and they are designated as a *regulated exotic species* in Minnesota Rules 6216.0260. It is illegal to release mute swans into the wild under the game farm and regulated exotic species statutes. Under federal laws, mute swans are considered migratory waterfowl. Beginning in 2002, the USFWS requires federal permits for possession, sale, and purchase of mute swans because they are now considered migratory waterfowl.

Goals

- The DNR's goal for mute swan management is to avoid the establishment of naturalized populations of mute swans in Minnesota.

Distribution

Unconfined mute swans were reported in Minnesota in 2003 (Table 17) and in previous years. They have occasionally escaped or have been released from golf courses, from individuals who live on lakes, from apartment complexes, and in park settings in Minnesota. There have been documented wild nesting pairs in some locations of the state.

Table 17. Unconfined mute swans reported in Minnesota counties during 2003.

County	Number of swans	Month Reported
Hennepin	1	November
Dakota	3	July
Rice	1	December
Washington	5	June
Total for all counties	10	

Progress in Mute Swan Management – 2003

Monitoring mute swans in the wild

Monitoring mute swans in the wild is a strategy necessary to help DNR respond to birds that may establish naturalized populations (see population management below). During 2003, the DNR recorded and investigated four reports of wild or escaped mute swans in the state. A total of 10 birds were reported in the wild in four different counties (Table 17). Sources of the reports include: conservation officers that flew over lakes, birders, calls from the public, and other DNR staff who observed unconfined birds.

Population management

The DNR did not apply for or obtain a depredation permit from the USFWS in 2003 and no management of wild mute swans occurred in the state.

Management in Other States

In July 2003, the U.S. Fish and Wildlife Service released a draft environmental assessment for the management of mute swans in the Atlantic flyway. The assessment analyzed the consequences of actions to minimize the damage caused by the increasing numbers of mute swans. The USFWS' 10-year goal is to trim the East Coast population from 14,000 to 3,000 and the national mute swan population from 21,400 to about 4,500.

In 2003, efforts of other states' wildlife agencies to conduct varying levels of mute swan population control were hindered by lawsuits. In spring of 2003, the federal government issued a permit to Maryland allowing state wildlife biologists and technicians to shoot up to 1,500 of Maryland's 3,600 mutes. About 100 birds were killed before animal activists and Eastern Shore bird lovers filed a lawsuit in U.S. District Court to challenge the permits. Maryland voluntarily surrendered its permit in May after the first suit was filed. Another federal suit, challenging the federal process used to approve federal permits, was pending in U.S. District Court in Washington D.C.

Future needs for management of mute swans

- Verify occurrences of mute swans in the state and take appropriate actions to have the birds confined under game farm licenses or remove the birds from the wild.
- Develop and distribute informational materials about mute swans and related state and federal laws.
- Obtain a depredation permit from the USFWS to control unconfined mute swans.

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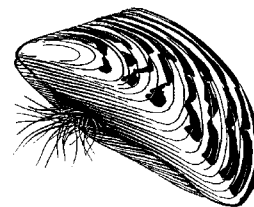
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Management of Zebra Mussels

Introduction

Issue

The zebra mussel (*Dreissena polymorpha*) is a small striped exotic mussel that was brought to North America in the ballast waters of trans-Atlantic freighters in the late 1980s. Unlike our native mussels, zebra mussels secrete sticky threads that are used to firmly attach to any hard surface in the water. The ability of these mussels to attach in large clumps can create numerous problems, such as clogging intake pipes for industry or killing native mussels. Attachment of the adults to recreational boats or aquatic vegetation (which may be transported by boaters) can serve to move zebra mussels to other waters.



Zebra mussels have a microscopic free-living larval stage (veliger) which may float in the water for two to three weeks. This larval stage ensures widespread distribution in lakes, and downstream of any established zebra mussel populations in rivers. Additionally, this microscopic life stage may also be moved to other water bodies in any water (such as bait buckets) transported over land. The high reproductive capacity and free-living veligers of the zebra mussel allows for rapid dispersal within a water body.

Zebra mussels feed by filtering algae and other small particles out of the water. These same small food particles are the food base for zooplankton and larval fish in our lakes and rivers. Hundreds of thousands of zebra mussels may filter so much of this food that it could interfere in the aquatic food chain, reducing the food availability for larval fish and impacting fish populations.

Goals

- Prevent the spread of zebra mussels to uninfested waters within Minnesota.
- Reduce the impacts of zebra mussels to Minnesota's ecology.

Distribution

Zebra mussels occur in the Mississippi River from St. Paul to the Iowa border, the lower 25 miles of the St. Croix River, the Duluth Harbor, Lake Zumbro, the Zumbro River downstream of Lake Zumbro, Lake Ossawinamakee, and Pelican Brook immediately downstream of Lake Ossawinamakee (Figure 22).

Progress in Management of Zebra Mussels – 2003

Monitoring

Samples of veligers were collected in 2003 from Lake Zumbro to determine how long the larval stage is present in the lake. Monitoring indicated that veligers could be found in the water from June through mid-September, suggesting that the reproduction of zebra mussels was extensive again this season. Diving in Lake Zumbro found significant settlement of zebra mussels at depths exceeding 15 feet in some areas of the lake.

The Volunteer Zebra Mussel Monitoring Program continued with mailing of report forms and results from the previous year to all lakeshore residents who had participated. An additional mailing was made to participants in the DNR Waters Lake Level Program. Reports to date from volunteers monitoring their lakeshore areas have not found any zebra mussels in any other waters of the state.

In October, a sample of suspected zebra mussels was collected by a commercial dock hauler pulling out a boat lift in Lake Ossawinnamakee. These were confirmed as zebra mussels, and Exotic Species staff surveyed several locations around the lake and in the upper reaches of Pelican Brook immediately as it leaves the lake to document settlement of this exotic. This new location represents the most disjunct population in the state. Lake Ossawinnamakee is over 100 miles away from the nearest known established zebra mussel population, in the Duluth/ Superior Harbor. The presence of zebra mussels in Lake Ossawinnamakee suggests that long distance dispersal, while uncommon, can occur to establish new exotic populations distant from known established infestations.

The National Park Service monitors for zebra mussels using slides on settling plate samplers in the federal zone of the St. Croix River, above the infested section of the river. Samples taken by the National Park Service were analyzed in the aquatic invertebrate laboratory by DNR biologists. No zebra mussels were found on the slides examined for 2003, suggesting that this exotic has not been moved upstream within these waters and continues to be confined to the lower 25 miles of the St. Croix.

Prevention of spread

Zebra mussels made a significant movement north with the discovery of a reproducing population in Lake Ossawinnamakee, in the Brainerd area. Scattered mussels were also found close to the lake in the outlet stream (Pelican Brook). This is only the second inland water body documented with zebra mussels in the state.

Research

Recent studies have suggested that a specific bacteria may kill zebra mussels after being eaten by the mussels. The bacteria occurs in North America, and is not another exotic species. Recent results from the researchers have suggested that while this may be effective for industry, it is not necessarily viable for ecosystem use. Many questions remain to be answered concerning this bacterial control. Mass production of such a control has not yet been developed. More extensive testing on a variety of aquatic animals (such as gamefish) would need to be done to determine the safety of such a control.

Effectiveness of Management

Despite the occurrence in a new location, Minnesota still only has two inland lakes that contain this exotic. Movement to inland waters has been much slower than other Midwest states. However, the infestation in the Brainerd lakes area puts this exotic in a heavily used vacation and recreation area. Public awareness efforts need to be intensified to try to prevent movement to other lakes in this area. In comparison to Minnesota, Wisconsin has more than 40 inland water bodies with zebra mussels, while Michigan has more than 160 infested inland waters. These states do not have statutes such as Minnesota that prevent movement of aquatic plants, which recent research has

suggested is the primary avenue for overland transport leading to new infestations. The prohibition on moving aquatic plants is extremely important as surveys in Lake Ossawinnamakee found substantial settlement on aquatic vegetation in many areas of the lake.

Participation of Others

Funding for an interstate management plan for coordinated actions against the zebra mussel for the St. Croix River was continued by USFWS. The Minnesota DNR, Wisconsin DNR, and the Great Lakes Indian Fish and Wildlife Commission received funding assistance for zebra mussel activities on the St. Croix River outlined in the management plan.

Monitoring efforts for zebra mussels continued by lakeshore residents throughout Minnesota. Over the past two years, approximately 225 people annually have participated in the Volunteer Zebra Mussel Monitoring Program, checking lakes across the state for zebra mussels. These efforts provide a much more extensive examination of Minnesota waters for this exotic than could be conducted by the Exotic Species Program alone. Inland lake infestations in Minnesota (Zumbro and Ossawinnamakee) were both reported by members of the public indicating the importance and value of this volunteer effort.

Future needs for management of zebra mussels

- Continue monitoring zebra mussel populations in various Minnesota waters.
- Continue the Volunteer Zebra Mussel Monitoring Program.
- Prioritize increased public awareness for the Brainerd lakes area.

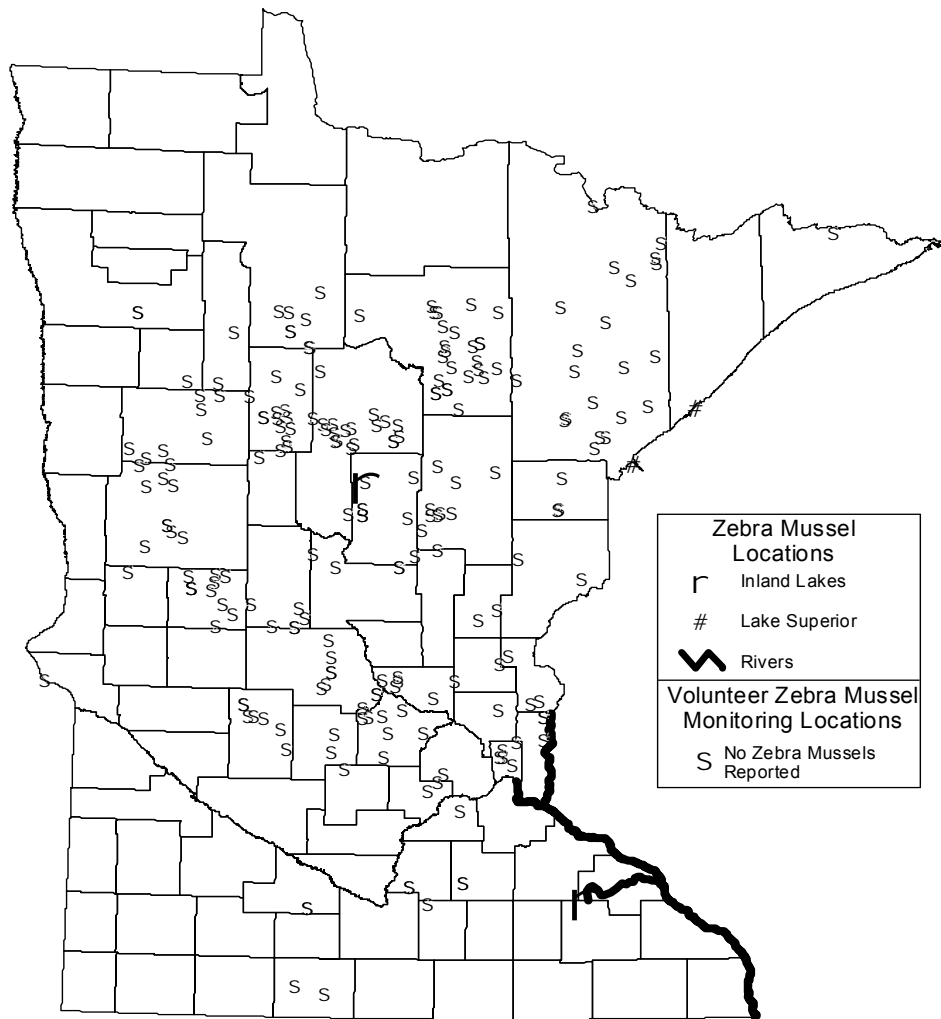


Figure 22. Zebra mussel and volunteer zebra mussel monitoring locations in Minnesota as of November 2003.

Other Harmful Exotic Species in Minnesota

Introduction

Numerous harmful exotic species of aquatic plants and wild animals exist in the state. The previous chapters described species and activities where there was ongoing management of the species. The species described in this chapter all exist in the state, but there were no efforts to manage them in the wild. They are included because they are or have been an interest within the state.

Brittle Naiad (*Najas Minor*)

Exotic Species Program staff have found what they believe is brittle naiad (*Najas minor*) in Lac Lavon, a small lake in Dakota County. A specimen has been sent to a national expert for further examination. *Najas minor* resembles the Minnesota rare species spiny naiad (*Najas marina*), but unlike *N. marina* it is not native to Minnesota. Brittle naiad can grow so densely it can completely clog the water column, which can result in negative impacts to native aquatic plants and recreation (Vermont Agency of Natural Resources and The Nature Conservancy of Vermont, 1998). Brittle naiad grows to about four feet in height, and has stems that are profusely branched toward the top of the plant. Brittle naiad is found as far north as Vermont and as far west as Oklahoma. Like other naiads, brittle naiad is an annual, reproducing primarily by seed (McFarland et al, 1998). The closest known population of brittle naiad is in Iowa where it has been confirmed in Crawford and Ida counties. Because of the large extent of the infestations, the Iowa DNR is planning to treat the brittle naiad in the spring of 2004 (Kim Bogenschutz, Aquatic Nuisance Species Program Coordinator, Iowa DNR, telephone conversation, November 6, 2003).

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Exotic Earthworms

The first importations of exotic earthworms into the United States began around 1500 A.D. when European settlers brought over plant material, some of which contained earthworms (Gates 1974; Reynolds 1994). In Minnesota, as well as other states covered by the most recent glaciation, there are no native terrestrial earthworms. Given the absence of these earthworms in Minnesota for the last 10,000 years, forested habitats have developed a unique ecology. Earthworms rapidly change this ecology. The most pronounced change has occurred with soil structure, which can have ecological effects beyond its physical characteristics, including altering or completely transforming habitat once occupied by native plants and animals.

Recent Developments

Exotic earthworms and their impacts have only recently been receiving local and national attention. In 2003, numerous media outlets such as *New York Times*, *Wall Street Journal*, *Los Angeles Times*, and several local radio stations and newspapers have run stories about the research and educational efforts being performed. Many of these efforts are occurring right here in Minnesota by the Exotic Species Program, and other parts of the DNR. These efforts include the distribution of informational posters to bait shops, additional verbiage in the fishing regulation booklet, development of an earthworm fact sheet, information on the DNR website, and the completion of an earthworm risk assessment.

During the fall of 2003, an international conference on earthworms took place. The Exotic Species Program helped send a University of Minnesota earthworm researcher to represent the state. One of the important outcomes from this conference will be the development of 12 papers regarding earthworm invasions and documented impacts. These papers will be completed by the fall of 2004.

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Round and Tubenose Goby

The round (*Neogobius melanostomus*) and tubenose (*Proterochinus marmoratus*) gobies (Figure 23) are bottom dwelling fish from Europe and native to the Black and Caspian seas. The gobies were discovered in Michigan waters in 1990, likely the result of ballast water exchange from transoceanic vessels.



Figure 23. The round and tubenose goby.

In 1995, the round goby was discovered in the Duluth/Superior Harbor. Since then, the population has increased to over 161,000 fish in the St. Louis River (Lori Evrard, U.S. Geological Survey, November 7, 2002). The round goby has documented negative impacts on mottled sculpin reproduction and suspected impacts on other native bottom dwelling fish, such as darters and sturgeon. The round goby has expanded its range throughout the Great Lakes, Detroit River, Lake Superior watershed and the Illinois waterway. It is likely that the fish will migrate from the Illinois River into the Mississippi River and up to Minnesota.

The tubenose goby was first discovered in the St. Louis River Harbor in 2001. Unlike the round goby, tubenose gobies do not seem to exhibit the same invasiveness. Nevertheless, Wisconsin DNR's index seining has captured more tubenose gobies in 2003, than previous years (Table 18).

Table 18. Number of round and tubenose gobies captured using a seine at nine sites (Dennis Pratt, Wisconsin DNR, October 31, 2003).

	1998	1999	2000	2001	2002	2003
Round Goby	14	25	316	18	148	1,836
Tubenose Goby	0	0	0	1	10	175

Rusty Crayfish

The rusty crayfish (*Orconectes rusticus*) is an exotic species in our state that is native to the eastern and mid-eastern United States. It has been spread across the Midwest through human activities, likely through release from bait by anglers. This exotic can out-compete native crayfish and may interbreed with our native species. It can displace native crayfish, reduce or eliminate aquatic vegetation, and may interfere with some fish populations in certain lakes. There are currently no selective and effective control methods once the rusty crayfish become established in permanent lakes or rivers. Researchers in Wisconsin have begun examining management of crayfish predators (specific fish species) to attempt to manage numbers of this exotic in some of their lakes; however, this research is still preliminary. With the lack of any selective or even effective control methods, the Exotic Species Program does not conduct any active management of rusty crayfish.

Rusty crayfish were found in two branches of the Zumbro River in southeastern Minnesota in 2003. These crayfish have been reported from over 40 lakes and eight rivers in the state, scattered from northeast to south-central Minnesota. Fisheries staff encounter rusty crayfish in their lake sampling gear and report findings to the Ecological Services Division. Many lakes in St. Louis and Lake counties are connected, and it has been shown that the rusty crayfish will move between interconnected water bodies. Judging from the widespread reported distribution, it is highly likely that rusty crayfish are present, but unrecorded in more waters in the state.

Spiny Waterflea

The spiny waterflea (*Bythotrephes longimanus*) is an exotic cladoceran zooplankter native to Europe. It was brought over to North America in ballast water in the late 1980s and first appeared in the Great Lakes. This zooplankter is a predaceous cladoceran, feeding on other smaller zooplankton. The long, barbed tail spine on this exotic can prevent predation by smaller larval fish as well as other aquatic animals. Some species of larger fish have been shown to feed heavily on the spiny waterflea. This exotic may interfere with lake food webs by preying heavily on and reducing the number of other zooplankton. Some research suggests that the most significant impacts will occur in larger, oligotrophic (lacking plant nutrients) lakes with simpler fish communities. The spiny waterflea produces resting eggs similar to those of native Cladocera, which can resist dessication and freezing, providing a long-range dispersal method for overland spread. Adults may become entangled in fishing gear and moved to other water bodies.

The spiny waterflea was discovered in Lake Superior in the late 1980s, and shortly after that was found in two nearby lakes (Fish and Island lakes, near Duluth). Monitoring by area Fisheries staff reported that it disappeared from Fish Lake, while remaining in Island Lake. In fall 2003, a resident on Saganaga Lake reported strange clumped zooplankton on his fishing line. Samples were confirmed as *Bythotrephes longimanus*. Sampling by Fisheries staff in Gull, Seagull and Gunflint lakes in Cook County found no spiny waterflea in these water bodies. However, the interconnectedness of many lakes in this area suggests that the spread to other lakes is likely to occur through natural movement. The resting eggs or viable adults can be carried through connections into other water bodies. The location of Saganaga Lake on an international border, as well as leading into the Boundary Waters Canoe Area leads to the necessity of coordination among federal agencies and with Ontario exotics programs to raise public awareness.

Daphnia lumholtzi

Daphnia lumholtzi is an exotic cladoceran native to the subtropical regions of Africa, Asia, and Australia. This species was first reported in North America in 1990 from a small reservoir in eastern Texas and shortly thereafter from a reservoir in southwest Missouri. Since its first sightings, it has spread rapidly throughout the southern and mid-western states. It was most likely brought to North America with African fish imported for the aquarium trade or to stock reservoirs. *D. lumholtzi* can be easily distinguished from native daphnia by its large pointed helmet, long tail spine, and numerous smaller spines along its carapace. Because of its armored body, *D. lumholtzi* may be less susceptible to predation than native daphnia and could compete with native daphnia, which are very important in the diet of juvenile fishes.

Individual specimens of *D. lumholtzi* were first found in Lake Pepin in 1999, but it was not until September 2003, that evidence of a reproducing population was found. Zooplankton samples have been collected from Lake Pepin since the early 1990s as part of the Long Term River Monitoring Program. In September 2003, both females with eggs and males were found throughout Lake Pepin, with highest densities in shallow water. Because *D. lumholtzi* is a subtropical species requiring warmer water temperatures than native daphnia, it generally does not appear until late summer and is often restricted to warmer shallow water. Similar to native cladocerans, *D. lumholtzi* survives the winter by producing resting eggs that can resist freezing and desiccation, and hatch the following summer when optimum temperatures return (25-31° C). These resting eggs can also be a means of dispersal for the species as they can be transported across land by migrating birds, wind, and human activities. Lake Pepin is the furthest north *D. lumholtzi* has been found so far. Water temperature may present a major physical constraint on its long-term success in northern latitudes, but this has yet to be determined.

Ruffe

The ruffe (*Gymnocephalus cernuus*), a Eurasian fish belonging to the perch family, was introduced into Minnesota in the mid-1980s. Its likely source of introduction was from ballast water discharge by transoceanic ships. Several studies examining the impacts of the ruffe to native fish communities have been performed. From these studies, the relationship between the ruffe and native fish populations is not clearly understood.

The state management goal for the ruffe is to prevent the spread of this exotic. Currently, there are only two water bodies in Minnesota, Lake Superior and the St. Louis River, where ruffe populations exist. For more than 15 years, the ruffe has not reached an inland lake. The St. Louis River and Lake Superior populations increased during the mid-1990s and have since declined and stabilized. The Exotic Species Program will continue to follow and support research, monitoring, and educational efforts for the ruffe.

Eurasian Collared-dove

The Eurasian collared-dove (*Streptopelia decaocto*), a bird native to the Indian Subcontinent and Turkey, was first described as a new exotic bird species in the state in the annual report for 1999. They were observed in Big Stone, Blue Earth, Brown, Carver, Dakota, Freeborn, Houston, Lyon, Kandiyohi, Martin, Pipestone, Renville, Rock, Roseau (the first reported sighting in a northern county), and Yellow Medicine counties during the years from 1999 to 2002.

In 2003, the collared-doves were observed in three additional counties. One bird was observed in Sauk Center (Stearns County), two birds were in Milan (Chippewa County), and two birds in Thief River Falls (Pennington County). They are likely to be in other Minnesota counties and to continue spreading throughout the state. Five collared-doves were reported in Caledonia (Houston County) near the town's city hall in 2003 where a pair of nesting birds had been observed in previous years.

The DNR is not attempting to eliminate or control the population of Eurasian collared-doves in Minnesota. There are several reasons: it would be difficult to prevent their continued introduction from adjoining states, the birds look similar to mourning doves, and there is not a regional or national effort to stop their spread.

Appendix A - Exotic Species Program Staff

Title / Area of Responsibility	Name	Phone	E-mail
Exotic Species Program Coordinator - rulemaking, legislation, state representative on regional aquatic nuisance species committees or panels and federal exotic species issues, education and public awareness	Jay Rendall	651-297-1464	jay.rendall@dnr.state.mn.us
Purple Loosestrife Coordinator - technical assistance for management of purple loosestrife, and biocontrol of other invasive species	Luke Skinner	651-297-3763	luke.skinner@dnr.state.mn.us
Eurasian Watermilfoil Coordinator - technical and financial assistance for management of milfoil, and technical assistance for other exotic aquatic plants	Chip Welling	651-297-8021	chip.welling@dnr.state.mn.us
Exotic Species Biologist - technical assistance for management of milfoil, curly-leaf pondweed and other exotic aquatic plants	Wendy Crowell	651-282-2508	wendy.crowell@dnr.state.mn.us
Exotic Species Biologist - technical assistance for management of milfoil, flowering rush, and other exotic aquatic plants	Nick Proulx	651-284-3589	nick.proulx@dnr.state.mn.us
Exotic Species Biologist - exotic species issues in northern portions of the state	Dan Swanson	218-828-2553	dan.swanson@dnr.state.mn.us
Watercraft Inspection Program Coordinator - supervises watercraft inspection interns; awareness events at water accesses	Heidi Wolf	651-297-4891	heidi.wolf@dnr.state.mn.us
Watercraft Inspection Program Assistant - awareness events at water accesses	Sarah Sillers	651-284-3586	sarah.sillers@dnr.state.mn.us
Aquatic Invertebrate Biologist - zebra mussels, rusty crayfish, and other exotic aquatic invertebrates	Gary Montz	651-297-4888	gary.montz@dnr.state.mn.us
Conservation Officer - statewide enforcement of exotic species regulations	Greg Turner	651-772-7906	greg.turner@dnr.state.mn.us
General Information		651-296-2835	

Appendix B - Other State Contacts for Exotic Species Prevention and Control Programs and Interagency Groups

Department of Natural Resources - Forest Pest Program

DNR's Division of Forestry, working in cooperation with the MDA, is charged with surveying and controlling forest pests, including exotic organisms such as gypsy moth and several bark beetles (an annual report is prepared by the DNR Forest Health Protection Team on those issues).

Forestry Division Contacts

Metro Forest Health Specialist	Susan Burks	651-772-7927
Southern Forest Health Specialist	Ed Hayes	507-285-7431
Northeast Forest Health Specialist	Mike Albers	218-327-4115
Northwest Forest Health Specialist	Jana Albers	218-327-4234
Forest Development		
Health and Use Supervisor	Al Jones	651-296-4482

U of Minnesota Sea Grant – Aquatic Invasive Species Information Center

The Aquatic Invasive Species Information Center at the University of Minnesota Sea Grant Program provides research, outreach, and education in collaboration with the DNR's Exotic Species Program. The Center has served as an important resource on aquatic nuisance species (ANS) and provides information to the public to prevent and slow their spread.

Center Coordinator - Duluth	Doug Jensen	218-726-8712
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Minnesota Department of Agriculture - Invasive Species Programs

The MDA has responsibilities related to noxious weeds, plant pests, and invasive species of terrestrial plants and insects. MDA's Invasive Species Program addresses species such as Japanese beetle, gypsy moth, long-horned beetle, Grecian foxglove, and Eurasian buckthorn. MDA prepares an annual report for these programs.

Agronomy and Plant Protection Division Contacts

Shade Tree and Invasive Species Unit	Anne Selness	651-296-8448
Terrestrial Invasive Species Program	Peter Dziuk	651-296-3343

Ag Development Division Contacts

Weed Biological Control	Tony Cortilet	651-282-6808
Integrated Pest Management Coordinator	Jeanne Ciborowski	651-297-3217

Interagency Invasive Species Groups

There are several invasive species committees or work groups to facilitate coordination between the involved agencies.

Minnesota Noxious Weed Potential Evaluation Committee – Peter Dziuk, Chair, MDA - Weed and Seed Unit, Agronomy and Plant Protection Division, 651-296-3343.

Weed Integrated Pest Management Committee - Jeanne Ciborowski, MDA - Integrated Pest Management Coordinator, Ag Development Division, 651-297-3217

Gypsy Moth Program Advisory Committee - Anne Selness, MDA - Shade Tree and Invasive Species Unit, Agronomy and Plant Protection Division, 651-296-8448

St. Croix River Zebra Mussel Task Force - Includes these primary members and other less active members: Minnesota Department of Natural Resources, Wisconsin Department of Natural Resources, Great Lakes Indian Fish and Wildlife Commission, U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, and the National Park Service.

Minnesota Invasive Species Advisory Council - Co-chairs: Anne Selness, MDA - Shade Tree and Invasive Species Unit, Agronomy and Plant Protection Division, 651-296-8448 and Jay Rendall, DNR Exotic Species Program, Ecological Services Division, 651-297-1464.