Invasive Species of Aquatic Plants and Wild Animals in Minnesota

Annual Report 2004

for the year ending December 31

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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 invasive 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 Invasive Species Program activities and other activities related to invasive species of aquatic plants and wild animals.

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Summary

Hot topics in 2004

Asian carp - Expanding efforts to prevent their spread into Minnesota
The Minnesota Department of Natural Resources (DNR) is working with other agencies to prevent the spread of Asian carp into the state. Bighead, silver, and grass carp are moving toward Minnesota. The closest known populations are in Iowa waters of the Mississippi River and its tributaries. There is also concern that these carp will enter the Great Lakes through the canal that connects the Illinois River with Lake Michigan. Unlike many invasive species that are spread primarily through human actions, these fish spread via connected waters. Three key actions undertaken by the DNR were:

- A feasibility study, funded by Minnesota DNR, U.S. Fish and Wildlife Service, and Wisconsin DNR, was completed in March 2004. The study focused on technology that could deter the spread of Asian carp, and the associated cost.
- DNR's Deputy Commissioner met with Congressional staff in Washington D.C. to discuss potential federal funding for the construction of two dispersal barriers; a key recommendation of the feasibility study.
- Minnesota is working with other Great Lakes states to help fund the installation of a new fish dispersal barrier in the canal between the Illinois River and Lake Michigan to prevent the spread of Asian carp and other invasive species. The DNR helped fund a required non-federal match for the $9 million project.

Lake Ossawinnamakee - Preventing the spread of zebra mussels within the state
Lake Ossawinnamakee, and the surrounding Brainerd area, was the focus of intensive efforts to prevent the spread of zebra mussels. In 2003, zebra mussels were discovered in this central Minnesota lake, creating a new source for spread into other central Minnesota water bodies. Three pathways of movement were targeted including 1) upstream movement via boat traffic, 2) downstream movement via natural waterflow, and 3) unintentional transport on trailered watercraft visiting Lake Ossawinnamakee. The DNR took actions to interrupt each of these potential pathways:

- Risk from boat traffic traveling upstream to Kimball Lake was eliminated by placing large boulders in Kimball Creek. Area DNR staff also worked with county commissioners to pass an ordinance prohibiting boat traffic through Kimball Creek.
- The DNR paid for weekly copper sulfate treatments during the summer and early fall to kill zebra mussel veligers (free-floating immature zebra mussels) in the bay that feeds Pelican Brook. This outlet stream provides a connection to the Mississippi River. By killing veligers, the DNR reduced risk that zebra mussels would establish in downstream waters including the Mississippi River.

- Public awareness and watercraft inspection efforts were increased in the Brainerd area. Watercraft access inspectors spent 183 hours on Lake Ossawinnamakee, inspecting 244 boats. In the Brainerd area as a whole, watercraft inspections were increased by 57% (to1,063 hours).

Curly-leaf pondweed - Improving management

There has been an increase in the number of lake residents and lake associations requesting assistance with problems caused by curly-leaf pondweed. In response, the DNR has increased its efforts to 1) provide technical assistance to lake residents and 2) research/develop new methods of managing curly-leaf pondweed. In 2004, the DNR provided technical assistance for numerous curly-leaf pondweed planning and management projects including a major project on Lake Benton (Lincoln County). Staff also presented information at three curly-leaf management workshops organized by University of Minnesota Extension Services and the Minnesota Lakes Association. The DNR has been actively supporting research into new curly-leaf pondweed management techniques since 1997. A key question is: Can we be more aggressive in controlling this plant without harming fish and wildlife habitat? During 2004, DNR staff continued to evaluate several methods of curly-leaf pondweed management including endothall herbicide, fluridone herbicide, and winter drawdown. As new methods of curly-leaf management become available, the DNR will evaluate their effectiveness in Minnesota lakes.

Status of Invasive Species in Minnesota: 2004

Aquatic Plants

- **Eurasian watermilfoil** was found in eight new water bodies, including Leech Lake in Cass County. This brings the total number of infestations to 160 water bodies (Figure 1).
- **Purple loosestrife** has been documented in more than 2,200 locations statewide. Management efforts are being carried out on nearly half of these locations with biological controls or herbicide applications.
- **Curly-leaf pondweed** is widespread; it is known to occur in 702 Minnesota lakes in 69 counties.
- **Flowering rush** is currently found in 16 lakes. The most problematic area of the state is near Detroit Lakes where the Pelican River Watershed District is leading ongoing management efforts.

Aquatic Animals

- No **Asian carp** (bighead, grass, silver, or black carp) were caught in Minnesota in 2003, a lone bighead carp (*Hypophthalmichthys nobilis*) was caught in Lake Pepin.
- No new **zebra mussel** infestations were discovered. To date, zebra mussels are found in two inland lakes, Lake Superior, the Mississippi River (below the Twin Cities), and the lower St. Croix River.
- **Spiny waterflea** were collected in four new lakes this year. Researchers from the University of Minnesota-Duluth found this non-native zooplankton in samples from Flour, Greenwood, McFarland and Pine lakes, all in Cook County. The

interconnections among many lakes in this area of the state may allow this species to spread quickly in northeastern Minnesota.

- No ***Daphnia lumholtzi*** were collected from Lake Pepin. However, in 2003, samples showed clear evidence of reproduction. Cooler water and higher flows may have prevented this sub-tropical invasive species from appearing this season.
- **Tubenose goby** populations are increasing in the St. Louis River estuary. The tubenose goby was first discovered in 2001 and was originally expected to be less invasive than the round goby.

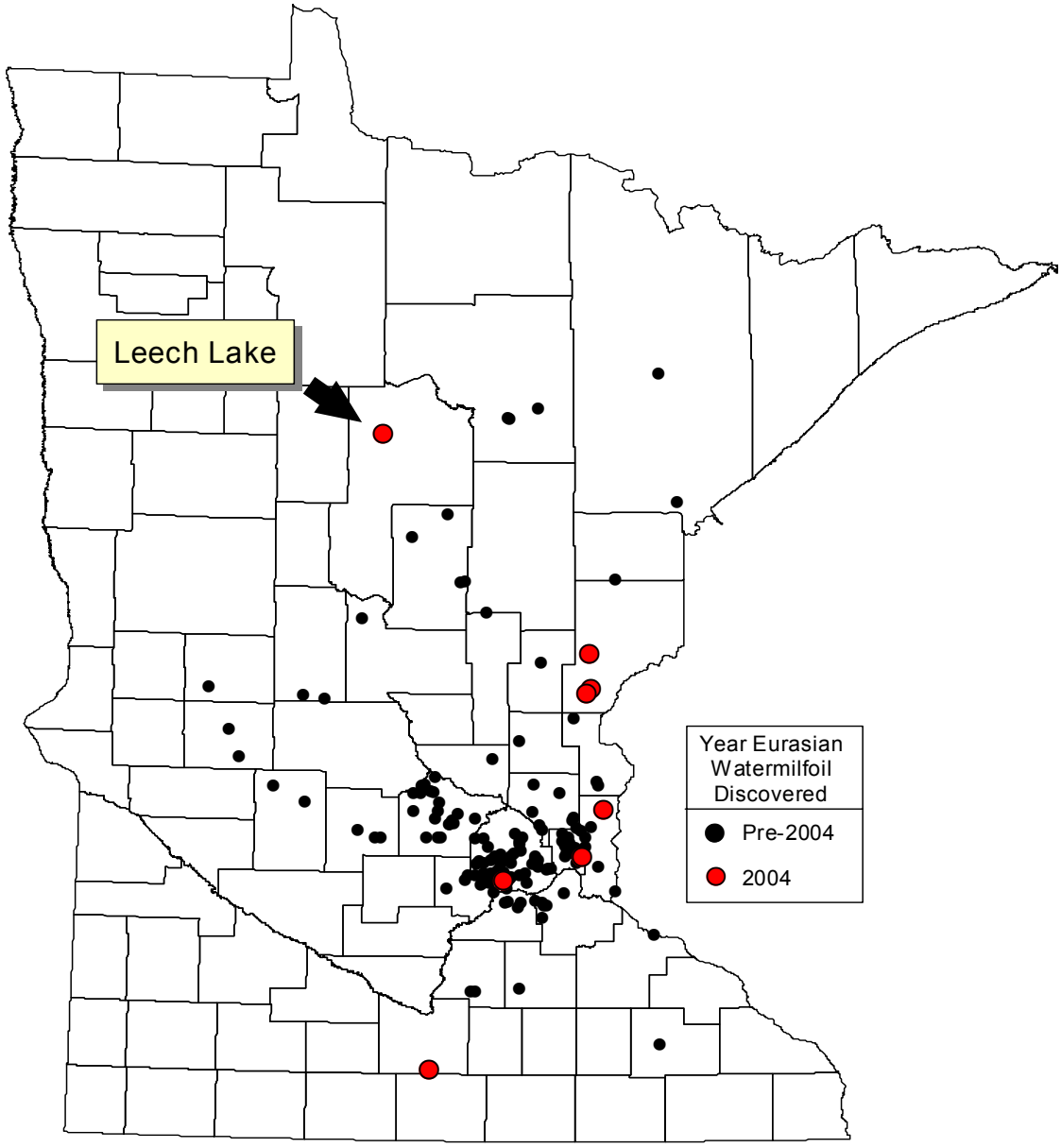

Figure 1. Eurasian watermilfoil infestations in Minnesota

The Problem

Invasive species have the potential to cause serious problems in Minnesota. Evidence from numerous locations in North America and from around the world demonstrates that these non-native species threaten the state's natural resources and local economies that depend on natural resources.

The Response

To address the problems caused by invasive species, the 1991 Minnesota Legislature directed the DNR to establish the Invasive Species Program and to implement actions to monitor and manage invasive species of aquatic plants and wild animals.

The three primary goals of the Invasive Species Program are to:

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

1. Prevent introductions of new invasive species into Minnesota

The best way to manage invasive species is to prevent their introduction into new habitats. Prevention efforts involve a variety of interrelated activities including: **risk assessment**, **education**, **regulations,** and **enforcement**. Risk assessments are focused on determining whether an invasive species will survive in Minnesota, the problems it might cause, and the pathways through which it might reach our state. Education efforts help explain the risks posed by invasive species and steps that people and businesses can take to prevent new introductions. Regulations help to prevent activities or practices that carry a high risk of introduction.

A new brochure, *Help Stop Aquatic Hitchhikers*, was produced. Designed for boaters, anglers, and other outdoor recreationists, the publication provides simple steps that individuals can take to help stop the spread of invasive plants and animals. Distribution efforts are ongoing through sport and outdoor shows, special events, information kiosks, and tourist information centers.

Several initiatives were carried out to prevent the spread of Asian carp into Minnesota (see Management of Asian Carp).

2. Prevent the spread of invasive species within Minnesota

Efforts to prevent the spread of invasive species within Minnesota are focused on people and their habits. Once an invasive species becomes established in Minnesota's lakes and rivers, a primary means for its spread is the unintentional transport on boats, trailers, and other water-related recreational equipment.

The DNR hired 40 watercraft inspectors to work at public water accesses, primarily on lakes and rivers already infested with invasive species. They inspect boats, inform owners about the problems invasive species can cause, and demonstrate actions that boaters can take to prevent spread. This year, inspectors worked more than 20,000 hours and inspected over 50,000 watercraft during the open water season. Inspections were conducted at 21 fishing tournaments and continued through October in order to reach waterfowl hunters. The DNR also worked cooperatively with five lake

associations and citizen groups to increase inspection efforts. These citizen groups funded additional hours of inspection at specific accesses while the DNR provided training, equipment, and supervision. For example, the Lake Minnetonka Conservation District funded an additional 946 hours of inspection on five Lake Minnetonka accesses.

Conservation officers spent 2,396 hours enforcing the invasive species laws and rules. Statewide, a total of five civil citations, 20 written warnings, and three summons were issued to individuals for violations of invasive species laws and rules.

Several initiatives were carried out to prevent the spread of zebra mussels from Lake Ossawinnamakee in north central Minnesota (see Management of Zebra Mussels).

3. Reduce the impacts caused by invasive species

Current efforts to reduce the harmful effects of invasive species are primarily focused on the management of aquatic plants.

Eurasian watermilfoil. To reduce the problems caused by Eurasian watermilfoil (milfoil), the Invasive Species Program worked closely with lakeshore owners, lake associations, local units of government, and others to manage milfoil with herbicides and mechanical harvesting. The amount of funding offered to cooperators for control of milfoil was increased. There was an increase in the total amount of control costs reimbursed by the DNR, though the number of cooperators seeking reimbursement declined. The DNR has been conducting research to evaluate the feasibility of using fluridone herbicide to control milfoil in Minnesota lakes. Research completed in 2004 suggests that low rates of fluridone reduce milfoil abundance in nutrient rich lakes, but also cause decreases in beneficial native plants.

Purple loosestrife. Both herbicides and biological control methods (the use of insects that eat purple loosestrife) are being used to manage this invasive plant. Since 1992, more than eight million leaf-eating beetles have been released in 800 of the 2,200 known purple loosestrife infestations. Severe defoliation of purple loosestrife by the beetles was observed on more than 20% of sites monitored in 2004. 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.

Coordination and cooperation among groups that manage invasive species

The successes achieved in preventing and managing invasive species results from cooperation among various organizations. Management of milfoil and purple loosestrife involves cooperation with local lake associations and local units of government. Efforts to prevent introductions of new invasive species into Minnesota often involve the participation of DNR staff in state and regional groups such as the 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 invasive species.

Revenue and Expenditures

The primary funding source for the Invasive Species Program is a $5 surcharge on watercraft registration of in Minnesota. This fee generates approximately $1.2 million per year. The 2003 Minnesota Legislature appropriated additional funding to the DNR ($380,000 in Fiscal Year 04 and $440,000 in Fiscal Year 05) to expand existing program efforts. Most of the funding (~70%) is spent on education, watercraft inspections, enforcement, and management/control efforts (Figure 2). Additional funding, primarily for research projects, was received from the U.S. Fish and Wildlife Service, the U.S. Environmental Protection Agency, and the Minnesota Legislature as recommended by the LCMR.

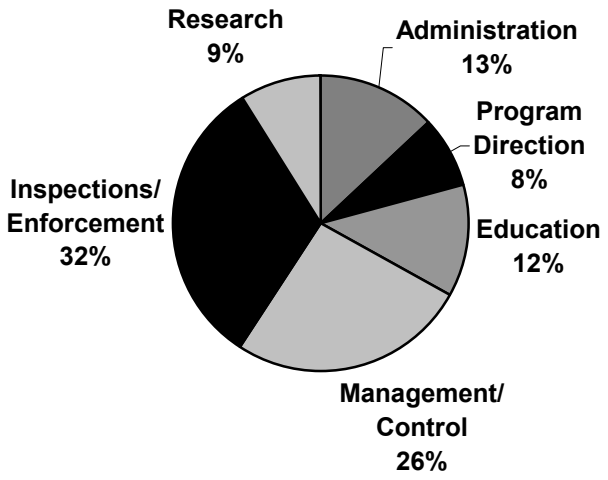

Figure 2. DNR's Invasive Species Program spending in fiscal year 04 by major categories.

Plans for the future

Continued investment in a comprehensive program to protect Minnesota's natural resources from future damage due to invasive species is paramount. The increase in funding provided by the 2003 Legislature has allowed prevention and management efforts to be expanded. The new funding is being used to:

- expand education efforts
- maintain the level of watercraft inspections at 20,000 hours
- increase grant funding to cooperators who are managing milfoil on infested lakes
- provide grants to improve curly-leaf pondweed management
- fund research to improve control efforts

The DNR plans to continue working with other agencies and groups who are members of the Minnesota Invasive Species Advisory Council to develop comprehensive strategies and actions that will position Minnesota to better address the multitude of invasive species issues.

Introduction

Overview of DNR's Invasive Species Program

Minnesota's Invasive Species Program was established in 1991 and was the first program of its kind in the nation. The Minnesota Department of Natural Resources (DNR) has responsibility to develop and coordinate a statewide program to prevent the spread of invasive species of wild animals and aquatic plants. This comprehensive 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).

The Invasive Species Program addresses many invasive species that are present in Minnesota such as Eurasian watermilfoil, purple loosestrife, zebra mussel, and ruffe (see Table 1). The DNR Invasive Species Program also attempts to prevent the introductions of invasive species that have the potential to move into Minnesota such as hydrilla, water chestnut, and Asian carp. To do so, the program identifies potentially invasive 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 (see Risk Assessment). Prevention efforts are often undertaken with other states, agencies, and partners with similar concerns.

Other State Invasive Species Control Programs

The Minnesota Department of Natural Resources (DNR) and the Minnesota Department of Agriculture (MDA) administer prevention and control programs for other invasive species (harmful exotic species) in Minnesota. The DNR's Division of Forestry, working in cooperation with the MDA, is charged with surveying and controlling forest pests, including non-native organisms such as the gypsy moth and several bark beetles. A separate annual report is prepared by the DNR's 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 Invasive Species Information Center in Duluth. The Center promotes education and outreach to prevent the spread of aquatic invasive species in the state.

Program Staff and Other DNR Support

Most activities of the Invasive Species Program are conducted or directed by a nine-person staff from DNR's Division of Ecological Services. Up to 40 seasonal 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 Division of Fish and Wildlife, Division of Enforcement, as well as the Bureau of Information and Education contribute significantly to the implementation and coordination of invasive species activities.

Table 1. DNR's Invasive Species Program efforts that address specific invasive species.

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

Invasive Species of Aquatic Plants and Wild Animals in Minnesota	Efforts of DNR's Invasive Species Program						
	A	**B**	**C**	**D**	**E**	**F**	**G**
Aquatic Plants							
Flowering rush (*Butomus umbellatus*)	X	X	X	X	X	X	X
Purple loosestrife (*Lythrum salicaria*)	X		X		X	X	X
Eurasian watermilfoil (*Myriophyllum spicatum*)	X	X	X	X	X	X	X
Other non-native aquatic plants	X		X		X	X	X
Curly-leaf pondweed (*Potamogeton crispus*)	X	X	X	**APM**		X	X
Animals							
Common carp (*Cyprinus carpio*)			**F**		**F/W**	**W**	X
Ruffe (*Gymnocephalus cernuus*)	X	X	**F/O**		**NIF**	X	X
Round goby (*Neogrobius melanstromus*)	X	X	**F/O**		**NIF**		X
Spiny waterflea (*Bythotrephes longimanus*)	X	X	**F**				X
Zebra mussel (*Dreissena polymorpha*)	X	X	X			X	X
Rusty crayfish (*Orconetes nusticus*)	X						X
Mute swan (*Cygnus olor*)			X		X		X

APM - Individuals or groups apply for aquatic plant management permits
F - DNR Fisheries monitors this species
F/O - DNR Fisheries and other agencies monitor this species
F/W - DNR Fisheries and/or Wildlife occasionally manage this species at priority sites
NIF - Inland waters will be addressed as outlined in a Nonindigenous Fish (NIF) plan
W - DNR 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 DNR Fisheries assist with the management of various invasive plants including purple loosestrife, Eurasian watermilfoil, and flowering rush. In addition to these staff, other individuals from the Division of Fish and Wildlife and the Division of Ecological Services 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 invasive species of aquatic plants and wild animals. A regional enforcement supervisor acts as invasive species enforcement coordinator within the Division of Enforcement to assist in scheduling, executing, and reporting on enforcement activities related to invasive 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 Invasive Species Program's public awareness activities (see Education and Public Awareness).

Participation in Statewide, Regional, and National Groups

The DNR Invasive 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 Invasive Species Program and others in the state participate in regional and federal activities regarding harmful invasive 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 Invasive Species Program Coordinator. Doug Jensen from Minnesota Sea Grant is the alternate member and represented the state at Great Lakes Panel meetings in 2004. Participation on this regional panel helps keep Minnesota informed of regional and federal efforts regarding harmful invasive 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. Jay represented the panel at the ANS Task Force meeting and Asian Carp Work Group meeting in May 2004.

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 - national garlic mustard biocontrol working group.

Expenditures

Funding Sources

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

State Funds

The primary funding source is 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, at the Department's request, expanded funding for the Invasive Species Program by appropriating additional funding from the Water Recreation Account. This funding was from the "regular" watercraft license receipts (Table 2). Funding was increased by $380,000 in FY04 and $440,000 in FY05.

Table 2. State and local funding (in thousands of dollars) received by the Invasive Species Program, fiscal years 2003, 2004, and 2005.

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
2005	1,201	440	54	17	1,712

[1] State appropriations, as recommended by the LCMR, from the Environment and Natural Resources Trust Fund or the Minnesota Resources Fund or both.

Over the last decade, significant support for invasive 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 FY04/05 biennium, funding has been provided for a project focused on European buckthorn species, two high-priority terrestrial invasive plants. This project is a joint effort by DNR and the Minnesota Department of Agriculture (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 invasive 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 (USEPA) to support research on the biological control of European buckthorn. Funding from the U.S. Forest Service (USFS) 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 Invasive Species Program that received federal funding.

Federal Grant				
Category	**Federal Fiscal Year[1] Grant Awarded**	**Calendar Year(s) Used**	**Grant Amount (1000's of $)**	**Source**
Implement St. Croix management plan for aquatic nuisance species				
	1998	1999	20	USFWS
	1999	2000	19	USFWS
	2000	2001	85	USFWS
	2001	2002	85	USFWS
	2002	2003	80	USFWS
	2003	2004	60	USFWS
	2004	2005	71	USFWS
Research on biological control of European buckthorn				
	2001	2002-03	75	USEPA
	2003	2004-05	50	USEPA
Research on biological control of garlic mustard				
	2003	2004-06	105	USFS
	2004	2004-06	65	USFS

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

Local Funds

Local groups work with the DNR to manage invasive aquatic species and, in some cases, provide funds to expand planned efforts (Table 2). During 2004, the Bay Lake Association, Plantagenet Lake Association, Pike Lake Association, Kandiyohi County, and the Lake Minnetonka Conservation District provided funding so that the number of watercraft inspections on specific lakes could be increased. See the Watercraft Inspections and Awareness Events chapter for a more detailed account of these cooperative efforts.

Timeframe

This report covers activities in calendar year 2004, which includes the last half of the Minnesota fiscal year 2004 (FY04), Jan. 1 - June 30, 2004, and the first half of fiscal year 2005 (FY05), July 1 - Dec. 31,2004. To provide a comprehensive review of expenditures that occurred during calendar year 2004, we report both expenditures that were incurred in FY04 and those planned in FY05.

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 invasive 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, Program Direction, 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 in the following chapters.

Administration

Administration includes *Support Costs* assessed by the Division of Ecological Services for general office supplies, office rent, telephones, postage, workers' compensation fees, computer support fees, and the state accounting system fees. *Clerical* costs and *Administrative Support* costs that fund administrative staff that work for the divisions of Fish and Wildlife and Ecological Services are shown separately. Administration also includes *Other Work*; staff time spent by invasive species program staff when they participate in activities that are not related directly to program work, e.g., training or assistance provided to other division or department projects, and a prorated portion of the salary of division staff that serve on regional management teams. Finally, all *Staff Leave Time* used for holidays, sick leave, or vacations (slightly more than 4% of the budget shown in Table 4) is included as an administrative expense.

Program Direction

This category includes a variety of activities and expenditures. *State coordination* includes general program planning, preparation of state plans and reports, and attendance at public meetings. Program staff meet with groups such as the Minnesota Lakes Association (MLA) and Lake Minnetonka Conservation District (LMCD) to discuss state activities and to coordinate efforts. Program staff also are members of state-level coordinating groups, such as the Minnesota Invasive Species Advisory Council (MISAC), which are included here. Expenditures primarily represent staff time spent on these activities. *Regional and federal coordination* includes staff time and out-of-state travel expenses to work with regional and federal partners on invasive aquatic species issues. Examples from 2004 include: the Great Lakes and Mississippi River Basin panels on Aquatic Nuisance Species (ANS), the Council of Great Lakes Governors' ANS Initiative, the Natural Areas Association's Invasive Species Workshop, and a Midwest Regional Workshop on ANS Regulations and Enforcement. Finally, *Equipment*

and Services includes fleet costs not assigned to a specific activity and the cost to purchase and repair boats, trailers, computers, and similar items.

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 invasive aquatic 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 invasive species information on the DNR's Web site.

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

Inspections/Enforcement
Expenditures in this category include the costs that conservation officers incur enforcing invasive 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 invasive 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 to improve existing control methods, better understanding of the ecology of invasive species, develop better risk assessment tools, and evaluate program success. When research is focused on a specific invasive species, such as Eurasian watermilfoil, purple loosestrife, or curly-leaf pondweed, detailed expenditure information for that species is shown.

Fiscal Year 2004 (FY04)

Expenditures on invasive species activities during FY04 (July 1, 2003 - June 30, 2004) totaled $1,797,000 (Table 4). Expenditures from the Water Recreation Account, the largest single source of funding, are listed along with spending from other accounts. For this report, spending from the "Surcharge" and "Regular" portions of the Water Recreation Account have been combined into a single column.

The Invasive Species Program manages other accounts that also support program activities. An example is revenue from the sale of public awareness material. This revenue is deposited in a "Publications Account" and is used to fund future public awareness efforts. Grants received from various state or federal funding sources, such as LCMR recommended appropriations and the USFWS are other examples. As is

shown in Table 4, most program activities focused on the management of non-native, invasive terrestrial plants are funded by grants from other organizations.

The final expenditure category reflects work by non-Program staff in the divisions of Ecological Services, Fish and Wildlife, and Enforcement who occasionally do invasive species work as part of their regular DNR jobs. In FY04, major expenditures in this category included $32,000 of invasive species work coded to the Game and Fish Fund (primarily reflecting the work of aquatic plant management specialists in DNR Fisheries); $26,000 to the Division of Enforcement (reflecting enforcement efforts that were not reimbursed by Invasive Species Program funds); and $22,000 provided by the Division of Ecological Services to help support buckthorn research. This summary may not reflect the contribution of all DNR staff that provide assistance to manage non-native invasive aquatic plant and wild animal species.

The $1,497,000 of "Water Recreation Account" expenditures by the Invasive Species Program during FY04 (Table 4) was slightly less than the $1,582,000 available. FY04 funds remaining at the end of year "roll over" and will be spent during FY05. Figure 3 provides a broad outline of how the $1.497 million was spent; a detailed breakdown of spending by category is shown in Table 4. As in past years, the Inspections/ Enforcement category ($478,000) and Management/Control category ($390,000) represent the two largest segments of the budget; these two categories accounted for 58% of "Water Recreation Account" funds expended in FY04. Also as in past years, the invasive species that received the largest focus (based on dollars spent) was Eurasian watermilfoil ($194,000 of targeted spending). Other invasive species that received substantial funding included: zebra mussels ($108,000), purple loosestrife ($77,000), and curly-leaf pondweed ($63,000). Individual chapters of this report provide details on the activities accomplished with those funds.

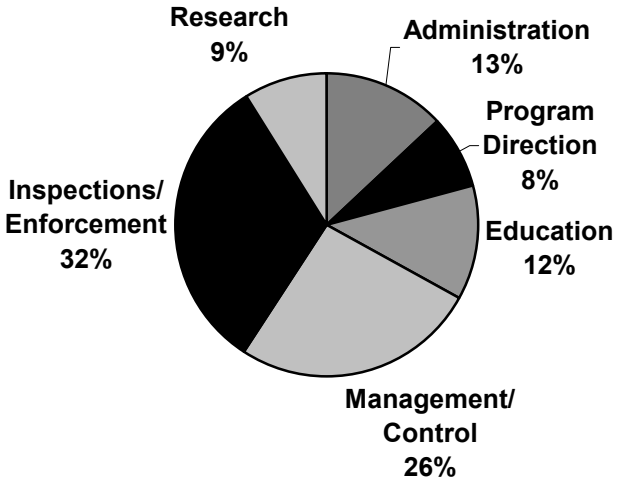

Figure 3. Invasive Species Program spending (Water Recreation Account only) in FY04 by major categories.

The Department sought the increase in watercraft license funding that occurred in FY04 to meet specific objectives. Those objectives included:

1) expanding grants offered to local groups/communities to offset the cost of managing invasive aquatic plants;
2) increasing funding available to the DNR's Division of Enforcement so that 2,000 hours of Enforcement effort is focused on invasive species activities each year;
3) allowing the Department to continue to conduct 20,000 hours of watercraft inspection efforts annually even though the number of lakes and the geographical area where inspections occur are expanding;
4) expanding the amount of technical assistance provided to lake groups that are managing invasive aquatic plants; and
5) expanding funding on research efforts targeted specifically at improving control options.

The increased funding available in FY04 allowed the Program to implement a number of those activities. Specific accomplishments included:

1) increasing public awareness efforts while continuing to provide 20,000 hours of watercraft inspections;
2) hiring an additional staff person in Brainerd to provide technical assistance to lake groups;
3) responding aggressively when zebra mussels were discovered in Lake Ossawinnemakee in Crow Wing County (spending on zebra mussel management and research efforts increased);
4) taking steps to identify and evaluate options designed to slow the movement of Asian carp into Minnesota waters (FY05 funds will help fund a dispersal barrier to limit Asian carp spread into the Great Lakes);
5) increasing research and management efforts targeted at curly-leaf pondweed.

Two of the objectives originally identified when the new funding was proposed were not achieved in FY04. Although the amount of grant funding offered to lake groups that manage Eurasian watermilfoil was increased, the amount of funding actually spent did not rise. The Eurasian watermilfoil chapter in this report provides a more in-depth discussion of this topic. Restructuring the current grant program may be necessary to meet the original objective. In addition, the Department decided that it was not appropriate at this time to reallocate additional revenue to the Division of Enforcement.

Fiscal Year 2005 (FY05)

Since this report is due in the middle of FY05, projected expenditures for this year are also reported (Table 4). Expenditures in some categories will increase because of the additional funding appropriated by the 2003 Legislature (see Table 2) and the FY04 funding that carried over. The following chapters describe in detail the activities that were conducted during 2004 with FY04 and FY05 funds.

Table 4. Invasive species related expenditures in fiscal year 2004 (FY04) and projected expenditures in fiscal year 2005 (FY05) (in thousands of dollars).

Categories of Expenditures	Water Recreation Account		Other Funding Sources	
	FY04	FY05	FY04	FY05
Administration				
Division Support Costs	33	37	--	--
Other Work: Staff Time and Regional	55	50		
Representation	67	67		
Staff Leave Time (Vacation, Holiday, Sick)	--	15		
Clerical	41	41		
Administrative Support				
Subtotal	**196**	**210**		
Program Direction				
State coordination	80	80	[1]14	[1]7
Support regional/federal activities	13	13		
Equipment and services	22	22		
Subtotal	**115**	**115**	**14**	**7**
Education				
Radio spots, TV, Web Site development	183	214	--	[1]50
Subtotal	**183**	**214**	**0**	**50**
Management/Control				
General	68	70	[1]32	[1]30
Eurasian watermilfoil	126	200		
Purple loosestrife	60	60		
Zebra mussel	98	80		
Curly-leaf pondweed	29	60		
Flowering rush	3	3		
Asian carp	6	68		
Terrestrial invasive plants	-	-	[1]89	[1]141
Subtotal	**390**	**541**	**121**	**171**
Inspections/Enforcement				
Watercraft inspections	350	360	--	--
Enforcement - access checks	56	56	[1]26	[1]30
Prevention - laws/risk assessments	72	70		[1]1
Subtotal	**478**	**486**	**26**	**31**
Research				
General	9	10	-	-
Eurasian watermilfoil	68	60	9	-
Purple loosestrife	7	7	-	-
Zebra mussel	10	10	-	-
Curly-leaf pondweed	34	40	-	-
Flowering rush	2	7	-	-
Other invasive plants	--	--	-	-
European buckthorn	3	3	[1, 2, 3]90	[1, 2, 3]90
Garlic mustard	2	1	[1, 2]40	[1, 2]60
Asian carp	--	22		
Subtotal	**135**	**160**	**139**	**150**
Total	**1497**	**1726**	**300**	**409**

[1]Other DNR funding, [2]LCMR funding, [3]Federal funding

Education and Public Awareness

Introduction

Issue

Public awareness of invasive species is one of the key strategies used to limit their introduction and spread. Since 1992, the DNR's Invasive Species Program has made substantial efforts to create and maintain a high level of public awareness and understanding about invasive species. An annual communications plan is developed by Program staff 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 invasives;
- Help these groups identify and report findings of specific invasive 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 invasives; and
- Enhance understanding of management options.

Progress in Public Awareness - 2004

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

Radio

Radio was used in 2004 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 greater Minnesota. In late summer, a special effort was made in the Duluth market and southeastern Minnesota (Rochester and Winona) where zebra mussel infestations occur.

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

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.

A newspaper advertising campaign was completed in 2004. The ad design incorporated the “Stop Aquatic Hitchhikers” national campaign logo and listed four simple steps that boaters and anglers could take to help stop the spread of aquatic invasive species. The ad ran in the outdoor or recreation sections of newspapers in targeted areas of the state including Brainerd, Duluth, Rochester, Twin Cities, and Winona during July and August. In addition, the ads ran in several specialty newspapers reaching boaters and tourists.

A new brochure, *Help Stop Aquatic Hitchhikers*, was produced this year. The publication provides simple steps that recreationists can take to help stop the spread of aquatic hitchhikers. Distribution efforts are ongoing to sport and outdoor shows, special events, information kiosks, and tourist information centers.

The 2004 *Minnesota Fishing Regulations* included a section on harmful invasive aquatic species. Descriptions and illustrations of these harmful invasives were provided along with a summary of invasive species laws, a list of infested waters, and information about how to stop the spread of invasives. 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 invasive plants and animals. The guide is updated annually and was distributed this year to more than 300,000 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 Sportshow and the Minnesota State Fair. The earthworm materials were developed and/or distributed by DNR the Native Plant Society, and other partners.

Information about harmful invasive species was included in the 2004 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 invasive 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.

The DNR also produced and distributed several video news releases (VNRs) to television stations in ten markets in greater Minnesota. The VNRs provided information on Asian carp and water gardening, for example.

DNR Web site
The DNR's Web site pages covering invasive species issues were updated (www.dnr.state.mn.us/ecological_services/invasive.html). The site includes an overview of the Invasive Species Program as well as information on individual programs and staff. A summary of Minnesota's invasive species laws, as well as lists of harmful invasive species and infested waters, and field guides to aquatic plants and aquatic invasive 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
Invasive Species Program staff participated in the Northwest Sportshow and the Minnesota State Fair to distribute literature and information. Watercraft inspectors staffed the invasive species display throughout the State Fair providing a venue for visitors to ask specific questions about invasive species while visiting the exhibit. An estimated 750,000 people visit the DNR's exhibits at the Northwest Sportshow and the Minnesota State Fair each year. Staff also participated in a number of additional events this year including the Minnesota Muskie Expo and the Minnesota Resort and Campground Association's fall conference.

Public water accesses
DNR watercraft inspectors completed 20,426 hours of inspection (see Watercraft Inspections and Awareness Events) providing boaters with information and tips on ways to reduce the spread of invasive species. 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 expanded and a greater variety of techniques have been used in getting the [invasive] species message out in Minnesota than in the other two states

surveyed. Survey results indicate Minnesota boaters are more knowledgeable about [invasive] species issues and have already changed their behavior to a greater extent (to prevent the spread of [invasives]) 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 invasives has continued to increase. In 2004, watercraft inspectors (see Watercraft Inspections and Awareness Events) continued to find high levels of public awareness of invasives by boaters 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 Invasive 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 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 invasive 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 previously 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 invasive 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 implemented in 2002 and 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 Web site address (www.protectyourwaters.net) that directs individuals to visit the site and learn about the steps they can take to stop the transport and spread of harmful aquatic hitchhikers. Beginning in 2003, the DNR began to use the 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.

In 2004, the Minnesota Invasive Species Advisory Council (MISAC), of which DNR is a member and co-chair, produced a 2005 invasive species wall calendar for distribution to natural resource, agricultural, highway, and other professionals in the state. It was a cooperative effort of the council members to raise awareness of all types of invasive species and to inform the recipients of the council's Web site—www.mda.state.mn.us/misac/.

Teachers throughout Minnesota can reserve educational "traveling trunks" that include hands-on activities for classroom instruction. The trunks contain a wide range of tools designed to teach youth about aquatic invasive species (AIS). In addition to the DNR, educators can obtain the trunks from several organizations including the University of Minnesota Sea Grant, Bell Museum of Natural History, Great Lakes Aquarium, and National Park Service. For a more detailed description of the trunks, visit: www.seagrant.umn.edu/education/ttea.html.

The University of Minnesota Sea Grant Extension Program's Aquatic Invasive Species Information Center is a leader in public education campaigns and programming. Sea Grant conducts research, outreach, and education often in collaboration with the DNR to avoid duplication of effort, leverage resources, and combine our expertise to effectively address AIS issues in Minnesota and beyond.

2004 Highlights of Minnesota Sea Grant's educational activities related to harmful aquatic invasive species in Minnesota:

- *Habitattitude*™ is a new national public education campaign launched in fall 2004 to prevent the release of unwanted aquatic plants and fish by aquarists and water garden owners. The campaign was created through a partnership of the Pet Industry Joint Advisory Council (PIJAC), the U.S. Fish and Wildlife Service (USFWS), and the National Oceanic and Atmospheric Administration's (NOAA) Great Lakes Sea Grant Network, led by Minnesota. Based on a two-year, $300,000 grant from NOAA-Sea Grant, the campaign leverages $100,000 from the USFWS, and more than $1.1 million from PIJAC and its members. The campaign features a new logo, "don't release" messages, and a Web site, www.habitattitude.net. It also promotes guidelines as alternatives to release that consumers should consider when dealing with unwanted aquatic plants and animals. *Habitattitude*™ prevention messages will appear on fish bags, new

aquaria, brochures and other print media, and ads in hobbyist and trade magazines across the country. In 2005, campaign partners will continue to staff booths at trade shows and society meetings, give presentations at meetings, as well as meet with federal and state agencies throughout the Great Lakes and beyond to broaden campaign partnerships. Dozens of agencies and organizations have expressed strong interest in becoming campaign partners (including several foreign countries).

- Sea Grant worked with seven other university entities and the DNR to successfully eradicate goldfish, koi, and other unwanted fish from a two-acre pond on the University of Minnesota-Duluth campus—likely released by aquarists or water gardeners. The pond was pumped dry so that the infestations would not spread via the outflow into a designated trout stream that flows into Lake Superior. Sea Grant produced signs and fliers and led mass media efforts to raise awareness, which reached an estimated 1.5 million people across the region.
- Sea Grant worked with DNR staff to develop a model education program designed to prevent the spread of aquatic plants from water gardens and shoreline restoration efforts. Educational messages and materials are being developed in collaboration with Michigan Sea Grant, nursery and landscape professionals, consumers, and educators, including the University of Minnesota Master Gardener Program. Consumer surveys and focus groups provided input on messages, graphics, and draft materials. Educational materials will be produced and distributed in 2005 across Minnesota, Wisconsin, and Michigan.
- Sea Grant continues to promote AIS youth education by promoting and distributing lesson plans, traveling resource kits, and curricula to teachers and educators. Presentations at *River Quest*, a Duluth-Superior youth education environmental stewardship event, reached nearly 600 sixth graders in May 2004. Sea Grant also partnered with the Newspaper in Education (NIE) programs across the Great Lakes to produce AIS educational tabloids, which were distributed to 49,000 students. In Minnesota, Sea Grant worked with the *St. Paul Pioneer Press* NIE program to sponsor an essay contest, which helped high school students incorporate AIS learning into their education. This program won the Outstanding Program Award from the Great Lakes Sea Grant Network in fall 2004.
- Center staff provided 59 presentations about harmful AIS at conferences, workshops, meetings, and festivals in Minnesota, including presentations of *Aliens A-Z: A History of Non-Native Introductions in Lake Superior* in several North Shore communities as part of the Sea Grant-sponsored Liquid Science Speaker Series. Sea Grant supported DNR efforts to update the *1995 Fisheries Management Plan for Minnesota Waters of Lake Superior* by presenting an update on invasive species and highlighting habitat issues and concerns at a Lake Superior Fisheries Conference in December. Sea Grant and DNR staff were interviewed for a public broadcast television program in the Twin Cities.
- Sea Grant and DNR collaborated to produce a new *Zebra Mussel WATCH* identification card, produced by Wisconsin Sea Grant. Minnesota Sea Grant also reprinted more than 600,000 cards for Eurasian ruffe, round goby, Eurasian watermilfoil, purple loosestrife, rusty crayfish, spiny and fishhook waterflea, and European frogbit. Each card provides identification features, helps prevent the spread, and encourages public reports of new infestations. Originally produced in

2002-03, these cards have become the most popular AIS outreach products across Minnesota and the Great Lakes region.

- Sea Grant partnered with Duluth's Park Point Community Club to release purple loosestrife-eating beetles (*Galerucella*) on infestations along Superior Bay.
- Center staff participate on state, regional, and national task forces including the Minnesota Invasive Species Advisory Council's (MISAC) Communication and Education Committee (chair), Great Lakes Panel on ANS's Information and Education Committee (alternate Minnesota representative), 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 invasive 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 invasive species management efforts.
- Expand public awareness activities that are cooperative ventures with lake communities outside the metro area.
- Increase information about harmful invasive species available through the various communication channels such as the DNR Web site, 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 invasive 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 Invasive Species Enforcement Plan that allocated hours and prioritized invasive species enforcement needs in each district was initiated.

Activities in the statewide Invasive Species Enforcement Plan were included as a specific component of the FY02, FY03, and FY04 annual work plans for all Enforcement Division activities. These annual work plans describe in detail each enforcement district's responsibilities in meeting various responsibilities, including invasive species, and ensure that appropriate work activities and levels are accomplished.

Goals

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

Progress in Enforcement Efforts - 2004

Several types of enforcement activities have occurred to limit the introduction and spread of invasive species including: educational work and presentations, checks of trailered boats at water accesses, monitoring commercial bait harvest equipment, and follow up on illegally-released invasive animals. In 2004, conservation officers spent 2,396 hours enforcing the invasive species laws and rules. Statewide, there was a total of five civil citations, 20 written warnings, and three summons issued to individuals for violations of invasive 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 2004 (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 invasive 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 invasive species 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 invasive 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 2004, officers spent time enforcing along the Mississippi and St. Croix rivers (including accesses near Hastings, Red Wing, Lake City, Kellogg, Winona, and LaCrescent).

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. Time was spent educating the public at accesses in Stillwater, Bayport, and Afton.

Enforcement during the waterfowl hunting season

Conservation officers conducted invasives 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.

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

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.

Enforcement near Lake Ossawinnamakee

The Invasive Species Program provided special training for conservation officers in the Brainerd area because of elevated concern about spread of zebra mussels and Eurasian watermilfoil from Lake Ossawinnamakee. In addition, the Invasive Species Program Coordinator and DNR conservation officers held an invasive species training session for Crow Wing County Water Patrol members in Brainerd.

Responding to escaped invasive 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 Other Invasive Animal Species in Minnesota). There were reports to conservation officers of escapes of invasive deer and other invasive wild animals. In the Twin Cities metro area, conservation officers have visited several ethnic food markets to evaluate the possible trade in invasive species. As a result of the information gathered in these visits, an educational initiative is underway with Invasive Species Program staff and other DNR personnel to provide resource materials to the communities in their respective languages.

Goals for 2005

The DNR believes that enforcement plays a critical role in reducing the spread of invasive species, however, it is only part of the larger prevention effort. In order for the regulations on invasive 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 aquatic vegetation.

Participation of Others

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

Regulations and Proposed Changes

Introduction

Issue

Minnesota's regulations related to invasive species of aquatic plants and wild animals currently in Minnesota Statutes and Minnesota Rules are generally considered to be comprehensive. The state statutes related to these invasive species are found in Minnesota Statutes, Chapter 84D. The administrative rules related to invasive 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 invasive (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 invasive 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/arule/6216.

The DNR is also required to adopt rules (per Minnesota Statutes 84D.12) that place non-native aquatic plant and wild animal species into various regulatory classifications and prescribe how invasive species permits will be issued (per Minnesota Rules 6216.0265). The DNR is authorized to adopt other rules regarding infested waters and invasive species of aquatic plants and wild animals.

Goals

The future needs identified in the 2003 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 invasive 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 invasive species, regulated invasive species, and unregulated non-native species.

Progress in Regulations - 2004

Federal

At the national level, the following are key regulatory areas: 1) related to reauthorization of the National Invasive Species Act (NISA); 2) national ballast water regulations; and 3) U.S.Fish and Wildlife Service (USFWS) potential designation of injurious wildlife. Activity on these areas is described below:

Reauthorization of NISA

Little progress was made to pass the National Aquatic Invasive Species Act of 2004. Bills to reauthorize NISA introduced in the House and the Senate never made it to the

floor for a vote. Therefore, the National Invasive Species Act of 1996 was not reauthorized in 2004.

National Ballast Water Regulations

Ballast exchange requirements are now mandatory nationwide. On June 14, 2004, the Coast Guard under the authority of the Nonindigenous Aquatic Nuisance Prevention and Control Act and the National Invasive Species Act, established penalty provisions in rule for vessels equipped with ballast water tanks which are bound for ports or places within the United States that fail to submit a ballast water management (BWM) reporting form. Penalties were also established for vessels bound for the Great Lakes or portions of the Hudson River that violate the mandatory ballast water management requirements and these regulations widen the reporting and recordkeeping requirements of vessels subject to the regulations. The final rule was published in the *Federal Register* initially on June 14 and corrected on July 7, 2004.

Designation of injurious wildlife

The USFWS is continuing to review information related to a proposal to designate black carp, silver carp, and bighead carp as an injurious wildlife species under the Lacey Act. The USFWS had not designated black carp, silver carp, and bighead carp as injurious as of December 31, 2004.

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

The DNR proposed statutory changes for consideration during the 2004 Legislative Session. The Legislature passed a bill that included 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 commercial fishing equipment in infested waters. The changes to specific parts of state statutes that became effective on June 1, 2004, are listed below:

M.S. 17.4982

The word “restricted” was replaced with “regulated” which is the appropriate term. This was apparently an error when this chapter of statutes was modified in the past.

MS 18.78 Control of purple loosestrife

Biocontrol for purple loosestrife has become a viable control option in recent years. The 2004 bill clarified that an annual list of priority sites where purple loosestrife control will occur is only for prioritization of herbicide treatments as initially intended before biocontrol was available.

M.S. 84.027

The terms for prohibited exotic species, regulated exotic species, and unregulated exotic species were changed to new terms—prohibited invasive species, regulated invasive species, and unregulated non-native species so they match a similar change in M.S. 84D.

M.S. 84D.01 Definitions

- A definition of aquatic plants was added. The Commissioner is given authority to address aquatic plants and wild animals. This addition clarifies the scope of the term and of the DNR Invasive Species Program.
- The definition of Eurasian watermilfoil was modified to include "its hybrids". There are lakes with hybrid milfoil in the state and they should be included in infested waters and eligible for DNR management.
- The definition of harmful exotic species is replaced with a definition of the term "invasive species" to more closely match the federal definition. The old definition is repealed. This change is repeated throughout M.S. Chapter 84D and related rules.
- The term "exotic species" was replaced by the term "non-native species" throughout MS 84D and related rules.

MS 84D.02 Management Program

The statute was changed to more clearly state the scope of the program is limited to non-native aquatic plants and wild animals.

MS84D.02 Management Plan

The legislation removed a past completion date for a management plan and now requires the Commissioner to "continue to maintain" a long-term management plan for invasive species of aquatic plants and wild animals.

M.S. 84D.02 Management Program - Inspection of Watercraft

- Reduces the existing 20,000-hour watercraft inspection requirement to 10,000 hours in order to provide more agency flexibility. It adds training of watercraft inspectors to DNR responsibility, and clarifies that the purpose of the inspections is to look for aquatic plants and aquatic invasive species.
- Eliminates the requirement in the annual report to review and report on management efforts in other states.

M.S. 84D.03 Infested Waters

The revised statutes now provide more consistent restrictions on netting bait, fish, and other aquatic species in infested waters. Some of these were inadequately covered in rule or statute. This change now places most of the restrictions in the statutes.

M.S. 84D.05 Prohibited Species

These statutes now allow prohibited species to be legally transported as specified in a commercial fish license for disposal or processing. This addresses the fact that commercial fisheries operating in infested waters may need a way to dispose of Asian carp, sea lamprey, or other prohibited invasive species they may capture during their fishing operations.

M.S. 84D.08 Escapes
Reduces the amount of time a person has to contact the Commissioner (or other designated individual) when a prohibited, regulated, or unlisted non-native species escapes. It was reduced from 48 hours to 24 hours. This makes the reporting requirement for invasive species the same as the farmed cervidae requirement.

M.S. 84D.13 Enforcement Criminal Penalties - Civil Citations
The penalties were increased to a level more consistent with other penalties. It also adds civil penalties for some actions that previously only had criminal penalties.

- The penalty for certain violations of 84D.05 was increased from a misdemeanor to a gross misdemeanor.
- Increased the civil penalty, from $100 to $250, for transporting a prohibited invasive species and allows the penalty to be imposed for the possession of a prohibited species.
- Sets the civil penalty for failing to drain water from watercraft and equipment when leaving certain waters at $50.
- Sets the civil penalty for transporting infested water off of riparian property without a permit at $200.

MS 84D.14 Exemptions
The reference to Chapter 18G, which clarifies Department of Agriculture and DNR responsibilities, was updated.

Required Rulemaking
Provides direction to DNR to fix the rules that will be replaced by this bill.

Revisor's Instructions
The bill included instructions to the Revisor to make the terminology changes in rules to match those in this bill.

Emergency rulemaking
In 2003 and 2004, DNR adopted emergency rules to designate waters found to have Eurasian watermilfoil, zebra mussels, and spiny waterflea as infested waters, as well as redesignated infested waters for which the previous designation in emergency rule expired. Designation of Northern snakehead fish (*Channa argus*) as a prohibited invasive species was included in the same emergency rule.

Permanent rulemaking
New rules will be proposed in 2005 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*), invasive earthworms**,** and other invasive animal and aquatic plant species will be assessed, classified, and proposed as additional prohibited and regulated invasive species in 2005. Some species such as water spinach, starlings, and English sparrows may be reclassified and redesignated into different categories.

Future needs

- The Department is proposing some minor changes to the commercial fishing and harvest related statutes in 2005.
- 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 invasive 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 invasive species, regulated invasive species, and unregulated non-native species.

Watercraft Inspections and Awareness Events

Introduction

Issue

The potential for boaters to accidentally move aquatic invasive 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 invasive 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 invasive species such as Eurasian watermilfoil, spiny waterflea, 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. Effective June 1, 2004, the 20,000-hour requirement was lowered to 10,000 hours.

Goals

Watercraft inspections help to achieve the second goal of the Invasive Species Program: preventing the spread of invasive species within Minnesota. The inspectors also help to:

- Complete up to 20,000 hours of watercraft inspection at public water accesses across the state;
- Increase public awareness about invasive species and the potential for boaters to transport invasive species between water bodies;
- Reduce the percentage of trailered boats carrying invasive species;
- Increase educational efforts with citizen groups.

Progress in Watercraft Inspections - 2004

Complete required hours of watercraft inspection

In 2004, 40 watercraft inspectors worked through the summer providing information to the public on watercraft inspections and invasive species. Inspections began in late April and continued though mid October. Within this 25-week period, watercraft inspectors logged 20,426 inspection hours. A total of 49,952 watercraft/trailers were inspected.

During the inspection season, inspections were conducted at 21 fishing tournaments and continued through October in order to reach waterfowl hunters. Inspectors distributed more than 6,800 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 (PWAs) at which they were stationed.

Inspection efforts were conducted across the state in rough proportion to the number of PWAs on infested water bodies, (Table 6 and Figure 4). The actual distribution of time reflects both the number of PWAs and the intensity of public use at those accesses. The percent of time that the program is spending in each region has stayed relatively stable from 2000 to 2004 with a slight decrease in time in Regions 1 and 4, and an increase in time in Region 2, (Figure 5). This change could be attributed to the new infestations in greater Minnesota in the past years.

Table 6. Number of watercraft inspections conducted by watercraft inspectors in 2000, 2001, 2002, 2003, and 2004. (*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	29,700	5,500	42,000
2004	1,200	6,800	35,600	6,800	50,500

The watercraft inspection program has primarily focused on water bodies with infestations of aquatic invasive 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 aquatic invasive 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 2004, inspections on uninfested waters represented about 13.31% of the total inspections (6,718 inspections) and approximately 14.7% of the inspection hours (3,001.25 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 "Invasive Species 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. Two relatively new infestations are of special concern. The lower 25 miles of the St. Croix River are infested with zebra mussels, discovered in 2000 (see Management of Zebra Mussels). Since this is a relatively new infestation, it is very important that watercraft users on the river are aware of the infestation and become educated on how to reduce the risk of

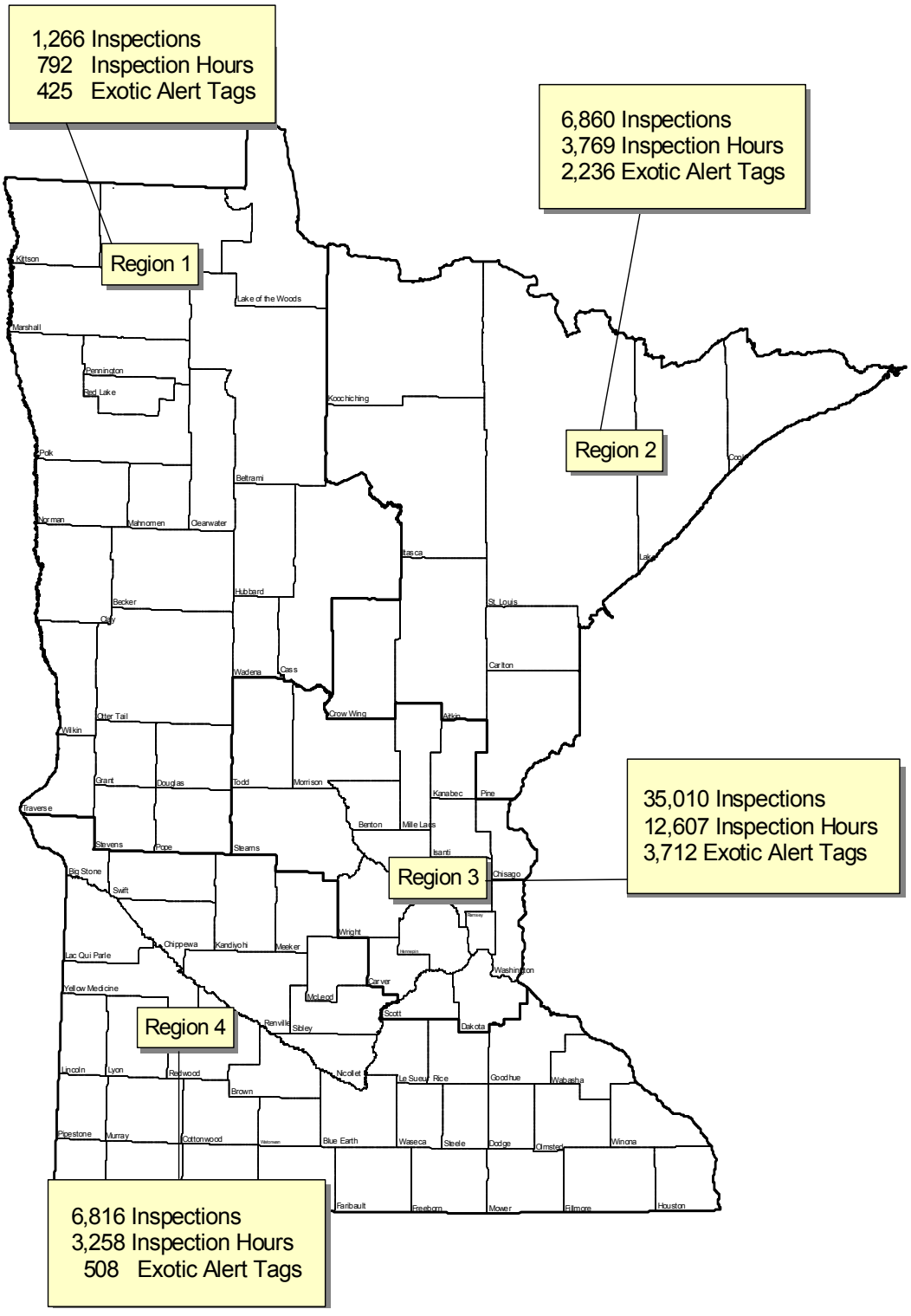

Figure 4. DNR watercraft inspections at public water accesses in 2004.

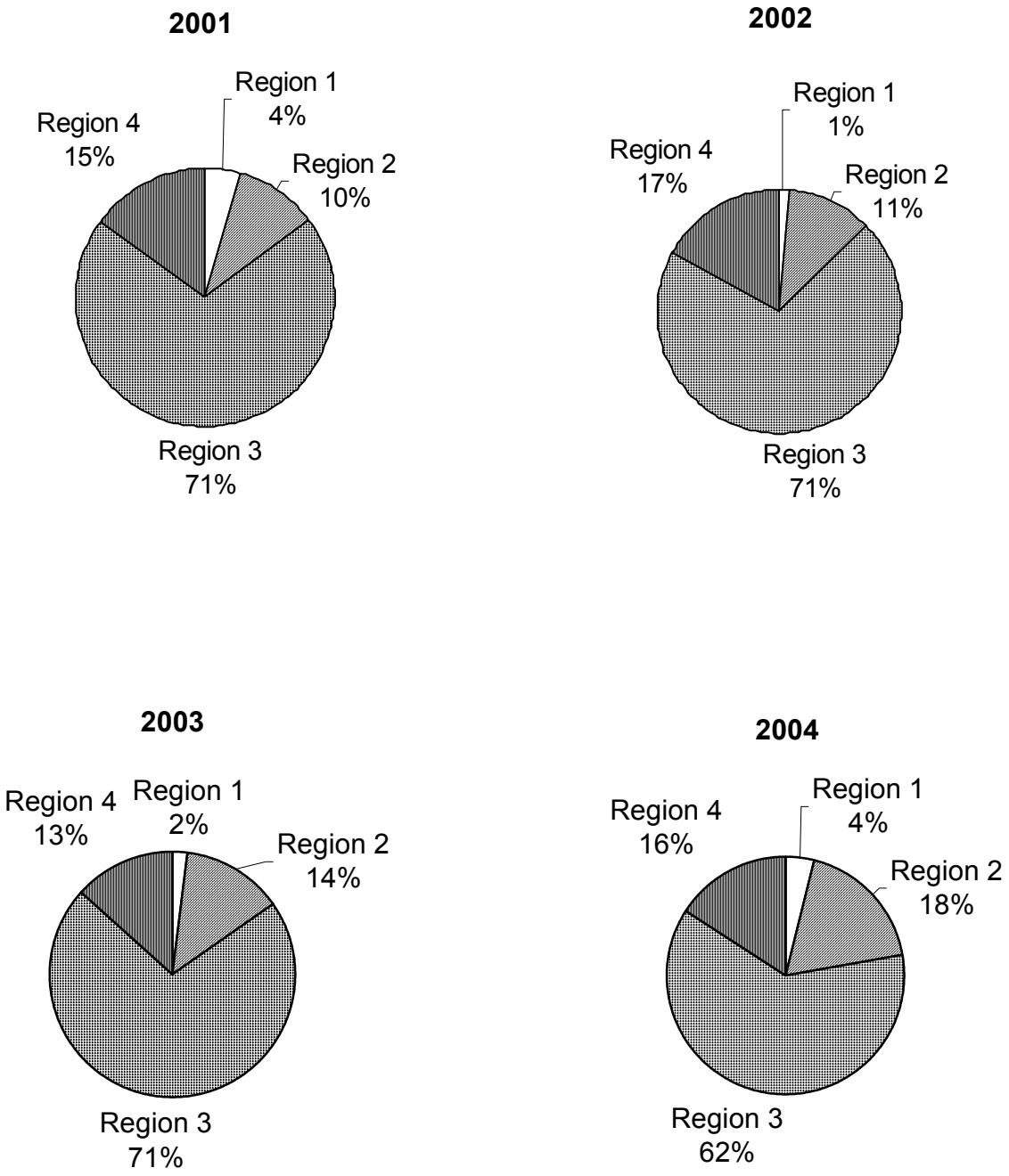

Figure 5. Percent of the state's total watercraft inspection hours spent in each region in 2001, 2002, 2003, and 2004.

transporting zebra mussels to other water bodies. In 2004, 414 inspection hours were spent on the St. Croix River and more than 1,200 watercraft were inspected.

The most recent zebra mussel infestation was discovered in October of 2003 in Lake Ossawinnamakee in the Brainerd area (see Management of Zebra Mussels). Due to Lake Ossawinnamakee's location in a popular recreation area for boaters and anglers and direct connection to the Mississippi River there is a significant potential for spread to other waters by natural or human-caused movement.

In response to this new infestation, the Watercraft Inspection Program increased inspection hours at Lake Ossawinnamakee and in the greater Brainerd Lakes area. Inspection hours on Lake Ossawinnamakee were increased by 29% and the access was visited 59 times, which was an increase of 68% from 2003. The Watercraft Inspection Program increased inspection hours in the Brainerd area by 57% (1,063 hours) and inspections by 53% (2,328 inspections) from 2003.

Increase public awareness

Surveys conducted by watercraft inspectors provide important information on the public's awareness of invasive 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 invasive species laws remains very high among Minnesota boaters. The percent of watercraft users who responded "yes" when asked if they were aware of the invasive species laws for the state was 97%, an increase of 1% from 2003. Boaters from other states using Minnesota water bodies had a slightly lower response at 91%. The range of percentages for each Minnesota county where at least 100 inspections had been done varied from 86% (in Douglas County) to 100% (in Big Stone, Hubbard, Meeker and Sherburne counties). Of those who said they were not familiar with the laws, slightly less than 3% (22 out of 859) had vegetation on their watercraft when they entered the access. In contrast, 1.3% (299 out of 22,151) 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) to signify that they have talked with a watercraft inspector. Of those with no decal, 6% said they were not familiar with the invasive species laws. In contrast, of those with a year 2004 decal, 15 out of 15,098 boaters or less than 1/10 of one percent said they were not familiar with the laws. This suggests that the Watercraft Inspection Program is successful at educating boaters about the invasive species laws.

Reduce the percentage of trailered boats carrying invasive species

The Watercraft Inspection Program has been unable to assist with roadchecks due to changes in the law that prevents the Department from conducting them (see Enforcement).

Increase educational efforts with citizen groups

In 2004, the Watercraft Inspection Program participated in many public awareness activities and worked with several citizen groups in order to educate the public about aquatic invasive species. Inspectors answered questions both at the invasive species display at the Minnesota State Fair and at the Minnesota Twins Outdoor Expo event.

The inspectors also educated citizens at the "Spring into Summer with the DNR" day at Cabela's sporting goods store in Owatonna and at Cannon Valley Trail Days in Welch. The Watercraft Inspection Program was also able to work with several citizen groups throughout the season both through awareness events and participation in lake association meetings. Inspectors worked side by side with the members of the Sportsmen's Club of Lake Vermilion during an awareness event at Lake Vermilion in late May.

The Watercraft Inspection Program also worked cooperatively with five lake associations and citizen groups to increase inspection hours in their areas. These citizen groups funded additional hours of inspection at their accesses while the Watercraft Inspection Program provided training, equipment, and supervision. The Lake Minnetonka Conservation District (LMCD) worked with the Watercraft Inspection Program for the third year. Inspectors spent an additional 946 hours on five Lake Minnetonka accesses because of the funding provided by the LMCD. This was also the third year that Kandiyohi County hired cooperatively to increase inspection on lakes within its county. For three lake associations, 2004 was their first year partnering with the Watercraft Inspection Program to increase inspections. Bay Lake Association's cooperative effort with the Watercraft Inspection Program increased inspection hours on its lake by 361 hours. Lake associations for Plantagenet and Pike lakes increased their inspection hours by 48 and 49 hours respectively.

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 6). 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 14% of the watercraft checked by watercraft inspectors were found with vegetation (3,302 watercraft) as they trailered out of the water. This rate demonstrates a clear risk that boaters will transport aquatic vegetation (and harmful invasive species) 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 1.2%. This is a good indication that the majority of boaters using infested waters are inspecting and cleaning their boats and trailers. Enforcement of invasive species laws continues in an effort to reduce the transportation of vegetation and harmful invasive species (see Enforcement).

Transportation of Other Invasive Species

There were no zebra mussels found on boats being launched into Minnesota waters. Zebra mussels were found on three 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 while angling and discard them in the bottom of their boats can also move them.

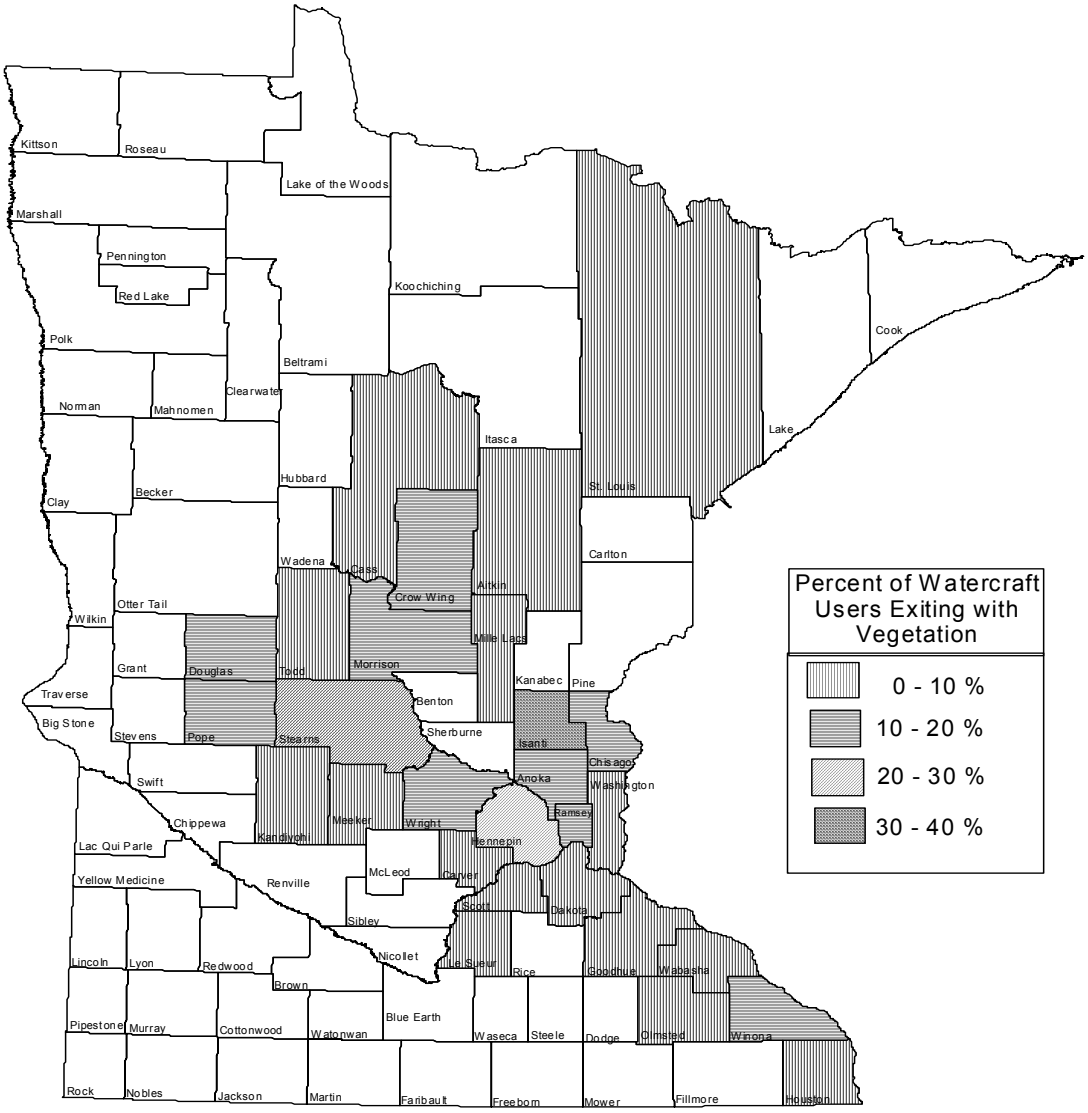

Figure 6. Percentage of exiting watercraft with attached vegetation prior to cleaning (in counties where more than 100 boats were inspected upon leaving an access).

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 invasive species (Figure 7). 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 34,471

decals distributed during the 2004 boating season also remind boaters to inspect their boats when inspectors are not present.

Figure 7. Decal provided to boaters by DNR watercraft inspectors in 2004.

Future needs and recommendations for watercraft inspections

- Increase cooperation and partnerships with citizen groups that would like to help raise awareness in their areas.
- Expand the number of community events in which we participate in order to educate new audiences about invasive species.

Risk Assessment

2004 Highlights

- A detailed risk assessment of brittle naiad (*Najas minor*) was completed.
- A risk assessment of Internet and catalog sales of aquatic plants funded in part by the DNR was published in 2004 (Maki and Galatowitsch, 2004).
- Invasive Species Program staff revised and widely distributed two publications aimed at slowing the movement of invasive species through the horticultural trade.

Introduction

Many invasive species that cause problems in other parts of the United States or in other countries do not yet occur in Minnesota but could become established here. 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 which bring these species to Minnesota, and to address high-risk species can result in introductions that are costly to manage and may become perpetual problems.

Risk assessments are a way to determine how non-native species move into the state and to identify which species pose the greatest threat to Minnesota. Risk assessments need to be updated regularly as new information becomes available. In addition, continuing to gather information about a non-native species in the state can help determine whether to undertake new steps to manage it.

Risk assessments provide the basis for planning and implementing risk management activities. Risk management activities include, but are not limited to, public education, regulation, and management. The results of a risk assessment can be used to recommend that species be classified as prohibited, regulated, unregulated, or unlisted (M.S. 84D.04-.07). For example, the results of the risk assessment of Eurasian watermilfoil led the DNR Invasive Species Program to propose the species be classified as a *prohibited invasive*, to implement a multi-prong public education effort, to support research on new management methods for milfoil, and to help manage nuisances caused by the milfoil through grants for control work using herbicides and harvesting (See Management of Eurasian watermilfoil).

Goals

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

- Identify invasive species that may be harmful to Minnesota resources;
- Identify the pathways by which invasive species come to Minnesota;
- Determine the best options to prevent the release and establishment of potentially invasive species and to implement them.

Risk Assessment of Individual Non-native Species

A risk assessment of a potentially invasive, non-native species includes an assessment of how likely it is to be introduced into the state, the likelihood of its naturalization in the

state, the possible adverse effects it may have on native species, outdoor recreation, and other uses of natural resources in Minnesota, and the potential for its control.

One of the first risk assessments of individual species of potentially invasive, non-native species in Minnesota was done by the Minnesota Interagency Task Force (1991). The Task Force ranked the relative risk posed by 126 invasive plants and animals found in Minnesota. They also identified 27 species that were not in Minnesota, as potential threats (Minnesota Interagency Task Force, 1991). The scope of their report included both terrestrial and aquatic plants and animals.

Subsequent risk assessments were done by the DNR since the establishment of the Invasive Species Program. Varying approaches to the assessment of individual species have been used depending on need. In 1992, a fact sheet format was introduced for each species that the Invasive Species Program deemed potentially harmful. This format is geared towards the general public and gives basic information about the species, such as what it is, where is occurs, what problems it causes, how it spreads, and what can be done about it.

The DNR has done risk assessments on many species in order to determine if they should be regulated under law. In 1993, the DNR recommended that 26 non-native species be designated as undesirable exotic species via emergency rule. This was the first DNR list of species to be regulated because they were determined to be ecologically harmful. In 1996, state laws intended to minimize the introduction and spread of invasive species of wild animals and aquatic plants were revised, expanded, and consolidated into a new chapter of Minnesota Statutes, 84D. These statutes include a regulatory framework for risk assessment of individual non-native invasive species and for classifying those species. Each classification limits the use of the species based upon its potential to harm Minnesota's natural and economic resources. Species are classified either as prohibited, regulated or unregulated. Species not yet classified are considered unlisted (See Regulations and Proposed Changes).

The criteria used to classify species are: (1) the likelihood of introduction of the species if it is allowed to enter or exist in the state; (2) the likelihood that the species would naturalize in the state were it introduced; (3) the magnitude of potential adverse impacts of the species on native species and on outdoor recreation, commercial fishing, and other uses of natural resources in the state; (4) the ability to eradicate or control the spread of the species once it is introduced in the state, and (5) other criteria the Commissioner of Natural Resources deems appropriate (MS 84D.04).

Recently, two additional risk assessment efforts have started. The Minnesota Invasive Species Advisory Council (MISAC) convened a series of expert panel meetings to screen a large number of organisms potentially invasive in Minnesota. Panel members were brought in from multiple agencies with various regulatory responsibilities, including the Minnesota Department of Agriculture, the DNR, private industry (Invasive Species Program, 2004).

In addition to participating on MISAC panels, DNR staff are preparing detailed risk assessments of individual species. These risk assessments are an extension of past

efforts. They contain more information than the MISAC panel risk assessments or the risk assessments done to classify species as prohibited, regulated, or unregulated.

These risk assessments can be used to guide risk management activities and are part of a process for deciding on risk management activities not only for species that are currently being evaluated, but ones that will be reviewed in the future.

Risk assessments of individual species answer the following questions:

1. Can it establish in Minnesota?
2. What are its pathways of spread?
3. What is the probability it can become established in Minnesota: high, medium, or low?
4. Could it be harmful to Minnesota's economy, environment, or society?
5. How can it be controlled?
6. How severe are the consequences of establishment: high, medium, or low?

In 2004, Invasive Species Program staff prepared a detailed risk assessment of brittle naiad (*Najas minor*). The following table shows a summary of the conclusions from the risk assessment for brittle naiad.

Can it establish in Minnesota?	Yes: currently in one lake in Minnesota
Pathways of spread	Seeds and fragments with seeds attached can spread on trailered watercraft and by water movement.
Probability of Establishment	**High**
Control methods	Annual control with herbicides or cutting.
Likely to cause problems?	Yes, but only in shallow water.
Consequence of Establishment	**Medium**

The DNR is currently considering which regulatory category to place brittle naiad in, and ways to educate the public about this species. More information about this species can be found in the "Other Invasive Aquatic Plant Species in Minnesota" chapter of this report.

Many less-detailed risk assessments have been completed on species of potentially invasive, non-native aquatic plants and animals that either have spread to or may spread to Minnesota. The following tables list the status of risk assessments of potentially invasive, non-native species. Table 7 lists invasive aquatic plants known to be present in Minnesota. Table 8 lists aquatic plants not known to be present in the state, and Table 9 lists invasive wild animals of concern to Minnesota.

Risk Assessment and Risk Management of Pathways of Invasive, Non-native Species Introduction

Pathway risk assessments are an attempt to predict how invasive, non-native species will enter Minnesota and in what numbers. Table 10 illustrates pathways the Invasive Species Program have identified and what has been accomplished to assess and manage the risks associated with those pathways. New pathways will be added as they become apparent.

Table 7. Non-native aquatic plants known to be established in Minnesota that either have been or may be subjected to risk assessments.

Legal Classification	Species	Distribution in MN	Risk Assessment	Status
Prohibited	Curly-leaf pondweed (*Potamogeton crispus*)	Widespread in MN	Completed	See curly-leaf pondweed chapter
Prohibited	Eurasian watermilfoil (*Myriophyllum spicatum*)	160 water bodies in MN	Completed	See Eurasian watermilfoil chapter
Prohibited	Flowering rush (*Butomus umbellatus*)	Limited number of known locations	Completed	See flowering rush chapter
Prohibited	Purple loosestrife (*Lythrum salicaria*)	Widespread in MN	Completed	See purple loosestrife chapter
Regulated	Yellow iris (*Iris pseudacorus*)	Numerous locations in MN	Completed	
Regulated	Non-native water lilies (*Nymphaea* spp.)	Limited number of known locations in MN	Completed	See other aquatic plants chapter
Unlisted	Brittle naiad (*Najas minor*)	One lake in MN	Completed	See other aquatic plants chapter
Unlisted	Common reed (Non-native genotypes) (*Phragmites australis*)	Widespread in MN	To be assessed by DNR in future	Research on distribution of non-native genotypes
Unlisted	Reed canary-grass (*Phalaris arundinacae*)	Widespread in MN	To be assessed by DNR in future	See other aquatic plants chapter
Unlisted	Hybrid cattail (*Typha x glauca*)	Widespread in MN	To be assessed by MISAC	
Unlisted	Narrow-leaved cattail (*Typha angustifolia*)	Widespread in MN	To be assessed by MISAC	
Unlisted	Salt cedar (*Tamarix ramosissima*)	One location in northern MN	In process by DNR	See other aquatic plants chapter
Unlisted	Watercress species (*Nasturtium* spp.)	Various locations in MN	To be assessed by MISAC	

Table 8. Selected non-native, invasive aquatic plants not known to be established in Minnesota which pose a potential risk to invade the state that either have been or may be subjected to risk assessments.

Legal Classification	Species	Closest occurrence	Risk Assessment
Prohibited	African oxygen weed (*Lagarosiphon major*)	Not found in the United States	Completed
Prohibited	Hydrilla (*Hydrilla verticillata*)	Pennsylvania, Arkansas	Completed
Prohibited	Aquarium watermoss (*Salvinia molesta*)	Found under cultivation in Minnesota; closest wild population in Virginia	Completed
Prohibited	Australian stone crop (*Crassula helmsii*)	Georgia	Completed
Prohibited	European frog-bit (*Hydrocharis morsusranae*)	Michigan	Completed
Prohibited	Water chestnut (*Trapa natans*)	New York, Pennsylvania	Completed
Prohibited	Indian swampweed (*Hygrophila polysperma*)	Texas	Completed
Prohibited	Water aloe (*Stratioites aloides*)	Florida	Completed
Prohibited	Water spinach (*Ipomoea aquatica*)	Found under cultivation in Minnesota; closest wild population in Florida	In process by DNR
Regulated	Carolina fanwort (*Cabomba caroliniana*)	Southeast Michigan	Completed
Regulated	Parrot's feather (*Myriophyllum aquaticum*)	Southern Missouri	Completed
Unlisted	Yellow floating heart (*Nymphoides peltata*)	Northern Illinois	In process by DNR
Unlisted	Brazilian elodea (*Egeria densa*)	Kansas	In process by DNR
Unlisted	Water primrose (*Ludwigia urugruayensis*)	Arkansas	To be done in the future by DNR
Unlisted	Water clover (*Marsilea* spp.)	Iowa	To be done in future by DNR

Table 9. Selected non-native, invasive wild animals that either have been or may be subjected to risk assessments.

Legal Classification	Species	Type of Species	Closest population	Risk Assessment
Prohibited	Bighead carp (*Hypophthalmichthys nobilis*)	fish	In southern Iowa. See Asian carp chapter	Completed
Prohibited	Black carp (*Mylopharyngodon piceus*)	fish	Illinois. See Asian carp chapter	Completed
Prohibited	Grass carp (*Ctenopharyngodon idella*)	fish	Southern MN. See Asian carp chapter	Completed
Prohibited	Round goby (*Neogobius melanostomus*)	fish	Lake Superior, St. Louis River estuary. See other invasive animals chapter	Completed
Prohibited	Rudd (*Scardinius erythrophthalmus*)	fish	Wisconsin, South Dakota	Completed
Prohibited	Ruffe (*Gymnocephalus cernuus*)	fish	Lake Superior, St. Louis River estuary	Completed
Prohibited	Sea lamprey (*Petromyzon marinus*)	fish	Lake Superior	Completed
Prohibited	Silver carp (*Hypophthalmichthys molitrix*)	fish	Mississippi and Des Moines rivers in Iowa. See Asian carp chapter	Completed
Prohibited	White perch (*Morone americana*)	fish	Lake Superior, St. Louis River estuary	Completed
Prohibited	Zander (*Stizostedion lucioperca*)	fish	North Dakota	Completed
Regulated	Alewife (*Alosa pseudoharengus*)	fish	Lake Superior	Completed
Regulated	Common carp, koi (*Cyprinus carpio*)	fish	Widespread in MN. See common carp chapter	Completed
Regulated	Goldfish (*Carassius auratus*)	fish	Naturalized in MN	Completed
Regulated	Rainbow smelt (*Osmerus mordax*)	fish	Northern MN	Completed
Regulated	Tilapia (*Tilapia* sp.)	fish	Texas; farmed in captivity in Minnesota	Completed
Unlisted	Tubenose goby (*Proterorhinus marmoratus*)	fish	Lake Superior, St. Louis River estuary. See other invasive animals chapter	In process by DNR

Table 9. (Continued)

Legal Classification	Species	Type of Species	Closest population	Risk Assessment
Prohibited	Northern snakehead (*Channa argus*)	fish	New England	In process by DNR
Unlisted	Snakehead (*Channa* spp.)	fish	Maryland	To be done in the future by DNR
Regulated	Chinese mystery snail (*Cipangopaludina* spp.)	invertebrate	Naturalized in MN	Completed
Regulated	Rusty crayfish (*Oronectes rusticus*)	invertebrate	Widespread in MN. See other invasive animals chapter	Completed
Regulated	Spiny waterflea (*Bythotrephes cederstroemi*)	invertebrate	Lake Superior, St. Louis River estuary. See other invasive animals chapter	Completed
Prohibited	Zebra mussel (*Dreissena* spp.)	Invertebrate	Mississippi and St. Croix rivers and two inland lakes in MN. See zebra mussel chapter	Completed
Unlisted	New Zealand mud snail (*Potamopyrgus antipodarum*)	invertebrate	Idaho	In process by DNR
Unlisted	*(Daphnia lumholtzi*)	invertebrate	Mississippi River in MN. See other invasive animals chapter	In process by DNR
Prohibited	Finnraccoon (*Nyctereutes procyonoides*)	mammal	Northern Europe	Completed
Prohibited	Eurasian swine (*Sus scrofa scrofa*)	mammal	In captivity in MN	Completed
Prohibited	European rabbit (*Oryctolagus cuniculus*)	mammal	Duluth, MN	Completed
Prohibited	Nutria, any strain (*Mycocastor coypu*)	mammal	Colorado, Ontario	Completed
Regulated	Egyptian goose (*Alopochen aegyptiaus*)	bird	Oregon	Completed
Regulated	Mute swan (*Cygnus olor*)	bird	Some wild in MN. See other invasive animals chapter	Completed
Regulated	Sichuan pheasant (*Phasianus colchicus strachi*)	bird	Michigan	Completed

Table 10. Potential pathways of invasive, non-native species introduction.

Pathway	Risk Assessment Progress	Risk Management Progress
Horticultural Nurseries	MN Sea Grant, MN DNR, in process	Laws passed to make possession and/or release of certain species illegal. MN DNR created and distributed educational documents to buyers and sellers of aquatic plants.
Biological Supply Houses	To be done in the future by DNR	Laws passed to make possession and/or release of certain species illegal.
Mail Order and Internet Catalogs	Perleberg (1998), Maki et al. (2004), completed	Laws passed that make possession and/or release of certain species illegal. MN DNR created and distributed educational documents to buyers of aquatic plants.
Pet Trade	MN DNR, in future	Laws passed that make possession and/or release of certain species illegal. MN Sea Grant and others are preparing educational materials.
Asian Markets	MN DNR, in process	Laws passed that make possession and/or release of certain species illegal.
Trading/Bartering	MN Sea Grant, in process	Laws passed that make possession and/or release of certain species illegal. MN DNR created and distributed educational documents.
Trailered Watercraft/ Recreational Activities	MN DNR, completed	Laws passed that make transporting aquatic plants on public roads, or launching watercraft with certain species attached illegal. DNR inspects boats and educates boaters – see Watercraft Inspections chapter.
Commercial equipment, i.e. aquatic plant harvesters, road construction, etc.	MN DNR, in process	Laws passed that make launching watercraft with certain species attached illegal.

Risk Assessment of 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 invasive species into Minnesota waters. The risk that invasive species 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. The Invasive Species Program has been involved in several projects to assess and manage the risks associated with water gardening and related activities. A study of the movement of invasive species by the University of Minnesota, which has been described in previous reports by the Invasive Species Program, was published in 2004 (Maki and Galatowitsch, 2004).

During 2004, Invasive Species Program staff worked with Minnesota Sea Grant on its initiative "Preventing New Introductions of Invasive Aquatic Plants through Water Gardening and Shoreline Restoration." This project examines the potential for the introduction of aquatic nuisance species through the nursery trade, both regionally and nationally, and will develop key messages, and transfer an outreach program to other states. Sea Grant staff are currently in the process of administering a questionnaire for aquatic plant sellers to assess what is moving and how much they know about the risks posed by aquatic invasive plants. They have also put together a survey for water gardeners. This questionnaire can be found at the Web site www.shorelandmanagement.org/survey/.

Risk Management of Aquatic Plant Sales

In 2004, Invasive Species Program staff revised and continued to widely distribute two publications aimed at slowing the movement of invasive 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 invasive species into Minnesota waters.

Invasive Species Program staff continued to make personal contact with nurseries throughout Minnesota, explaining the risks associated with some non-native aquatic plants, the laws which govern the sale and use of those plants, and how they can help prevent new introductions of invasive species into Minnesota. Nursery managers throughout the state have been extremely cooperative and offered to pass educational material along to their customers and staff.

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

Risk Assessment

- Continue to identify non-native species that may be likely to enter Minnesota and evaluate their potential to cause problems if they become established in the wild.
- Continue to identify pathways which could bring non-native species into the state.
- Develop a database and maintain files at the DNR of literature about invasive aquatic plant and wild animal species, and pathways of their introduction to guide risk management activities.

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 non-native species are likely to naturalize and be harmful in Minnesota, and to examine the risks associated with particular pathways of introduction of those species.

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Management of Curly-leaf Pondweed

2004 Highlights

- The DNR has provided funding to the U.S. Army Research and Development Center to determine the lowest rate of fluridone herbicide needed to control curly-leaf pondweed and stop turion production.
- DNR staff assisted with several projects to evaluate management of curly-leaf with endothall herbicide, fluridone herbicide, and winter drawdown. In addition, staff initiated a study to determine the longevity of curly-leaf turions in lake sediments.
- Lake associations in many parts of the state have been successful controlling curly-leaf pondweed with endothall herbicide in cold water.
- DNR staff worked on 15 Lake Vegetation Management Plans for lakes with curly-leaf pondweed.
- Invasive Species Program staff were presenters at three well-attended curly-leaf pondweed symposiums. These workshops were co-sponsored by the Minnesota Lakes Association, the Initiative Foundation, and MInnesota Sea Grant.

Introduction

Issue

Curly-leaf pondweed (*Potamogeton crispus*) is a perennial, rooted, submersed vascular plant that was first noted in Minnesota about 1910 (Moyle and Hotchkiss, 1945). Curly-leaf pondweed is known to occur in 702 Minnesota lakes in 69 of the 87 counties in Minnesota (Figure 8). 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.

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 an increase in phosphorus (Bolduan et al., 1994) and undesirable algal blooms. A key question underlying management of curly-leaf pondweed is: to what extent do lakes experience algal blooms due to the presence of curly-leaf pondweed, and to what extent do lakes grow large amounts of curly-leaf pondweed due to an abundance of algae and the nutrient regime that supports this condition?

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 that interfere with the use of a lake can be obtained using contact herbicides or mechanical harvesting. Over the past few years, there has been an increase in the number of lake residents and lake associations

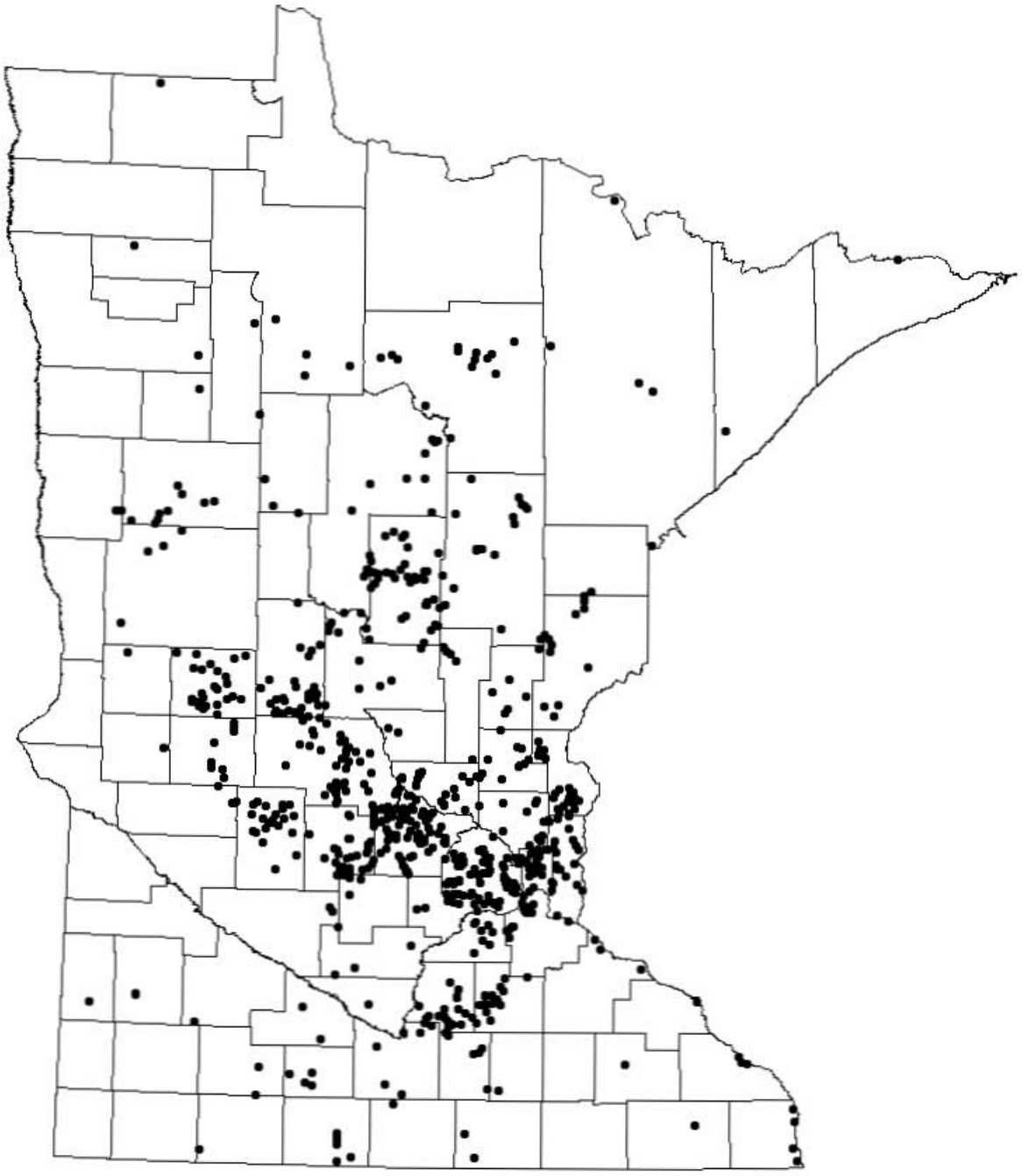

Figure 8. Curly-leaf pondweed locations in Minnesota as of December 2004 (compiled from reports from DNR Fisheries, Wildlife, and Ecological Services staff).

requesting assistance with problems caused by curly-leaf pondweed. More specifically, people want to know whether control can:

1. Reduce the lake-wide abundance of curly-leaf pondweed for long periods of time;
2. Increase the abundance of native submersed aquatic plants, and;
3. Improve water quality by reducing peaks in concentrations of phosphorous, and associated algal blooms.

In response, the DNR has increased its efforts to 1) provide technical assistance to lake residents and 2) evaluate new methods to control curly-leaf pondweed. In order to obtain 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.

The DNR uses our Watercraft Inspection Program (see Watercraft Inspections and Awareness Events), enforcement (see Enforcement), and general public awareness efforts focused on the boating public (see Education and Public Awareness) to help achieve the first goal. The DNR has two strategies to achieve the second goal. One is to provide technical assistance to people who are managing curly-leaf pondweed. The other is to support and conduct research to improve the management of curly-leaf pondweed, and to communicate research results to the public.

Progress in Management of Curly-leaf Pondweed - 2004

Management of curly-leaf pondweed

DNR staff provided technical assistance to many lake groups working to control curly-leaf pondweed. Technical assistance included inspections and surveys of lake vegetation to determine the distribution and abundance of curly-leaf pondweed and native plants in these lakes. These efforts served as the basis for evaluation by the local residents and the DNR of the extent and severity of the problems caused by curly-leaf pondweed in these lakes. Following these evaluations, DNR staff reviewed options for control with the local residents. These evaluations also provide a basis to evaluate the effects of curly-leaf pondweed management efforts.

On a limited number of lakes, DNR Fisheries staff worked with local residents to produce Lake Vegetation Management Plans (LVMPs). The purpose of an LVMP is to develop agreement on goals for the aquatic plant community, identify issues, and design methods to reach those goals. LVMPs contain a description of the condition of the lake and plans to address any identified problems. DNR Fisheries staff worked on 15 LVMPs for lakes with curly-leaf pondweed in 2004. On eight lakes there were early-season curly-leaf treatments with endothall herbicide. DNR staff conducted lake

vegetation surveys to determine the effectiveness of the treatments and the effects on native plant communities.

The DNR also provided technical assistance to people interested in controlling curly-leaf pondweed by providing guidance from CerexAgri, the manufacturer of the endothall based herbicides Aquathol K, Aquathol Super K, and Hydrothol 191. In 2004, CerexAgri provided new recommendations for the use of its products against curly-leaf pondweed. CerexAgri recommends that entire ponds or lakes or large area treatments should be done at 0.75-1.5 ppm, and that lake or pond margin or spot treatments be done at 1.5-2.0 ppm. CerexAgri states that these curly-leaf pondweed treatments may be made when water temperatures reach approximately 50ºF. These recommendations were made in part based on the research which has been done in Minnesota on early-season treatments with endothall (see Research section immediately following).

Research to improve management of curly-leaf pondweed

DNR staff have conducted research and provided technical assistance and financial support to researchers working on curly-leaf pondweed. The principal activity in this area has been whole-lake management with herbicides to control the invasive plant. These treatments have four main goals:

1. Reduce the interference with use of the lake caused by curly-leaf pondweed.
2. Reduce the abundance of curly-leaf pondweed for long periods of time.
3. Increase the abundance of native, submersed aquatic plants.
4. Reduce peaks in concentrations of phosphorous and associated algal blooms.

Operational applications of herbicides to whole lakes that are classified as public waters (Minnesota Statutes (M.S.) 103G.005) are not allowed in Minnesota (Minnesota Rules Chapter 6280: Aquatic Plant Management) because this destroys more vegetation than is necessary to give riparian owners access to lakes. Unnecessary destruction of vegetation in Minnesota waters is not permitted because plants provide many benefits to lake ecosystems (M.S. 103G.615). For these reasons, application of herbicides to control submersed vegetation in Minnesota lakes is limited to treatment of no more than 15% of the littoral zone. A variance from this limit may be issued by the DNR. Variances have been issued for studies of control of curly-leaf pondweed by whole-lake management, where there is a well-developed plan and a commitment to monitor and report the effects of the treatment on the lake.

Repeated whole-lake treatments with endothall to control curly-leaf pondweed

Invasive Species Program staff continued to assist U.S. Army Engineer Research and Development Center (USAERDC) staff in their study of repeated whole-lake treatments of endothall herbicide against curly-leaf pondweed at low temperatures. The USAERDC has been treating two small lakes in Minnesota, Schwanz and Blackhawk, every spring since 2000 with endothall, a contact herbicide, to determine whether this approach can provide long-term control of curly-leaf pondweed. USAERDC researchers also monitored two untreated reference lakes as part of this study. It is hypothesized that this approach may deplete the “bank” of turions in the lake sediments and so reduce the growth of the invasive 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. After whole-lake treatments four years in a row, curly-leaf pondweed was reduced to very low levels in these two lakes. In April 2004, curly-leaf was almost non-existent in Schwanz Lake and in one-half of Blackhawk Lake. In the other half of Blackhawk, curly-leaf was very rare. Enough curly-leaf was present in the one-half of Blackhawk Lake to warrant treatment, so that half of the lake was treated in April 2004.

There were several good-sized patches of curly-leaf pondweed in Schwanz by June 2004, though they were not at nuisance levels. In the untreated half of Blackhawk Lake, curly-leaf was still almost non-existent. It is not clear why curly-leaf came back so quickly in Schwanz and not in Blackhawk.

Based on the USAERDC research so far, the Invasive Species Program recommends that if you wish to use herbicide to control curly-leaf pondweed, you should use an endothall-based herbicide such as Aquathol K when water temperatures are 50 to 60 degrees 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. It is not possible to completely eliminate curly-leaf pondweed from a water body using these early-season treatments, but it does appear to be possible to significantly reduce the amount of curly-leaf pondweed present.

Whole-lake management with low rates of endothall combined with 2,4-D for selective control of curly-leaf pondweed and Eurasian watermilfoil

The USAERDC is working in cooperation with Mississippi State University, the DNR, and CerexAgri to test the efficacy of early spring applications of endothall in combination with 2,4-D against curly-leaf pondweed and Eurasian watermilfoil in two Minnesota lakes. Their goal is to determine if selectively removing these invasive plants can result in a more diverse and abundant native plant community and to determine how these changes in the aquatic plant community affects the abundance, size, and species richness of fish communities. Bush Lake in Hennepin County and Zumbra Lake in Carver County were selected as treatment lakes. Piersons and Auburn lakes in Carver County were selected as untreated reference lakes. Pre-treatment plant data were collected during June and August 2003 by determining percent occurrence of aquatic plants and harvesting shoot biomass. Pre-treatment measurement of fish populations was conducted during June and September 2003 using nighttime boat electro fishing, pop-nets, seine nets, and larvae traps in the littoral zone. Plant and fish monitoring continued in 2004, and will continue through a two-year post-treatment period (Skogerboe et al., 2004).

Bush and Zumbra lakes were treated with 2,4-D and endothall herbicides in early May 2004. DNR staff assisted with pre-treatment and post-treatment surveys of Bush and Zumbra lakes. Initial surveys showed good control of curly-leaf pondweed and Eurasian watermilfoil.

Repeated whole-lake management with endothall to control curly-leaf pondweed

The City of Plymouth applied for and received a variance to treat almost the entire littoral zone of Medicine Lake with endothall herbicide in cold water. The City is

planning similar treatments for the next two years. The goals of the treatments are long-term control of nuisance growth of curly-leaf pondweed, establishment of a diverse native plant community, a reduction in the internal loading of phosphorus, an improvement in water quality, and an increase in recreational opportunities (Vlach et al., 2004).

There were two reasons why the DNR approved a variance for this treatment. The first reason is that there was a large body of water quality data from the lake taken over the past several years that indicated that curly-leaf pondweed was contributing to phosphorus loading and algal blooms in the lake. The second is that the City, as a condition of the permit, agreed to do extensive monitoring of the water quality and plant community in the lake. This monitoring will allow a determination of whether or not the goals of the treatment were met.

The City of Plymouth received technical support from the USAERDC, the Three Rivers Park District, and the DNR in planning and implementing the monitoring. The USAERDC did plant frequency sampling with assistance from the DNR, and Blue Water Science did quadrant stem counts and collected biomass samples. Three Rivers Park District monitored the water quality on a bi-weekly basis.

There is evidence from data collected this summer that the treatment led to a decrease in mid-summer phosphorus loading in the lake. In 2002 and 2003, there was a phosphorus pulse in June associated with curly-leaf pondweed dieback, and an associated decline in water clarity. In early May of 2004, almost the entire littoral zone of Medicine Lake was treated with endothall herbicide. In June 2004, there was no increase in phosphorus. There was a phosphorus pulse in May associated with the treatment, but it was smaller than the pulses associated with curly-leaf die back in 2002 and 2003, and there was no associated decline in water clarity (Vlach et al., 2004).

A similar, though somewhat smaller, effort is being undertaken on Spring Lake in Scott County by the Prior Lake-Spring Lake Watershed District. Monitoring was done by Blue Water Science.

Whole-lake treatment with fluridone to control curly-leaf pondweed

Lake Benton, Lincoln County

Lake Benton is a 2,857-acre lake with a maximum depth of nine feet. In August 2003, the Lake Benton Lake Improvement Association (LBLIA) requested permission to treat the lake with a multi-year series of fluridone herbicide treatments to control curly-leaf pondweed and deplete the turion bank in the lake. Recently curly-leaf pondweed has covered the entire lake during its peak biomass season of May-June. The LBLIA proposed to start treatments in 2004.

The DNR suggested to the LBLIA that treatment of up to 1,000 acres with endothall herbicide for at least three consecutive years was a better option because endothall has been shown to effectively control curly-leaf pondweed and encourage the growth of native plants. Lake Benton area groups, including the LBLIA, countered that the suggested endothall treatments would be too expensive, and would not be effective at

reducing curly-leaf on a lakewide scale, because so much curly-leaf would remain in the lake to produce turions each year.

After additional discussion, the DNR agreed that an initial fluridone treatment could be scheduled for 2005 but that treatments in future years would be dependent on the success of the initial treatment. Specific criteria to define treatment success were identified, including specific plant community and water quality outcomes. DNR's Invasive Species Program is committed to collecting pre-treatment and post-treatment plant community data and water quality data.

The rate of fluridone used for the initial treatment will depend on the research currently being done by the USAERDC (see Evaluation of low rates of fluridone to control the growth and reproduction of curly-leaf pondweed section below).

Monitoring of the plant community and water quality was initiated in 2004 in anticipation of a 2005 treatment of Lake Benton with fluridone herbicide. DNR Invasive Species Program staff surveyed the plant community in the lake on June 1, 2, and 3, 2004, and on July 15 and 16, 2004. The Redwood-Cottonwood River Control District has been collecting water samples and turion samples from the lake with assistance from the Minnesota Pollution Control Agency. The DNR has arranged for these samples to be analyzed by the Minnesota Department of Agriculture. Lake residents have been collecting water clarity readings on the lake.

One of the goals of the treatment is to increase native plants in Lake Benton. Both the June and July surveys of Lake Benton showed an extremely depauperate community of native plants. Because of this, there has been interest in attempting to plant more native plants in the lake. DNR staff conducted assays on 22 Lake Benton sediment samples to determine whether native plant propagules already occur in the lake, so that replanting efforts could be focused on plants that will not recruit naturally. As expected, there was quite a lot of curly-leaf pondweed sprouting from the sediments. Curly-leaf sprouted from turions in 20 of the samples (91%). In many pots, many curly-leaf plants sprouted, and when they were removed, more sprouted in their place. Two native submersed species emerged from the sediments, leafy pondweed *(Potamogeton foliosus)*, and water stargrass *(Zosterella dubia)*.

<u>Weaver Lake, Hennepin County</u>
Various stakeholders suggested that it would be important to have at least one other lake to test low-dose fluridone. The DNR chose Weaver Lake because it is mesotrophic, it has several species of native submersed aquatic plants which should increase following a fluridone treatment, because there is good pre-treatment water quality and plant community data for the lake, and because there is a willingness from the lake association to fund the treatment and continue the monitoring.

Mesotrophic lakes generally have better water clarity than eutrophic lakes. Lake Benton is a highly eutrophic lake. The DNR felt it was important to test fluridone against curly-leaf in a mesotrophic lake because the outcome of fluridone treatments may vary between mesotrophic and eutrophic lakes. In our study of fluridone to control Eurasian watermilfoil (see Management of Eurasian Watermilfoil), we found that poor water clarity

can exacerbate the impacts of fluridone on native plants, and make it difficult for native plants to re-establish.

The DNR has agreed to provide $10,000 each to the Weaver Lake Association and the Lake Benton Improvement District to help fund the fluridone test treatments.

Winter drawdown to control curly-leaf pondweed

Curly-leaf pondweed turions have been shown to be susceptible to freezing and/ or desiccation (Sastroutomo, 1982). Rice Lake (Hennepin County) was drawn down over two consecutive winters to a depth of 5 to 5.5 feet. These drawdowns effectively controlled curly-leaf pondweed for the summers following the drawdowns in the areas where lake sediments were exposed (McComas and Stuckert, 2000a). Although this management strategy may have limited application, the DNR is helping other groups evaluate this management approach. During the winter of 2003-2004, two Minnesota lakes were subjected to winter drawdown in an effort to control curly-leaf pondweed.

Cleary Lake, Scott County

Cleary Lake has been dominated with curly-leaf pondweed and rough fish. In October 2003, Three Rivers Park District and the DNR attempted to drain all of the water out of Cleary Lake in an effort to control curly-leaf pondweed and rough fish. Because of problems digging the channel to drain the lake, they were not able to drain all of the water out of the lake in 2003. There was an area in the center of the lake where the sediments were not exposed; there was ice sitting on top of the sediments. Curly-leaf was not controlled in this area, though it was controlled in the other areas of the lake where the sediments were exposed to drying and freezing (Vlach et al., 2004). They are in the process of drawing the lake down again, and are planning to use a pump to remove most of the water that remains after it drains as much as it can.

Lake Orono, Sherburne County

In November 2003, the City of Elk River in cooperation with the Lake Orono Improvement Association drew Lake Orono down approximately five feet. Lake Orono is an impoundment of the Elk River, and has a dam, which can be used to manipulate lake levels. This drawdown was done to control curly-leaf pondweed, which was growing in several near shore areas of the lake. A survey in December 2003 by DNR and City of Elk River staff found that the sediments, which were exposed to air, were frozen solid. Dead curly-leaf plants were found in this area. Areas, which had a layer of snow and ice over the lake sediments, were not frozen.

DNR staff surveyed Lake Orono in May and June 2004. It appears that the winter drawdown reduced the abundance of curly-leaf pondweed in the lake in the areas where lake sediments were exposed to drying and freezing. Nevertheless, curly-leaf still occurs in the lake. The City of Elk River and the lake association are considering future use of winter drawdown to control curly-leaf pondweed. There was some concern expressed by lake residents about observed turtle mortality caused by the drawdown. In order to prevent turtle mortality in the future, the lake must be drawn down in early October, before turtles have burrowed into the lake sediments for the winter.

Studies of biomass and carbohydrate allocation in curly-leaf pondweed
Researchers at Minnesota State University-Mankato completed studies of biomass and carbohydrate allocation in curly-leaf pondweed to determine the best time of year to control the invasive, non-native plant. This research was funded by the Invasive Species Program, which provided $53,000 of program funds to the researchers over a two and a half year period. The results of this study were published early in 2004 (Woolf and Madsen, 2003).

Evaluation of low rates of fluridone to control the growth and reproduction of curly-leaf pondweed
The DNR is providing $50,000 to the USAERDC to study the effects of fluridone herbicide on curly-leaf pondweed. This study will investigate the effects of fluridone on the growth and reproduction of curly-leaf pondweed. Two small-scale studies are being conducted using low rates of fluridone herbicide in cool water temperatures. The first study will evaluate various concentrations and exposure times of fluridone against curly-leaf pondweed to determine the herbicide doses that suppress or inhibit plant growth and prevent turion formation. The second study will evaluate the ability of fluridone-treated curly-leaf pondweed to withstand varying levels of turbidity. Results from the first study should be available in January 2005. Results from the second study should be available by April 2005.

Study of turion longevity in curly-leaf pondweed
In order to obtain long-term control of curly-leaf pondweed, the production of turions must be stopped. Nevertheless, it is unclear how long the “bank” of turions in lake sediments remains viable. There is very little information available on the longevity of curly-leaf turions in lake sediments. A study by Skogerboe and Poovey (unpublished data 2004) found that lakes, which had been treated with endothall to stop turion production, still had good recruitment from turions in the sediments after three consecutive years of treatment. McComas and Stuckert (2000b) found that after three consecutive years of early cutting aimed at stopping turion production in the cut areas, there was still curly-leaf growing in the cut areas.

During 2004, Invasive Species Program staff and Dr. Ray Newman from the University of Minnesota designed a study to determine the longevity of turions in lake sediments. The basic design is to place turions in “dark” mesh bags at different locations in several different lakes. The bags would be dark to enforce turion dormancy in the lake. At least 10 bags would be placed at each location. Each spring one bag of turions would be retrieved from each location and would be sprouted in the lab. Theoretically, turions will lose viability as they age. Eventually turions pulled from the lake should not sprout. By determining how many years it takes turions to lose viability in lake sediments, it will be possible to estimate how long a “bank” of turions might persist in a lake.

In 2004, DNR staff and Dr. Newman set up a test of these methods. Staff of the Invasive Species Program collected turions from standing plants in Cedar Lake in Rice County. They placed 15 turions each in approximately 40 mesh bags. Dr. Newman placed the bags in Smith’s Bay of Lake Minnetonka. Half of the bags were placed in 2.1 meters depth. The other half of the bags were placed in 4.4 meters depth. Dr. Newman will pull one bag from each depth next spring to attempt to sprout the turions. If this

method works, this effort will be expanded to include turions from more than one lake, and putting turions in several lakes.

Provide technical assistance

Staff of the Invasive Species Program have continued to provide the public with information on the best management practices for curly-leaf pondweed control through individual contacts and participation in public meetings. In 2004, staff presented talks at three curly-leaf pondweed symposiums organized by the Minnesota Lakes Association, Minnesota Sea Grant, and the Initiative Foundation. Staff also attended many lake association meetings, including meetings with the Lake Benton Lake Improvement Association in Lincoln County, the Weaver Lake Association in Hennepin County, and the Lake Orono Improvement Association in Sherburne County.

In 2003, Invasive Species staff wrote an article for the *Minnesota Lakes Association Reporter* about curly-leaf pondweed and its control (Crowell, 2003). Copies of this article continue to be been given out to many people requesting information on the control of curly-leaf pondweed.

Prevention of spread

Invasive Species Program staff have worked with the general public, lakeshore residents, and researchers to support our goals for curly-leaf pondweed. The Invasive 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).

Future needs for management of curly-leaf pondweed

- 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 invasive in Minnesota. Provide funding for identified research needs.
- Continue to 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 TV and radio advertising, 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

2004 Highlights

- Eurasian watermilfoil was discovered in eight additional Minnesota water bodies during 2004 including Leech Lake in Cass County. There are now 160 Minnesota lakes, rivers, and streams known to contain the invasive submersed aquatic plant.
- In 2004, the Invasive Species Program increased both the total amount of funding and the amount available to individual lakes for control of Eurasian watermilfoil by cooperators such as lake associations or local units of government. Though there was an increase in the total funds paid out by the DNR to cooperators, there was a decrease in the number of lakes where cooperators were reimbursed by the DNR.
- Results of research completed in 2004 suggest that use of fluridone herbicide, even at low rates, to control Eurasian watermilfoil in lakes with low water clarity, five to seven foot Secchi depth or less, is likely to do more harm than good due to deceases in native plants.

Issue

Eurasian watermilfoil (*Myriophyllum spicatum*) is an invasive 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) Invasive Species Program to manage milfoil, as well as certain other harmful invasive species. Milfoil is classified as a *prohibited invasive species*, which means that it may not be bought, sold, or possessed in Minnesota. In this report, we describe the efforts of the Invasive Species Program to manage milfoil and limit its spread in Minnesota during 2004.

Goals

The Invasive Species Program has two primary goals for management of milfoil in Minnesota. They are listed below along with the principal strategies that are pursued 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)
- 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 2004

Milfoil was discovered in seven new lakes and one new river during 2004 (Tables 11 and 12, plus Figure 9). Three of these lakes are located in the seven-county metropolitan area. In addition, milfoil was found during 2004 in two counties where the invasive had not previously been discovered, Leech Lake in Cass County and Lura Lake in Blue Earth County.

The discovery of milfoil in Leech Lake may signal future problems in a part of Minnesota that has not had to deal with this invasive plant in the past. Only a few other Minnesota lakes are larger than Leech, which covers approximately 112,000 surface acres. Immediately following the confirmation of the identity of the milfoil found in Leech Lake, the DNR sent crews to search for the plant along the entire shoreline. Milfoil was only found in five harbors along the southern shore. The DNR had a contractor apply herbicide to milfoil in all five harbors to reduce the amount of milfoil and thus reduce the likelihood that boaters might accidentally carry the plant from the lake on trailered watercraft.

Leech Lake has nine public water accesses and numerous private harbors and resorts. Consequently, boaters using these accesses may inadvertently transfer milfoil to other lakes in the area if they are not especially careful to clean all vegetation from their boats, trailers, and other equipment before leaving the access.

Though much of Leech Lake does not support growth of submersed aquatic plants, some bays like those in the northern and eastern parts of the lake support stands of cabbage and other native plants. In the future, milfoil may take hold in some parts of the lake where native aquatic plants now grow.

Similarly, the discovery of milfoil in Lura Lake in Blue Earth County means that the invasive plant is now in another part of Minnesota that has not had to deal with this invasive plant in the past. Nevertheless, the clarity of waters in lakes and so potential problems caused by milfoil in this part of Minnesota are, on average, lower than that of lakes in the northern part of the state near Leech Lake.

Milfoil is now known to occur in 160 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 invasive, has changed little over the last three to four years (Table 11). This observation is based on the running three-year average for number of lakes in which milfoil was discovered, which appears to have declined slightly after experiencing an increase that began in 1998 and reaching a peak in 2000.

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 non-native, invasive plant 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 Leech Lake, a well-developed recreational lake in Cass County, a staff person from the Minnesota Pollution Control Agency while off-duty discovered milfoil on a beach near a public water access.

Subsequent inspection of the lake by the DNR found milfoil, which in one case was matted on the water's surface, in a number of additional areas of the lake. This suggests that milfoil 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.

In other lakes, milfoil appears to have been discovered before the invasive became abundant or widespread when an unusually knowledgeable person noticed the plant (Table 12). For example, a new occurrence of milfoil on Big Marine Lake in Washington County was reported by an individual who is familiar with the invasive plant because he was a summer intern for the DNR's Invasive Species Program. Further, the plant was discovered by the intern while scuba diving and could not be re-located by other DNR staff who subsequently searched the area by boat. This experience suggests that it would be highly unlikely that other users of the lake would discover this milfoil unless they happened to unintentionally catch a plant on a fishing line or anchor.

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 Invasive Species Program. During 2004, 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. 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 (Table 11). This assistance is very important because people in the Invasive 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 invasive 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 invasive is present, then it is important to minimize the risk of spread to uninfested waters by notifying 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 11. Number of lakes or rivers where Eurasian watermilfoil is known to occur in Minnesota as of December 2004.

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	11
1992	10	10	2	63	13
1993	5	5	0	68	13
1994	2	5	0	70	14
1995	7	5	1	78	14
1996	5	5	0	83	15
1997	5	6	0	88	15
1998	9	7	1	98	17
1999	8	10	0	106	20
2000	14	11	1	121	22
2001	12	11	0	133	23
2002	8	10	0	141	25
2003	11	9	0	152	26
2004	7	-	1	160	28

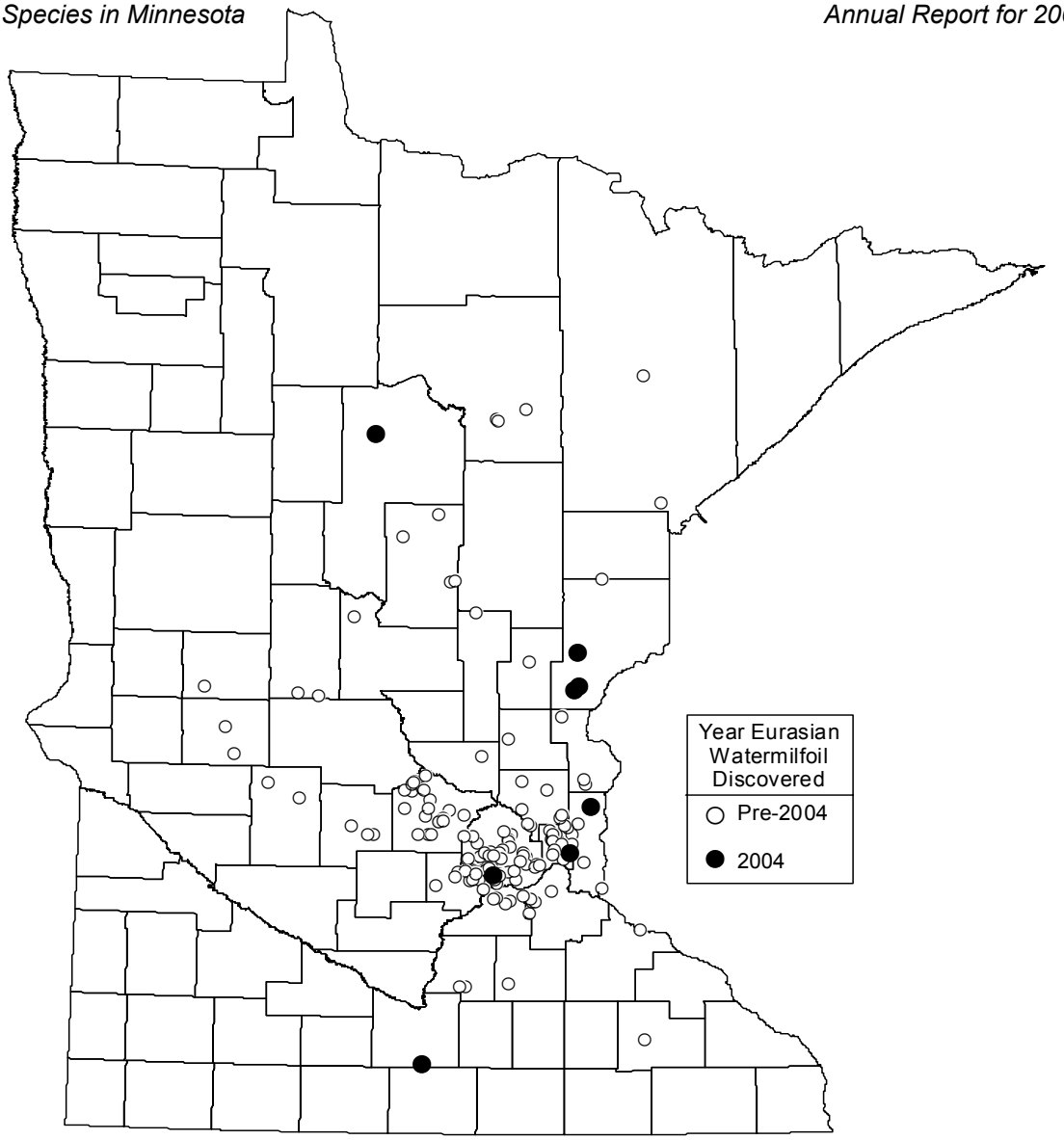

Figure 9. Distribution of water bodies with Eurasian watermilfoil in Minnesota as of November 2004.

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 Invasive Species Program discuss identification of the non-native Eurasian watermilfoil with the observer and so increase the number of people who in the future are likely to be able to distinguish the invasive from native plant species that are similar in appearance.

Table 12. Minnesota lakes and rivers where Eurasian watermilfoil was discovered in 2004.

Number	Date Reported	Lake and County Names	DOW Number	Reporter
1	9 July	Beaver, Ramsey	62.0016	DNR Fisheries
2	14 July	Leech, Cass	11.0203	Pollution Control Agency
3	19 July	Big Marine, Washington	82.0052	DNR Invasive Species Program
4	29 July	Susan, Carver	10.0013	Citizen
5	1 September	Unnamed gravel pit, Pine	58.____	Citizen
6	9 September	Lura, Blue Earth	7.0079	DNR Fisheries
7	14 September	Cross, Pine	58.0119	DNR Invasive Species Program on different assignment
8	14 September	Snake River, Pine	58.____	DNR Invasive Species Program on different assignment

Management of Eurasian Watermilfoil in Minnesota during 2004

Classification of water bodies for management of Eurasian watermilfoil

In the spring of 2004, the Invasive Species Program classified the 152 bodies of water known to have milfoil on the basis of information available in 2003 (Table 13). One hundred thirteen 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. Most lakes are assigned to the maintenance management class. During 2004, two lakes were assigned to the high-intensity management class (Table 13).

Some 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, flowing waters such as rivers and streams are not usually considered for management of milfoil with state funds because: 1) users of these waters in Minnesota rarely encounter problems caused by milfoil like those found in lakes, and 2) use of herbicides is less reliable in rivers and streams than in lakes.

Five of the eight water bodies that were discovered to have milfoil during 2004 were eligible for management with state funds because they have public water accesses (Table 13). All five were classified for maintenance management. None was placed in the high-intensity management class because all of the newly discovered lakes had more than a limited amount of milfoil or were located in the Twin Cities metro area. Two lakes found to have milfoil in 2004 have no public water access and, consequently, are ineligible for management with state funds.

Maintenance management of Eurasian watermilfoil

During 2004, state funding and technical assistance were available from the Invasive Species Program to potential cooperators for management of milfoil on lakes in the maintenance management class (Table 13). The offer of state funding is described in an announcement that is available to potential local cooperators (DNR 2004) who are expected to take the lead in assessment and control of the milfoil. The offer is briefly summarized here. 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. 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. These funds may also be used for control intended to slow the spread of the invasive to other lakes.

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 and again in 2004 (Table 14).

Table 13. Classification of water bodies in Minnesota with Eurasian watermilfoil during 2004.

Classification	Spring	New in Summer	Fall
Eligible for management with state funds			
Maintenance management	106	5	116
Fluridone evaluation (treated & reference)	5	0	0
High-intensity management	2	0	2
(Subtotal)	(113)	(5)	(118)
Ineligible for management with state funds	26	1	28
Public water but no public access	1	0	0
Fluridone evaluation (treated)	5	1	6
Not public water	(32)	(2)	(34)
(Subtotal)			
Other			
Rivers or streams	7	1	8
Total	152	8	160

Table 14. Basis for offer of state funding to potential local cooperators for management of Eurasian watermilfoil on Minnesota lakes that are public waters and have public water accesses.

Year	Littoral Acres		
	0-50	51-100	> 100
2002	≤ $700	≤ $700	$700 plus $4 for each littoral acre above 100
2003	≤ $700	≤ $1,200	$1,200 plus $5 for each littoral acre above 100
2004	≤ $700	≤ $1,200	$1,200 plus $7 for each littoral acre above 100

The DNR received applications for state funding to control milfoil from potential cooperators on 26 lakes (Table 15). Applications were reviewed by the Invasive Species Program in relation to the standards described in the announcement that is available to potential cooperators (DNR 2004). More than half of the applications were approved as submitted. Questions about the other applications led to inspections of the milfoil in these lakes by staff of the Invasive 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 two lakes, proposals were modified by reducing the size of the area to be treated, and subsequently approved. Applications for reimbursement were denied on six lakes. Lastly, in two cases, applications for reimbursement were not pursued because the local cooperator did not actually undertake control.

Table 15. Number of Minnesota lakes in the maintenance management class where management of Eurasian watermilfoil was supported with state funds in 2002-2004.

Status	Number of Lakes		
	2002	2003	2004
Applications received	32	32	26
Applications approved	15	19	16
Applications approved after modification	6	4	2
Applications denied	3	6	6
Applications not pursued	8	3	2
Total approved	21	23	18

As a result, the DNR expects to reimburse 14 cooperators on 18 lakes for costs of milfoil management during 2004. In addition, the Invasive Species Program initiated treatment of milfoil in the immediate vicinity of public water accesses operated by the DNR on five lakes in the maintenance management class. 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.

During the spring of 2004, the DNR offered funding to local cooperators for assessments of problems caused by milfoil (Table 16). Guidelines for preparation of these assessments were provided by the DNR. These efforts were intended to provide assessments of the potential interference by milfoil with the use of individual lakes (see DNR, 2004). The assessment described here is not a management plan because it is not intended to include descriptions or recommendations of approaches to control milfoil. Nevertheless, an assessment could well become the basis for development of a plan. The DNR will review the assessments completed in 2004 and discuss them with cooperators to determine how to proceed in 2005.

Table 16. Number of Minnesota lakes in the maintenance management class where development of plans for management or assessments of Eurasian watermilfoil was supported with state funds in 2002 and 2004.

	Number of lakes	
Plan or assessments by cooperator	**2002 (Plans)**	**2004 (Assessments)**
Applications received	11	9[1]
Applications approved and projects to be completed during the current calendar year	9	4
Applications approved and projects to be completed during the next calendar year		2
Applications denied	2	1
Applications not pursued		2

[1] Includes three applications received in 2003.

High-intensity management of Eurasian watermilfoil

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 invasive 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 Invasive 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. During 2004, the Invasive Species Program conducted high-intensity management of milfoil (see description above) on the two

lakes in this class (Table 13): McKinney and Ice. High-intensity management began with surveys of the lakes by staff of the Invasive Species Program and was followed by consideration of possible control. In 2004, the DNR decided not to proceed with application of herbicides by commercial applicators under contract to the DNR on either of the two lakes in the high-intensity management class.

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 invasive 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 Sonar™ herbicide (see Exotic Species Program, 2000). Inspection of the lakes by the DNR in 2004 found a much larger area with milfoil in Lake McKinney, which was not treated by the DNR. No milfoil was seen in Ice Lake during 2004, as was the case in the four preceding years. Based on past experience in Minnesota with fluridone treatments on other lakes, we expect that milfoil will reappear in Ice Lake in the future.

Technical assistance to cooperators and other citizens

Technical assistance was provided by the Invasive Species Program to cooperators and other citizens and managers. Staff of the Invasive 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 Invasive Species Program have many conversations with people over the telephone. In addition, staff of the Invasive Species Program exchange correspondence by regular mail and e-mail with people who need assistance in dealing with milfoil.

Effectiveness of management of Eurasian watermilfoil in Minnesota lakes

Though the number of Minnesota lakes known to have milfoil increased in 2004, the number of applications received for DNR funding for maintenance management control projects was less than the number in 2003 (Table 15). The number of lakes where cooperators received DNR funding for control of milfoil during 2004 decreased by comparison with the previous year (Table 17). Nevertheless, the cost of control by cooperators that was reimbursed by the DNR in 2004 increased by 40% by comparison with 2003. This is attributed to the increase in funds offered to individual lakes by the DNR.

In 2004, potential cooperators used only 73% of the funds that were budgeted by the DNR for reimbursement for control of milfoil (Table 17). 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.

Table 17. Number of lakes, budgets, and expenditures in different classes of management of Eurasian watermilfoil in Minnesota during 2001-2004.

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
2004	105	$145,000	18	$106,000
Assessment by Cooperators and Reimbursed by DNR				
2004		$30,000	4	$11,000
Control by DNR at DNR Public Water Access				
2001	--	--	1	$600
2002	--	--	7	$11,000
2003	--	$15,000	8[1]	$11,000
2004		$15,000	5[2]	$12,000
High-Intensity Management				
2001	16	--	8	$34,000
2002	5	$15,000	2	$9,000
2003	5	$15,000	3	$9,000
2004		$10,000	0	0
Totals				
2001	90	$149,000		$105,000
2002	100	$95,000		$77,000
2003	107	$153,000	31	$96,000
2004	114	$200,000	26	$140,000

[1] Three of these lakes also received funding for maintenance management.
[2] One of these lakes also received funding for maintenance management.

In 2004, the growth of milfoil and also the problems caused by the plant in many lakes seemed to be somewhat less than levels observed in some previous years. In the Minneapolis area, reduced water clarity might have resulted from high levels of precipitation in May followed by levels that appear to be somewhat below average in June (Figure 10). 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.

It is interesting to note that levels of precipitation in the Minneapolis area during April, May, and June averaged over the four years from 2001 to 2004 are greater than the long-term averages for these months (Figure 10). For comparison, precipitation levels in 1988, a year when we experienced drought in spring, were very low and the growth of milfoil was high.

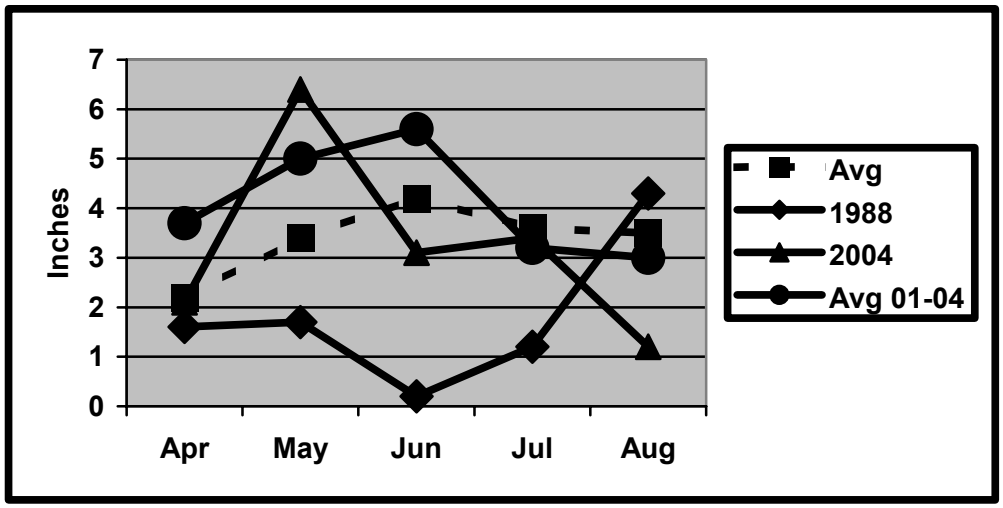

Figure 10. Monthly precipitation in Minneapolis, Minnesota, averaged for the last 112 years; in 1988, which was a drought year; in 2004; and averaged for 2001-2004.

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

Cooperation between the Invasive 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 Invasive Species Program has also received valuable assistance from staff from DNR 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 Invasive Species Program has supported or conducted a number of research projects to improve management of milfoil. In this section, we briefly summarize activities or results of recent efforts by researchers.

Potential for biological control of Eurasian watermilfoil

In 2004, researchers at the University of Minnesota concluded efforts to evaluate the potential for biological control of milfoil that have been supported with funding appropriated by the Minnesota Legislature as recommended by the Legislative Commission on Minnesota Resources (LCMR) since 1992. The research was focused on a weevil (*Euhrychiopsis lecontei*) and found that its activities can cause declines in milfoil, but that these declines do not occur in all lakes with the weevil, and that declines may be temporary (Newman, 2004a).

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 Invasive Species Program funds (see Overview of DNR's Invasive Species Program, Funding Sources).

During 2004, Ray Newman, the principal investigator at the University of Minnesota, published one paper (Newman, 2004b), had one manuscript in review (Ward and Newman), and had two manuscripts in preparation (Newman, Huser, and Brezonik; Newman).

Assessment and modeling of growth and abundance of Eurasian watermilfoil

In February 2004, the Invasive Species Program committed $35,000 to support research by the University of Minnesota on milfoil. Analysis of data collected from previous studies on the biological control of milfoil with herbivorous insects led to development of a model to predict that 38% of Minnesota lakes that are not known to have milfoil are susceptible to invasion (Newman, Herb, and Roley, 2004). The researchers parameterized and calibrated simulation models of milfoil growth and abundance. Subsequent simulations reasonably predicted variation among years in biomass of submersed plants as a function of water temperature, Secchi depth, and solar radiation. Needs for additional work to improve the utility of models were described.

Effects of treatments with alum on Eurasian watermilfoil

Four lakes in Minneapolis dominated by milfoil were treated with alum in attempts to increase water clarity. Overall, these treatments produced little or no increase in the abundance of milfoil, and neither enhanced native plants nor increased species richness (Newman et al., 2004).

Hybrids between the non-native Eurasian and native northern watermilfoil

Late in the summer of 2003, the Invasive Species Program committed an additional $5,000 to support research by the University of Connecticut to determine whether there are differences in growth between Eurasian watermilfoil and the hybrid. This research

determined that rates of growth of the hybrid and Eurasian watermilfoils were similar (Moody and Selsky, 2004).

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 milfoil 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 lakes selected for this evaluation were eutrophic lakes, which had average Secchi depths of approximately five to seven feet.

The effect of fluridone on the plant community was evaluated by examination of the distribution and standing-crop biomass of individual species in the lakes. The distribution of individual species was 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 began in 2001 and continued through 2004.

Results of sampling done from 2001 through 2003 became available during spring, 2004 (Crowell et al., 2004). Crowell et al. (2004) reported that treatment with fluridone reduced the frequency of milfoil to zero. Treatment also reduced the biomass of native submersed plants by an average of 94%. Following treatment with fluridone, the frequency of curly-leaf pondweed increased. Treatment with fluridone did not reduce the distribution or abundance of waterlilies. Following treatment with fluridone and resulting lake-wide reductions in the distribution and abundance of submersed plants, Secchi depth in one of the lakes decreased by half during the year after treatment by comparison with the preceding year.

Preliminary results of sampling done in 2004 indicated that milfoil had not yet been found in any of the three treated lakes. In one of these lakes, Crooked Lake, there was a rebound in the above ground biomass of native submersed aquatic plants during 2004, two years after treatment. This trend was not observed in the other two treated lakes. In addition, the average number of native submersed taxa per sampling site in Crooked Lake rebounded during 2004.

The results of whole-lake treatments of three eutrophic Minnesota lakes made in 2002 suggest that use of fluridone herbicide, even at low rates, to control milfoil in lakes of this type is likely to do more harm than good due to deceases in native plants. Additional information from similar treatments made in mesotrophic lakes, where

average Secchi depth would be about 14 feet, suggests that control of milfoil in lakes of this type may be followed by increases in native plants. More research on the effects of fluridone in mesotrophic lakes would appear to be useful.

At this time, the DNR does not intend to allow additional whole-lake treatments with this herbicide to control milfoil before 2006. This means that we would not review any proposal for such a treatment before 2005, when pre-treatment surveys of the vegetation would need to be done.

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. If such a situation were to arise, the DNR would consider use of fluridone.

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

In 2004, the U.S. Army Corps of Engineers continued a study in Minnesota to determine whether early spring treatment with low rates of endothall and 2,4-D herbicides will control both milfoil and curly-leaf pondweed. 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 is being conducted in cooperation with Mississippi State University and the DNR. Financial and technical support are being provided by CerexAgri, an herbicide manufacturer. Herbicides were applied in spring and monitoring was done during the open water season of 2004. Preliminary results are expected to be reported to the DNR this winter.

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.
- 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.
- Continue to improve our understanding of the ecology and management of milfoil.

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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 11). Flowering rush may also grow as a non-flowering submersed plant with limp, ribbon-like leaves.

The plant spreads primarily vegetatively from thick rhizomes (Figure 12) 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.

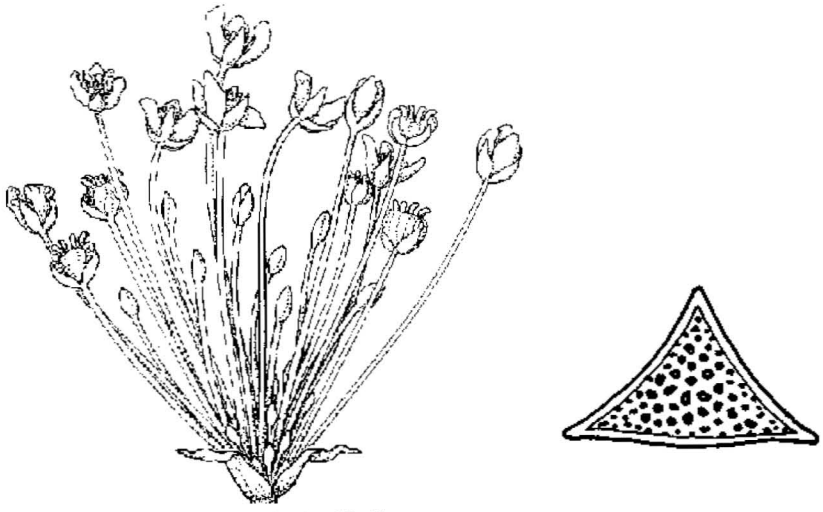

Figure 11. Flowering rush umbel and cross-section of a leaf.

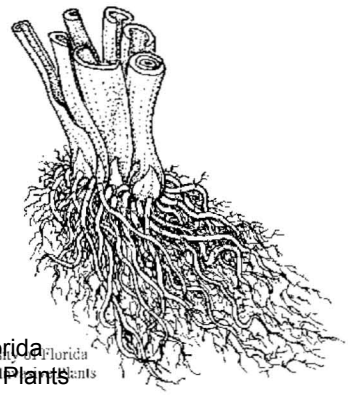

Figure 12. Flowering rush rhizomes

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 characteristics of flowering rush, it is classified as a *prohibited* invasive species in Minnesota. A prohibited invasive 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 widely scattered and uncommon (Figure 13). 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 2004.

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 invasive 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 charges.
- Support research to develop and implement better management methods.
- Provide information to those interested in how to best manage flowering rush.

Progress in Management of Flowering Rush - 2004

Prohibit the sale of flowering rush

Flowering rush is a prohibited invasive plant in Minnesota, which means that it is unlawful to possess, purchase, or sell this invasive in Minnesota. Nevertheless, horticultural sales are the most likely means of introducing this plant into a new area. Flowering rush is advertised for sale in catalogs and Internet companies as a hardy, desirable ornamental water garden plant. An effort to inform aquatic plant sellers and buyers about the potential negative impacts of releasing non-native plants into the wild will continue, utilizing various public education materials and personal contacts.

Monitor current distribution and assess changes

Invasive Species Program staff surveyed flowering rush distribution during peak biomass on Detroit Lake (Becker County) and performed a late season survey on Forest Lake (Washington County). The goals of these surveys were to document spread of flowering rush and to monitor the effects of management.

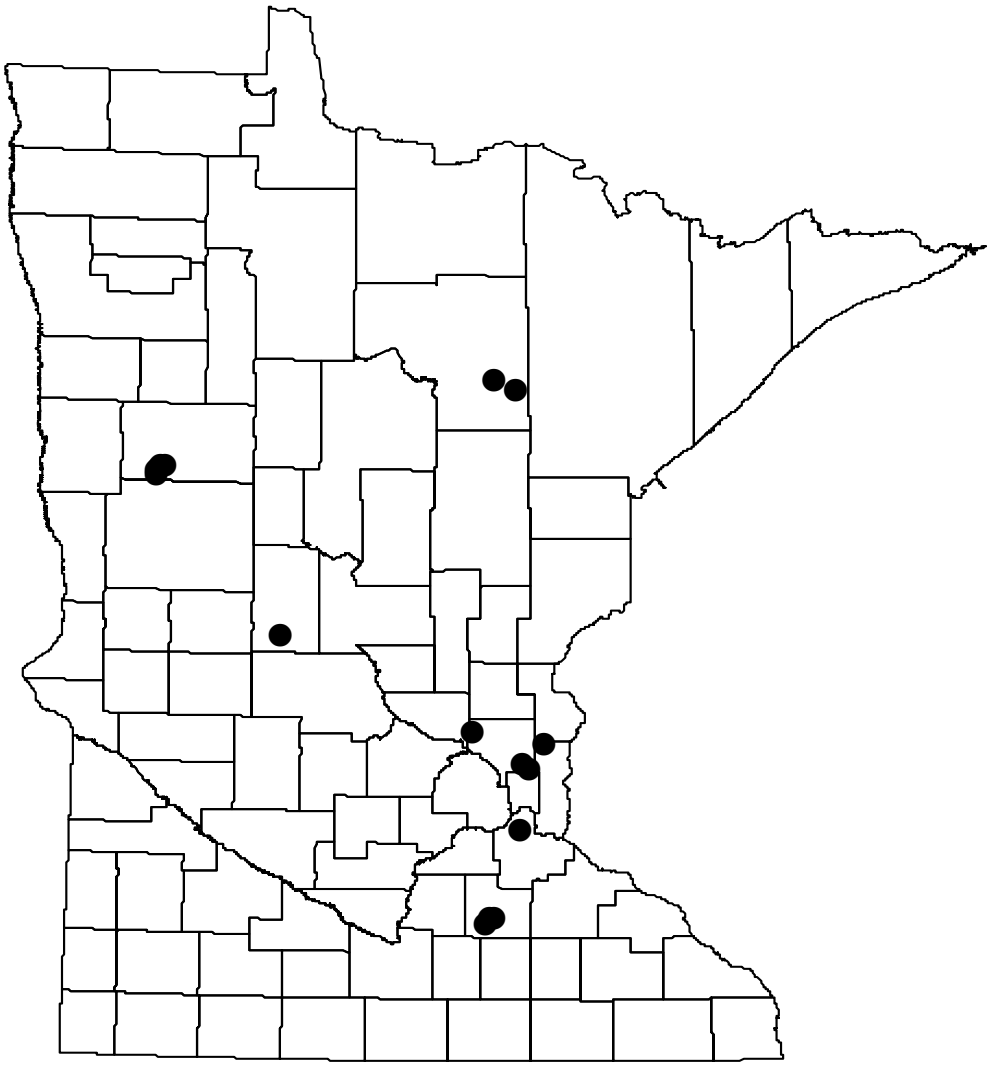

Figure 13. Minnesota flowering rush locations as of December 2004.

Since 2002, a point intercept plant survey has been implemented on Detroit Lake. A point intercept survey is performed by placing sample points equally spaced over the area of interest. In this case, the points were spaced 125 meters apart and within the 10-foot contour line (Figure 14). In 2002, spring and fall surveys were completed, but they did not measure peak biomass of flowering rush. As a result, in 2003, the survey was moved to July. As expected, the results indicate that the spring and fall surveys did not capture the highest frequency of flowering rush (Table 18). During the last two years, the frequency and location of flowering rush have not changed significantly (Figure 15). Given the original intent of these surveys, to monitor the flowering rush population, the scale of these surveys may need to be adjusted in 2005.

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 within the “third” or east basin (Figure 16). In 2004, no visible increase in distribution was noted.

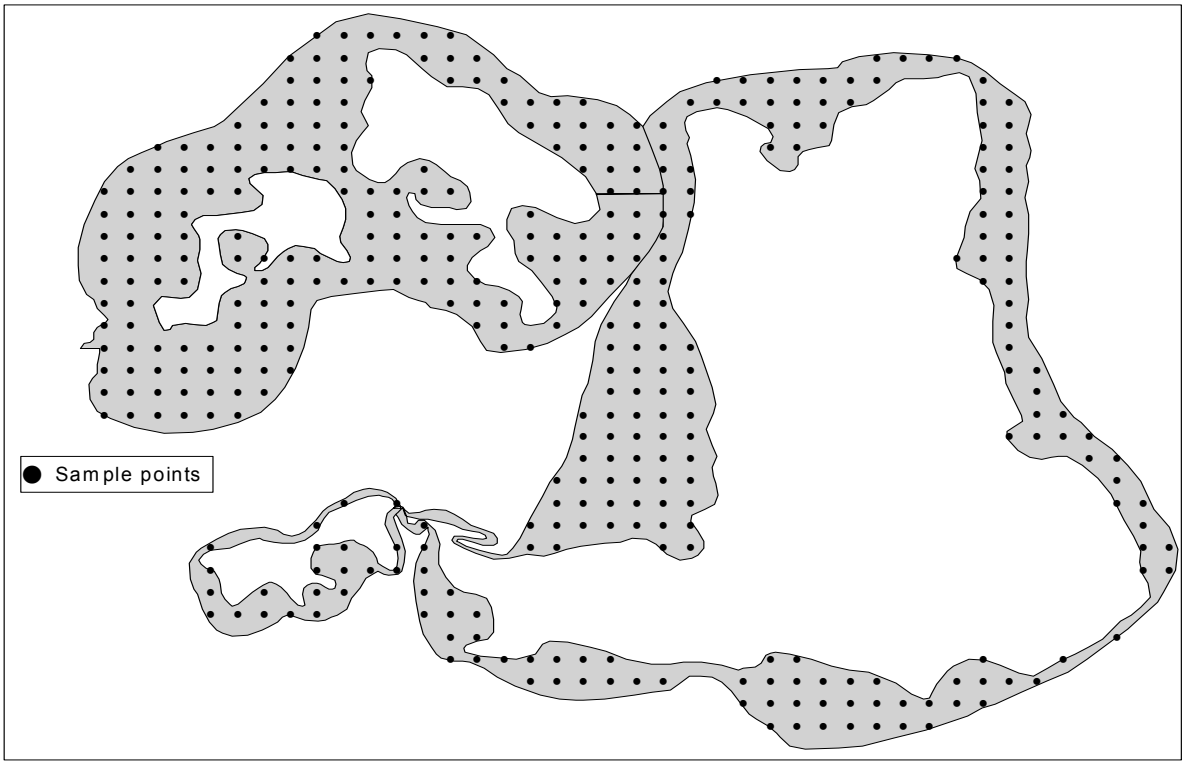

Figure 14. Sample locations on Detroit Lake.

Table 18. Flowering rush frequency on Detroit Lake.

Year of Survey Performed By	Number of Sample Sites	Frequency of Flowering Rush
Spring 2002 – Exotics Program	241	6%
Fall 2002 – Exotics Program	260	7%
Summer 2003 – Invasives Program	190	18%
Summer 2004 – Invasives Program	278	17%

Figure 15. Locations of flowering rush in 2004 in Detroit Lake.

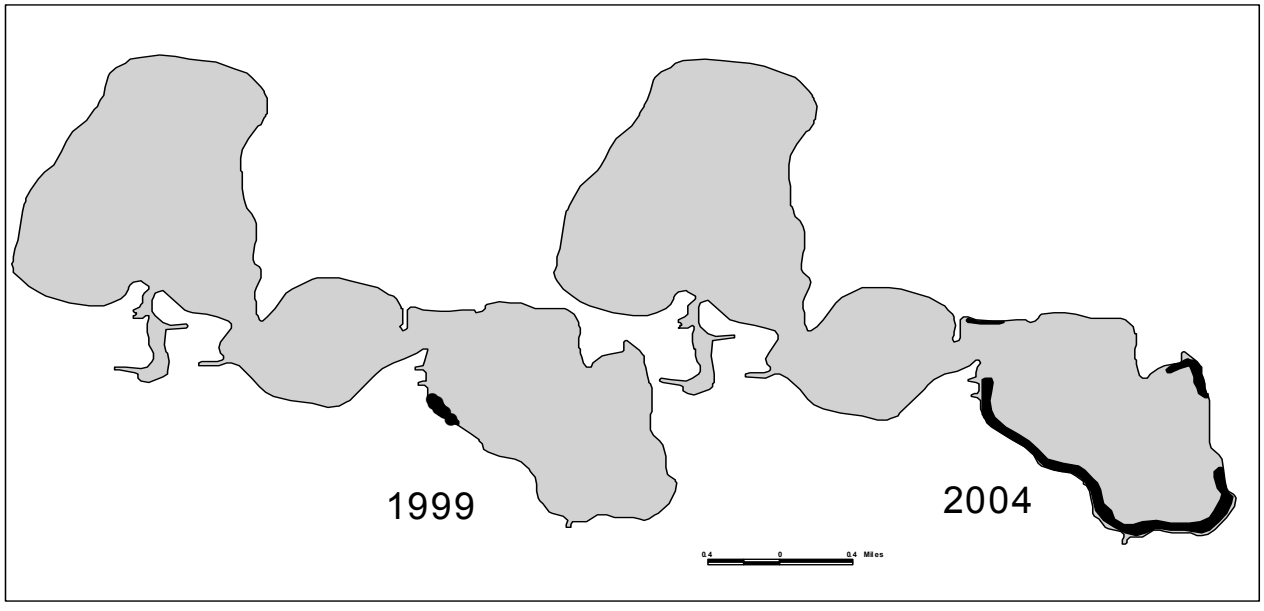

Figure 16. Flowering rush locations in Forest Lake in 1999 and 2004.

Support research to develop and implement better management methods
In 2003 and 2004, the Pelican River Watershed District (PRWD) contracted with a private herbicide applicator to test different aquatically registered herbicides on small plots of flowering rush. In 2003, six sites were sprayed with different herbicides and rates including glyphosate, 2, 4-D (granular and liquid), diquat, and various adjuvants. Two glyphosate sprayed plots showed roughly 50% reduction in flowering rush density. The remaining plots did not show any visible reduction. One potential complicating factor was the unseasonably cool water temperatures in late August 2003, which may have played a part in the early senesce of flowering rush. As a result, in 2004, the treatments were moved up a month. Preliminary results suggest most of the treatments knocked back flowering rush in the year of treatment. The only herbicide that did not reduce flowering rush in the year of treatment was imazypyr. Additional information will be available in 2005, when these plots are looked at again.

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, Invasive Species Program staff removed the umbels (flowers) in late summer.

Provide information to those interested in how to best manage flowering rush
Hand-cutting has been successful at seasonally reducing dense stands of emergent flowering rush. In the past, the Invasive Species Program coordinates and assists with a flowering rush hand-cutting project at a public swimming beach in Twin Lakes (Itasca County). 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. In an attempt to reduce flowering rush without the labor-intensive cutting, diquat and 2, 4-D were applied in the spring of 2004. The herbicide treatment did not reduce the amount of flowering rush at the beach and public water access area on North Twin Lake.

The PRWD annually meets with DNR staff including representatives from the Invasive Species Program 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. During the past two years, the PRWD has been engaged in testing various herbicides on flowering rush. Support of this project, including technical assistance will continue.

Effectiveness of Management

Flowering rush often grows in stands with native vegetation, making it difficult to control this invasive 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). The disadvantages of cutting are that it lacks selectivity, it is labor intensive, and does it not eliminate the invasive. Digging flowering rush may increase its spread if the entire rhizome is not removed. Recent work contracted by the PRWD, may show some new herbicide combinations that maybe effective on flowering rush. As that information becomes available, the Invasive Species Program staff will evaluate the utility of these treatments.

Participation by Other Groups

Others involved in flowering rush management in Minnesota in 2004 include: DNR's Division of Fish 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 (Blossey et al., 2001). 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 invasive.

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 17). In 2004, 31 new purple loosestrife infestations were identified in Minnesota. There are now 2,212 purple loosestrife infestations recorded statewide (Table 19). 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 - 2004

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.

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 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.

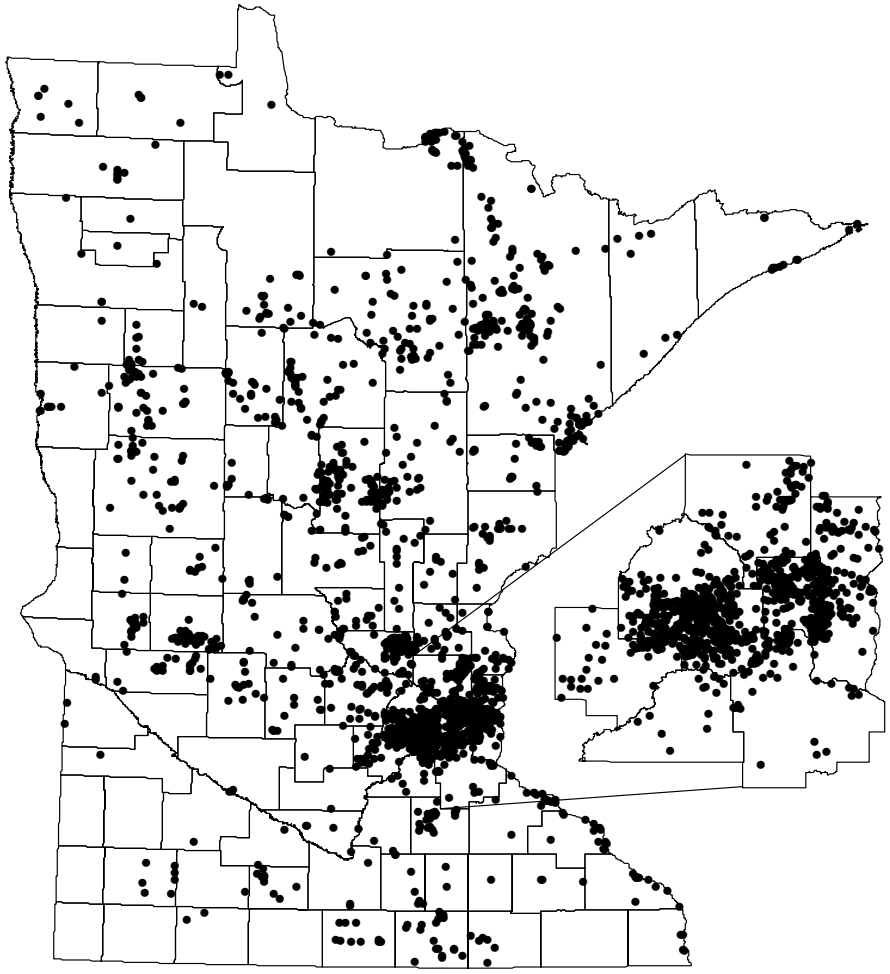

Figure 17. Purple loosestrife infestations in Minnesota as of December 2004.

Table 19. Purple loosestrife infestations in Minnesota recorded by the Minnesota Department of Natural Resources in 2003 and 2004.

Site Type	Total sites 2003	New sites 2004	Total sites 2004
Lake	659	8	667
River	202	1	203
Wetland	687	6	693
Roadsides and ditches	471	16	487
Other[1]	162	0	162
Total	**2,181**	**31**	**2,212**

[1]Includes gardens and other miscellaneous sites.

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 (Welling and Becker, 1990). Herbicide treatments kill the existing loosestrife population only, creating 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 small loosestrife infestations 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 that had greater than 1,000 plants was treated in 2004.

Between 1989 and 2004, the number of sites, number of plants, and total cost of treating purple loosestrife with herbicide has decreased (Table 20). 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. In 2004, only DNR Staff were used to treat purple loosestrife stands statewide. DNR staff visited 60 purple loosestrife stands for herbicide control work (Figure 18). At 20 sites, workers found no loosestrife plants to treat. A total of 39 sites were treated with herbicides. Most of the sites were very small: 80% had less than 100 plants. At one location, seven purple loosestrife plants were hand-pulled. This work took a total of 370 worker hours, and only 0.58 gallons of Rodeo™ were used to treat the purple loosestrife. Total cost for this effort was $9,400.

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 (ten in 2004) 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 after the insects were approved for release by the United States Department of Agriculture (USDA). To date, four species of insects, two leaf-eating beetles, *Galerucella calmariensis* 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, DNR area wildlife managers, nature centers, lake associations, schools, 4-H and garden clubs with a “starter kit” for rearing their own leaf-eating beetles. 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. From 1997 to 2004, this cooperative effort has had a significant effect on total number of insects released (Figure 19).

With success of insect establishment in the field, organized rearing efforts have come to an end in 2004. Resource managers are be able to collect insects from established release sites and redistribute to new infestations. Current research suggests that these insects will move up to five kilometers on their own if purple loosestrife is present (McCornack et al., 2004). The "collect and move" method has reduced the effort needed to further distribute leaf-eating beetles in Minnesota. In 2004, an estimated 140,810 leaf-eating beetles were collected and released on 41 sites. To date, the leaf-eating beetles have been released at more than 771 sites statewide (see Figure 19, Table 21).

Table 20. Historical herbicide applications performed by DNR and applicators contracted by DNR in Minnesota (1989-2004).

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
2004	60	30	9	20	370	0.58	$9,400

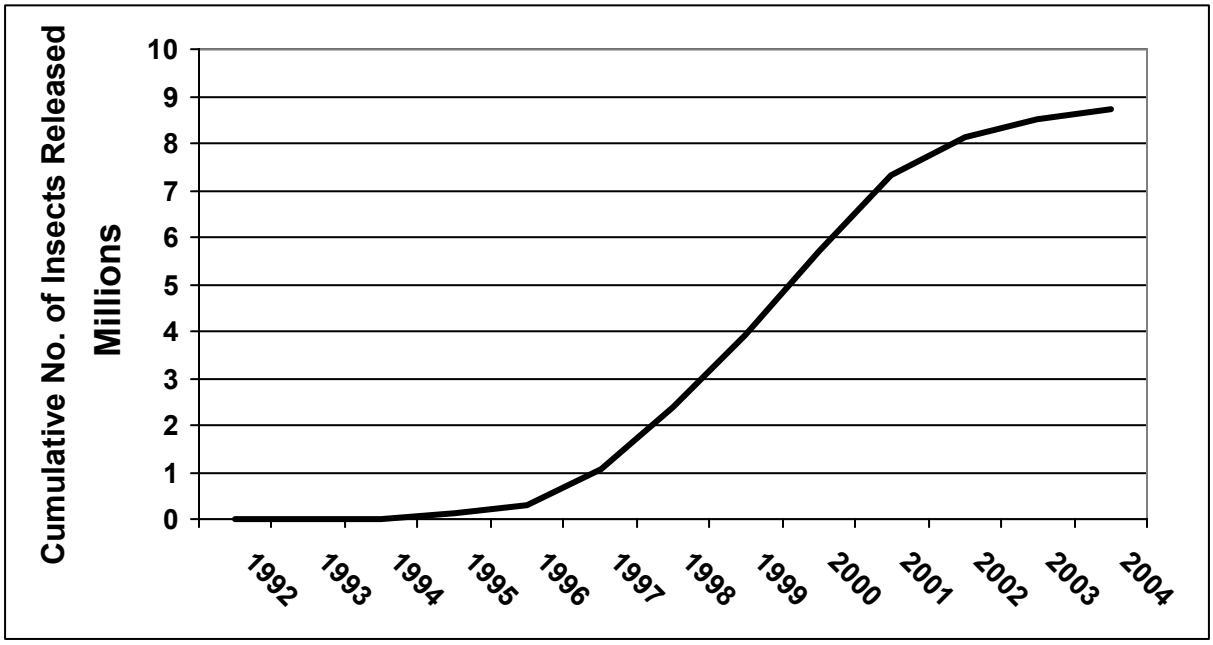

Figure 18. Locations where DNR staff used herbicides to control purple loosestrife in 2004.

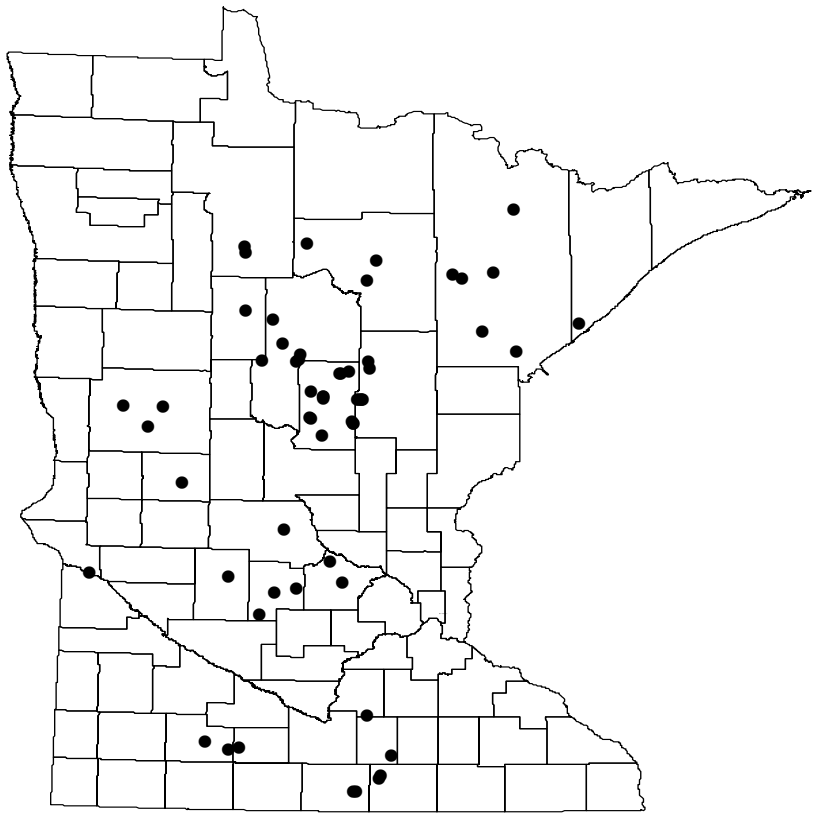

Figure 19. Cumulative number of insects released to control purple loosestrife by year.

Biological control insects released between 1992 and 2004 have established reproducing populations at more than 80% of the sites visited. Insect populations increased significantly at many locations with pronounced damage to loosestrife plants. In the summer of 2004, 178 insect release sites were visited to assess the insect establishment and level of control achieved. At 44% (78 sites) of the sites surveyed, the insect populations are rapidly increasing and causing significant damage to the loosestrife infestations. At 12% of all visited sites, the loosestrife was severely defoliated (90-100%) (Figure 20).

Root-Boring Weevils: Initially, only a small number of root-boring weevils were brought to Minnesota. As of December 2004, there are 12,223 weevils comprising 30 releases, at 23 different sites in Minnesota. In 2004, no weevils were made available for release, but in the future, Minnesota will be receiving additional weevils.

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 2004 demonstrated that *Galerucella* introductions have caused moderate to severe defoliation of loosestrife populations on 44% of sites visited (Figure 21). 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

A three-year study to evaluate biological control of purple loosestrife in Minnesota, was completed in 2004. This research was funded by the Minnesota Legislature, as recommended by the LCMR. Evaluation of purple loosestrife biological control found that the leaf-beetles, *Galerucella* spp., can provide long-term control of purple loosestrife. As purple loosestrife populations were reduced, the diversity of other plant species increased. *Galerucella* spp. populations fluctuate over time in response to purple loosestrife abundance (Skinner et al. 2004). At some sites, the leaf beetle populations declined and have not rebounded, suggesting control may vary depending on a number of factors. Evaluations were also made to assess whether *Galerucella* spp. were feeding on non-target species. *Galerucella* spp. did not impact two native Lythrum species. Although *Galerucella* larvae were present and some feeding observed on swamp and winged loosestrife, plant growth or reproductive parameters were not affected (Stamm Katovich et al. 2004). A third study was carried out to monitor movement of *Galerucella* species. *Galerucella* spp. can readily disperse and colonize purple loosestrife infestations within wetlands and across landscapes. *Galerucella* spp. on average, dispersed five kilometers to new purple loosestrife infestations within 3 years. The maximum dispersal distance recorded was 20 kilometers. Beetles were found in 85% non-release sites visited (McCornack et al. 2004). From these data we can advise resource managers who wish to maximize

redistribution efforts of *Galerucella* spp. to select wetlands that are greater than five kilometers from any known release.

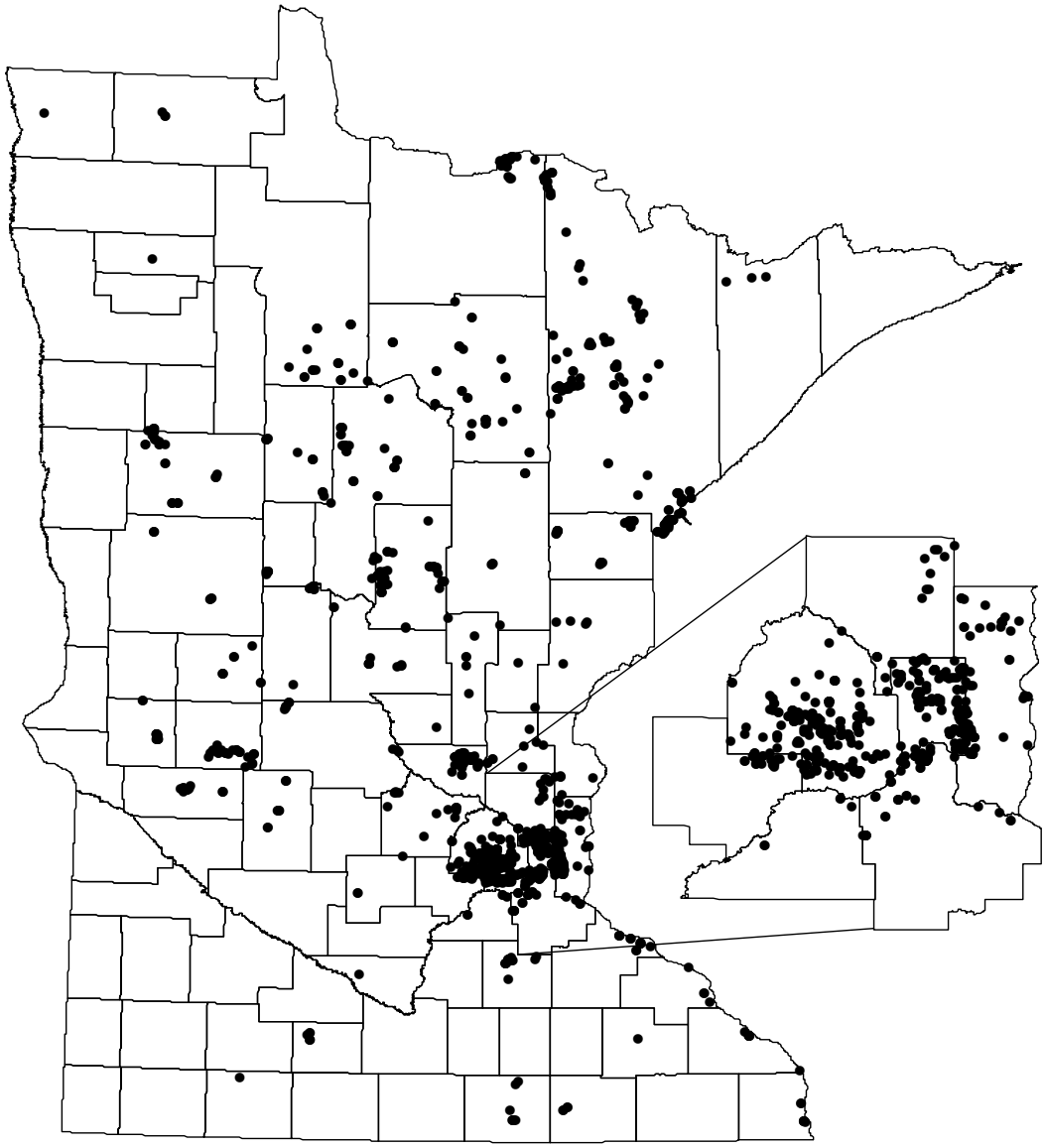

Figure 20. Locations of insects released to control purple loosestrife in Minnesota through 2004.

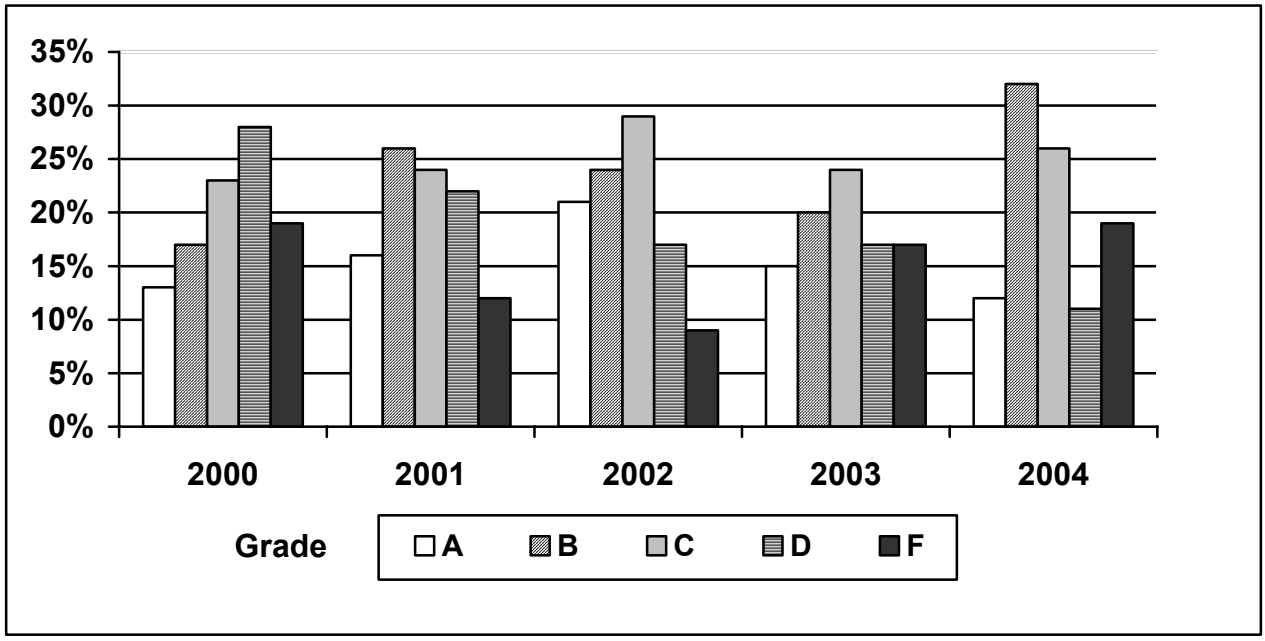

Figure 21. Sites graded for insect establishment and control.

Table 21. Summary of number of insects released in each region to control purple loosestrife (1992-2004).

Minnesota DNR Regions	Number of Release Sites	Number of Insects Released
1 – Northwest	121	1,318,800
2 – Northeast	193	1,602,890
3 – Central	400	5,118,320
4 – South	57	700,800
Totals	**771**	**8,740,810**

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.

Future needs for purple loosestrife management

- Continue Implementation and evaluation of biological control of purple loosestrife.
- Continue DNR funding of herbicide control efforts on small, high-priority infestations.
- Continue to assess effectiveness of overall management strategies.
- Continue to collaborate with county agriculture inspectors, MnDOT, DNR area wildlife managers, nature centers etc., to expand management efforts.

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Other Invasive Aquatic Plant Species in Minnesota

Introduction

Numerous invasive species of aquatic plants exist in the state. The previous chapters described species for which there were ongoing efforts. The species described in this chapter exist in the state, but there are no ongoing efforts by the DNR to manage them in the wild. They are included because they are or have been of interest within the state. In addition to the information presented on brittle naiad, reed canary-grass, hybrid hardy water lilies, and salt cedar in this chapter, Table 22 presents a summary of other invasive aquatic plant species in Minnesota.

Brittle Naiad

In 2004, Invasive Species Program staff confirmed that brittle naiad *(Najas minor)* is in Lac Lavon, a small lake in Dakota County. Brittle naiad resembles the Minnesota rare species spiny naiad *(Najas marina),* but unlike *N. marina* it is not native to Minnesota. Brittle naiad is native to Europe and was first reported in the United States in the Hudson River in 1934 (McFarland et al., 1998).

Brittle naiad spreads by seeds carried on plant fragments. The primary means of reproduction in brittle naiad is by seed, and it is highly fertile (McFarland et al., 1998). During the late summer or early fall, the stems of brittle naiad become brittle, and the top portions of the stem break into small fragments. Seeds remain attached in the leaf axils of these fragments, and the fragments are dispersed by water currents (U.S. Army Corps of Engineers, 2002). In Lac Lavon, brittle naiad has spread from a few scattered plants noted in 2001 to approximately 20% of the littoral zone in 2004 (Wendy Crowell, unpublished data, Nov. 2004).

Brittle naiad can be a severe nuisance in shallow water but does not generally cause problems in deeper water. Brittle naiad grows to about four feet in height, and has stems that are profusely branched toward the top of the plant. In shallow water, 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, U.S. Army Corps of Engineers, 2002). In deeper water, brittle naiad may become abundant but not cause nuisances. In 2003, in Lac Lavon brittle naiad formed dense stands near the bottom of the lake. Because of the water depth these stands did not cause a nuisance (Nick Proulx, personal communication, April 22, 2004). This situation was also noted in Lac Lavon in 2004 (Wendy Crowell, unpublished data, Nov. 2004).

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Hardy Hybrid Water lilies (*Nymphaea* spp.)

Colorful hardy water lilies are popular with water gardeners. Because they are hardy in Minnesota, if planted in natural waters they will survive and spread. Hybrid water lilies may crowd out native lilies and other native aquatic plants that occur in a lake and may hybridize with native *Nymphaea*, making them less suited for Minnesota climate.

Because of this, they have been classified as a *regulated invasive species* (see M.R. 6216). This means that they cannot be placed into a free-living state (into public waters), or into ponds connected to public waters, but they can be sold and used in private water gardens.

A few populations of hybrid water lilies have been found escaped in Minnesota waters. In at least one water, Portage Lake in Park Rapids, the pink water lilies are widespread. In 2004, a small population of pink water lilies was found in Crawford Lake, near Montrose. Because of the small size of the infestation, the DNR treated the lilies with herbicide to control them.

Reed canary-grass

Reed canary-grass (*Phalaris arundinacea*) was first included in the annual report for 2000 as an "emerging issue" (Exotic Species Program, 2001:19). There are several active research groups in the upper Midwest that are investigating the ecology and management of this invasive species. In 2004, a research group at the University of Minnesota-Saint Paul initiated a new study of revegetation of wetlands following control of reed canary-grass. This study is funded by the Minnesota Department of Transportation (MnDOT), which manages reed canary-grass in some of its projects.

The research by the University of Minnesota is directed by a Technical Advisory Panel, which includes a representative from the DNR's Invasive Species Program. In addition to the current study described above, proposals for additional research on the ecology of reed canary-grass are under review by MnDOT and the DNR.

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 22). 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.

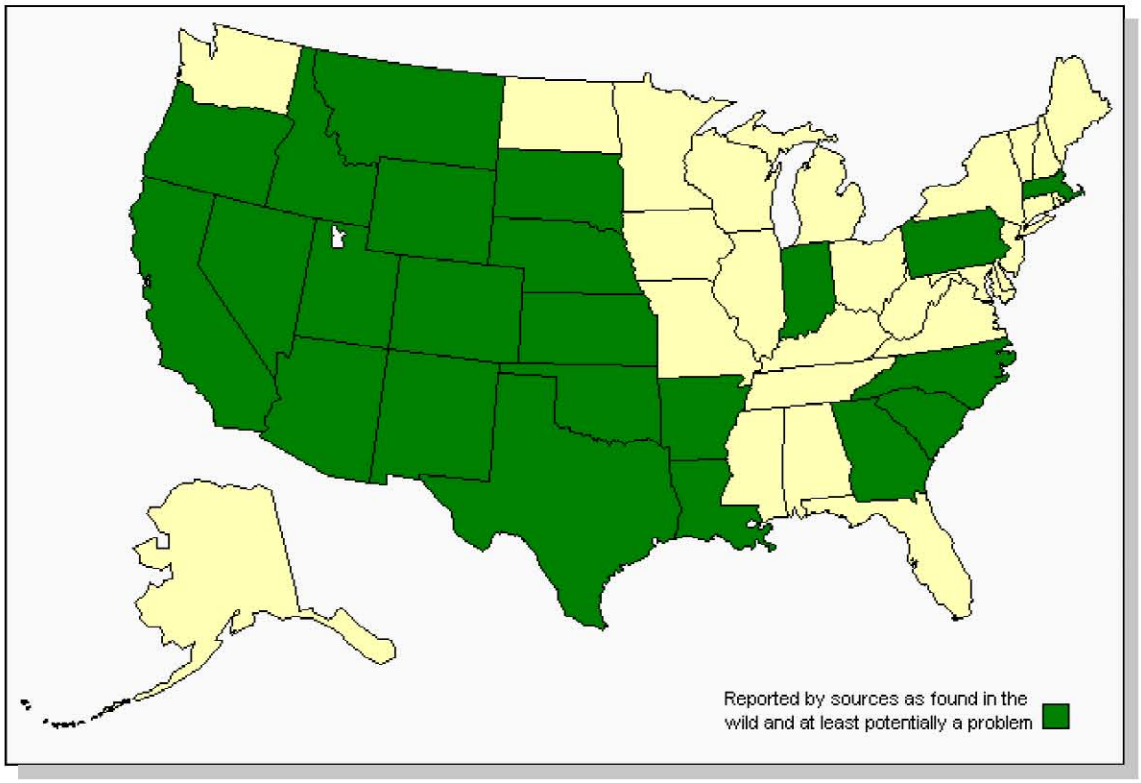

Figure 22. Saltcedar distribution in the United States prior to discovery in Minnesota. (Source: www.nps.gov/plants/alien/map/tama1.htm)

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, Invasive 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 was revisited in September 2004 to evaluate control effectiveness and to control any surviving plants. Overall effectiveness of the 2003 control effort was excellent with only one live saltcedar plant was observed. This remaining plant was pulled and removed from the site.

Table 22. Other Invasive Aquatic Plant Species in Minnesota.

Species	Status	Legal Status	Last annual report to include info on this species
Yellow iris *(Iris pseudacorus)*	Commonly sold, public education has focused on preventing people from planting it in natural water bodies	Regulated	2002
Water lettuce *(Pistia stratiotes)*	No new infestations found since 2001	Unlisted	2001
Reed canary-grass *(Phalaris arundinacea)*	Widespread in Minnesota	Unlisted	2001
Introduced genotypes of common reed (*Phragmites australis)*	Only a few known populations in the state, distribution information is lacking	Unlisted	

Terrestrial Invasive Plant Management

Overview

The Invasive Species Program is playing a key role to improve the management of terrestrial invasive plants in natural areas, including DNR managed lands. A major focus was placed on providing support and technical expertise to DNR land managers statewide and the development of new control methods such as biological control for common buckthorn and garlic mustard. This work is being funded by a combination of sources that includes state funding (LCMR and Heritage Enhancement), and federal funding (U.S. Forest Service, and U.S. Environmental Protection Agency-Great Lakes National Program Office).

Heritage Enhancement Collaborative Projects

The Division of Ecological Services is leading a collaborative effort with the Divisions of Parks and Recreation, Fish and Wildlife, and Trails and Waterways to enhance DNR staffs' ability to effectively manage terrestrial invasive plants. Started in FY04 using Heritage Enhancement Funds, this effort has expanded work in four high priority areas. Those areas are: 1) terrestrial invasive plants inventory, 2) research on control methods, 3) invasive species management, and 4) information/education.

Inventory

Using standardized protocols developed by the DNR and MDA, more than 6,000 locations of invasive plant species on state-managed lands have already been mapped using GPS/GIS technologies. This includes surveys conducted in 20 state parks, 120 wildlife management areas, and along 140 miles of state trails. Managers will now be better able to target and monitor results of control efforts on these populations.

Research

Funds are being provided to support research on biocontrol methods for garlic mustard and buckthorn. Research is also underway to refine methods of controlling Canada thistle in the Talcot area, where Canada thistle dominates many of the wildlife management areas. The goal of the research is to improve control of Canada thistle, reduce herbicide use, and reduce impacts to native plants.

Management

Best management practices are being developed to reduce the movement of invasive plants during DNR management or development projects. Funding is being provided for a demonstration project to manage invasive plants in a public/private effort across ownership boundaries in western Minnesota.

Information/Education

Web pages are being created and updated to provide information to citizens and others on identification and recommended management of invasive plants. A buckthorn web page on the DNR Web site was completed in September 2004. Follow the link below to access the buckthorn and other invasive plant pages:
www.dnr.state.mn.us/invasives/terrestrialplants/index.html

Buckthorn Biological Control Research

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. In Minnesota, common and glossy buckthorn are restricted noxious weeds that are illegal to import, sell, or transport statewide.

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 Lake 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, from the Environmental Trust Fund to continue this research. This funding was matched the EPA-GLNPO with an additional $50,000. This funding will allow the research to continue through 2005.

Initial research results suggest 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 cathartica* and 70 on *R. frangula*.

Several insect species have been selected for detailed host specificity studies based on their food niche, period of attack, potential availability, and likely specificity. Most of these species are targeted for *Rhamnus cathartica*. These are: *Trichochermes walkeri, Philereme vetulata, Synanthedon stomoxiformis,* and as a lower priority, *Triphosa dubitata*. The other priority species, *Sorhagenia janiszewskae* and *Oberea pedemontana*, are targeted for both *R. cathartica* and *Frangula alnus*. Researchers are currently rearing potential control agents and testing whether they feed and/or reproduce on non-target native plants that are closely related to buckthorn. Currently, two North American and three European buckthorn species are being cultivated at the research facility in Switzerland for host specificity testing. More native plant species will be collected and shipped to Switzerland from the United States this summer as the host specificity testing continues.

Preliminary screening tests were carried out with three insect species: *Philereme vetulata*, *Sorhagenia janiszewskae,* and *Trichodermes 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 are

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. 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.

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.

As part of developing biological controls for buckthorn, it is important to know what insect species are currently utilizing buckthorn in Minnesota. A contract with the University of Minnesota is in place to conduct surveys for insects on buckthorn in Minnesota. Surveys began in late May 2004. Seven locations in Minnesota are being surveyed systematically throughout the growing season to capture insects utilizing buckthorn. To date, more than 350 insects (adult and immature stages) representing eight insect orders have been collected. Immature insects are allowed to complete development prior to preserving and identification. Identifying all the specimens will take place after the field season and collections have ended.

Garlic Mustard Biological Control Research

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 non-native plant can cover large areas where it displaces the native woodland ground flora such as spring ephemerals. Garlic mustard is a prohibited noxious weed in Minnesota, making it illegal to import, sell, and transport, which requires control. 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 15 counties: Anoka, Brown, Carver, Cass, Clay, Dakota, Hennepin, Kandiyohi, Nicollet, Otter Tail, Pine, Ramsey, Scott, Washington, and Wright counties. 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 has been 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 develop a 3-5 year plan for continuing the project to develop a biological control program for garlic mustard. In 2002-2004, the consortium has cooperatively provided technical and financial assistance to continue the host range testing in Europe, established laboratory colonies of promising agents in

a quarantine facility in the U.S., and established 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. Testing is currently being carried out to make sure the potential control agents do not feed on native plant species. Working with researchers in Europe (CABI Bioscience, Switzerland) who have completed most of the testing to date, a list of plant species was developed based on their inability to collect or cultivate these species in Europe (Table 23). To date, ten of the 12 species listed in Table 23 have been field-collected and are growing in a greenhouse facility on the University of Minnesota campus. Cooperators in Illinois, Indiana, Michigan, Minnesota, and Wisconsin have helped collect these plant species from the field and shipped them to Minnesota. We will continue to search for the additional two species.

Table 23. Plant species to be used in host specificity testing of garlic mustard biological control agent in quarantine, St. Paul, MN.

Plant Species
Brassicaceae *Arabis Canadensis* *Cardamine bulbosa* *Cardamine pensylvanica* *Dentaria angustata* *Dentaria laciniata* (cut-leaved toothwort)
Fabaceae *Amphicarpaea bracteata* (Hog peanut)
Cyperaceae *Carex laxiflora*
Liliaceae *Erythronium americanum* (yellow trout lily) *Erythronium albidum* (white trout lily)
Ranunculaceae *Ranunculus septentrionalis* (swamp buttercup) *Aconitum noveboracense* (northern blue monkshood) *Anemone Canadensis* (Canada anemone)

Starting in the fall of 2003, two insect species have been brought into the quarantine facility on the St. Paul campus. Three hundred *Ceutorhynchus scrobicollis* adults were received in both 2003 and 2004, and 300 *Ceutorhynchus roberti* adults were received in April 2004 from the CABI facility in Delemont, Switzerland. The weevils arrived in excellent shape and were placed under quarantine conditions in the High Containment Security Facility on the University of Minnesota campus. To date, sequential host range studies were conducted with mating pairs of *C. scrobicollis* on the plant species.

Results of host specificity completed to date are found in Table 24. No *C. scrobicollis* feeding was noted for any of the test plant species (Table 24). However, several eggs were found on three of the test plant species. In each case, eggs were laid directly on the leaf or stem surface. This is not considered normal oviposition behavior by *C. scrobicollis* which normally inserts eggs into the stem or underneath the leaf mesophyll.

Because the eggs were left exposed, they all desiccated and did not hatch. Eggs that were found on a leaf or stem of the test plant were held and the eggs were checked periodically. All eggs either desiccated on the leaf surface, or rolled off of the leaf and were not found. Also, when an egg was found on a test plant, the mating pair was offered a leaf of the same test plant species for a second time. No eggs were laid on the test plant leaf in the second test.

Table 24. Results of current *Ceutorhynchus scrobicollis* host specificity testing in quarantine at the University of Minnesota, St. Paul, MN. 2003-2004.

Species	Number of valid Replications	Feeding	Oviposition
Canada anemone (*Anemone canadensis*)			
Sequential no-choice test	12	No	No
Single choice test	12	No	No
Sedge spp.(*Carex laxiflora*)			
Sequential no-choice test	12	No	No
Single choice test	12	No	No
Hog peanut (*Amphicarpaea bracteata*)			
Sequential no-choice test	8	No	1 egg *
Single choice test	9	No	No
Swamp buttercup (*Ranunculus hispidus*)			
Sequential no-choice test	8	No	3 eggs *
Single choice test	8	No	No
Northern blue monkshood (*Aconitum noveboracense*)			
Sequential no-choice test	8	No	4 eggs *
Single choice test	10	No	1 egg *

* Eggs desiccated and never hatched

These results are encouraging, but more testing needs to be carried out. Once all the testing is completed, the results will be evaluated and a decision will be made whether to petition the federal government for permission to release the control agents into the United States.

Management of Asian Carp

Introduction

Four non-native species of carp, collectively known as Asian carp, have been imported for commercial aquaculture use in the Mississippi River basin and appear to have significant potential to harm aquatic ecosystems in Minnesota. The species are: Bighead carp (*Hypophthalmichthys nobilis*), silver carp (*Hypophthalmichthys molitrix*), grass carp (*Ctenopharyngodon idella*), and black carp (*Mylopharyngodon piceus*). All four species have escaped from captivity and all but the black carp are known to have established populations in the Upper Mississippi River Basin (UMRB). Monitoring has documented that these populations are expanding their geographic range and are moving up the Mississippi River towards Minnesota (a single bighead carp was caught in Lake Pepin in 2003). There is also concern that these fish could enter the Great Lakes through the Illinois waterways that connect the Mississippi River basin with the Great Lakes and potentially reach the Minnesota waters of Lake Superior.

Resource managers throughout the UMRB are concerned about Asian carp and their associated impacts on natural resources and human safety. The distribution of these fish species in Asia and risk assessments suggest that they will thrive in the UMRB. Asian carp are already the most abundant large fish in parts of the Missouri River and are present in large numbers in parts of the Mississippi River and its tributaries. Each of these species has unique characteristics and poses different threats to fish and other aquatic species. Taken together they appear capable of having profound effects on aquatic resources and recreational opportunities.

At present, no populations of Asian carp are known to have established in Minnesota. No Asian carp were reported caught in the state in 2004. The closest known populations are in Iowa waters of the Mississippi River and its tributaries. Monitoring has documented that these populations continue to move upstream. Asian carp can move up to seven miles a day (Anderson, 2004) and 150 miles in a season (Chapman, 2004), so there appears to be a short window of opportunity to limit the spread of these species throughout the UMRB. Without deliberate actions to slow their spread, populations of bighead and silver carp are likely to move into state waters of the Mississippi River in one to two years.

Bighead Carp

The bighead carp are a planktivorous fish (they eat microscopic organisms) and are native to China. 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 over 60 pounds. A unique feature that distinguishes the bighead carp from our native fishes is the placement of the eyes, which are located below the mouth. Bighead carp feed on the same food items as many of our native species and they will directly compete with the commercially-harvested bigmouth buffalo, the threatened paddlefish, young-of-the-year of many fish species, and freshwater mussels.

Bighead carp were imported to the U.S. by the aquaculture industry as a specialty food item, as well as to improve water quality in fish rearing ponds. Since the bighead carp

were first discovered in the Mississippi and Ohio rivers, they have expanded their distribution into nearby states such as Illinois, Iowa, South Dakota, and Missouri. Two bighead carp have been caught in Minnesota border waters by commercial fishermen. In 2003, one fish was caught near the south end of Lake Pepin — a widening of the Mississippi River near Lake City. Another specimen was captured in the southern half of the St. Croix River in 1996, but not identified as a bighead carp until 2003.

In 1998, a fish farmer illegally brought "breeder" bighead carp from Missouri to a fish farm in Iowa with the intention of raising the species in ponds. These carp subsequently spawned, creating about one million bighead "fry" that were later returned to ponds at the Missouri farm.

Silver carp

Silver carp are native to eastern Asia. They were imported into the U.S. and stocked in private waters in other states to control algae/phytoplankton. The fish was first found in natural waters in Arkansas around 1980, likely the result of escapes from private aquaculture facilities. This fish has the potential to cause considerable damage to native species because it feeds on plankton required by larval fish, gizzard shad and other plankton eating fish, and native mussels. The silver carp has also attracted attention because of its habit of jumping out of the water in response to passing boats (Figure 23). Because of their size and the height the fish reach, this behavior creates a serious hazard to boaters. Silver carp have not yet been documented in Minnesota waters.

Figure 23. A silver carp jumping in response to a powerboat.

Grass carp
Grass carp are native to eastern Asia. Wild populations are now present in many natural waters in the United States. These fish have been and continue to be widely stocked to control aquatic vegetation. A proposal to allow the introduction and use of triploid grass carp in isolated waters licensed for private aquaculture was introduced during Minnesota's 2003 legislative session, but did not pass. According to fisheries biologists in Midwest states, reproducing populations of grass carp are found in tributaries of the Mississippi River south of Minnesota. Grass carp have not become established in Minnesota waters, but individual fish have been caught in state border waters (Mississippi River below the Twin Cities and Okamanpeedan Lake on the Minnesota-Iowa border). They have been sampled periodically in the Mississippi River with the northern-most record at Wabasha, Minnesota, in 1994, and the earliest record in Lake Winona in 1977.

Black carp
Black carp are native to eastern Asia. This species was first brought into the United States in the early 1970s as a "contaminant" in imported grass carp stocks for a private fish farm in Arkansas. In the early 1980s, black carp were imported as a food fish and to control the spread of yellow grub *Clinostomum margaritum* in aquaculture ponds (Source: http://nas.er.usgs.gov/queries/SpSimpleSearch.asp). Their establishment in the wild would pose a significant risk to the mollusk and fisheries resources throughout the Mississippi River and its tributaries.

Black carp are already present in, or are proposed for use in, aquaculture ponds in at least three southern states. Black carp were also illegally imported into aquaculture ponds in Iowa in 1998. If these practices continue, it is likely that black carp will escape or be inadvertently released and become established in the wild. According to a U.S. Geological Survey fact sheet (http://nas.er.usgs.gov/queries/SpSimpleSearch.asp), a number of escapes have already been documented. In 1994, about 30 black carp escaped from a fish farm in Missouri into the Osage River, Missouri River basin. The first specimen reported from the wild was captured in March 2003 from Horseshoe Lake, Illinois. In April 2004, two black carp were captured from the wild in the lower Red River, Louisiana. In June 2004, a single black carp was collected in the Mississippi River near Lock and Dam 24 across the river from Clarksville, Missouri. Black carp have not yet been found in Minnesota.

Management Goals and Options
There are three general options to manage wild populations of Asian carp:

1) do nothing;
2) attempt to prevent further geographical spread; and
3) attempt population control after colonization.

Based on results in areas where Asian carp have already become established, it is clear that, if no actions are taken, Asian carp will eventually jeopardize aquatic resources and use of those resources in much of the Mississippi River Basin. Currently there are no effective measures that would selectively control these species. The Minnesota DNR's goal is to prevent or slow the introduction of Asian carp into state waters and continue to support research efforts to develop new control techniques. To accomplish this goal,

states, federal agencies, and Congress will need to act promptly, ideally during 2005 and 2006, to limit the northern spread of Asian carp in the UMRB.

Progress in Management of Asian Carp

Actions

Because of the potential for significant impacts, the DNR has worked with several partners to identify and implement steps to keep Asian carp from entering the state.

1998 - the DNR designated black, bighead, grass, and silver carp as a *prohibited invasive species* in Minnesota. Prohibited invasive species are illegal to possess, transport, import, propagate, and release in the state.

2003 - the DNR was one of the groups opposing a bill introduced in the state legislature to allow use of triploid grass carp in the state. The bill did not pass.

The DNR investigated the use of electrical barriers to deter Asian carp species from moving up the Mississippi River and invited other agencies to help evaluate the Asian carp problem and recommend next actions (see Annual Report for 2003).

2004 -

- A feasibility study, funded by DNR, the U.S. Fish and Wildlife Service (USFWS), and Wisconsin DNR was completed by the FishPro consulting firm (FishPro, 2004). The study focused on technology that could deter the spread of Asian carp and their costs.
- Public awareness materials about Asian carp were prepared and distributed to the public.
- An interagency team of experts from the Minnesota DNR, Wisconsin DNR, Iowa DNR, U.S. Army Corps of Engineers, USFWS, and the National Park Service reviewed the FishPro feasibility study and recommended steps to implement the study's recommendations (the recommendations of that interagency team are listed below).
- DNR staff continued to conduct surveys and contact commercial fishing operators in the Mississippi River to help determine the northernmost extent of the Asian carp species.
- DNR's Deputy Commissioner met with congressional staff to discuss potential federal funding for two dispersal barriers.
- DNR funded and USFWS provided fish for studies of the response of fish to various sound frequencies (audiograms) by Fish Guidance Systems Ltd. on paddlefish and lake sturgeon to help determine their potential response to proposed acoustic barriers. Fish Guidance Systems Ltd. reported (Nedwell, Lovell, and Pegg, 2005) that a significant difference between the hearing of paddlefish and lake sturgeon versus bighead and silver carp raises the possibility of building a selective acoustic fish barrier to allow paddlefish and sturgeon to pass while deterring the passage of bighead and silver carp species.

The results indicate that a differential acoustic fish deterrent barrier that would be greater than 95% effective on Asian carp and less than 20% effective on paddlefish and lake sturgeon might be achievable, but additional work is needed before such a system could be designed and built.

- Minnesota and the other Great Lakes states recognize the critical need to keep aquatic invasive species, such as Asian carp, out of the Great Lakes and worked actively with the Council of Great Lakes Governors, the Great Lakes Fishery Commission, and other groups to fund and install a new dispersal barrier in the Illinois waterways. The Department of the Army will contribute $6,825,000 of federal funds, the Illinois Department of Natural Resources will contribute $1.8 million, and the states of Minnesota, Indiana, Michigan, Ohio, New York, Wisconsin, and Pennsylvania contributed $67,857 each toward the non-federal cost share. DNR's Invasive Species Program provided the funds for Minnesota.

Interagency Team Recommendations

- Install barriers in conjunction with two Mississippi River locks and dams (L&D) such as L&D11 and L&D 14 or 15 by spring 2006 (Figure 24).
- Use a combination of barrier technologies and an integrated pest management approach (e.g., harvest, education, and regulations) to maximize the probability of success of limiting the upstream movement of Asian carp in the UMRB.
- Seek federal leadership from USFWS for technical assistance, and USACE for barrier design, installation, and operation and maintenance.
- Obtain funding and initiate work on environmental documents and barrier design.

Concerns/Issues

- Restricting migration of native fishes is a concern, because the current goal for states within the UMRB and their federal management partners is to make fish passage improvements at dams, and to remove small dams to restore native fish migrations. Therefore, when barriers are used, their potential benefits to deter upriver passage of Asian carp at key sites should outweigh the limitation of upriver passage of native fish. Some currently proposed technologies could be somewhat selective given differences in the responses of fish species. Future solutions to limit the spread of Asian carp and other invasive species should include development of more selective approaches that would allow the migration of native species.
- Flooding and technological limitations pose challenges for preventing upstream spread of Asian carp past potential fish barriers.
- The costs will be significant. According to the feasibility study (FishPro, 2004), the costs to build two fish barriers will depend on the sites and types of technologies:
    - Sound and bubble diversions (Bio Acoustic Fish Fence) placed at the lock chambers are estimated to cost approximately $1.2 - $1.6 million each.
    - Costs of $.5 - $3 million are estimated for creating a harvesting area for carp that congregate below each lock.

The need and feasibility of adding additional barrier technology along the spillway of the dam that will not compromise other river management concerns is still being examined and, if pursued, could cost an additional $8 to $10 million per dam.

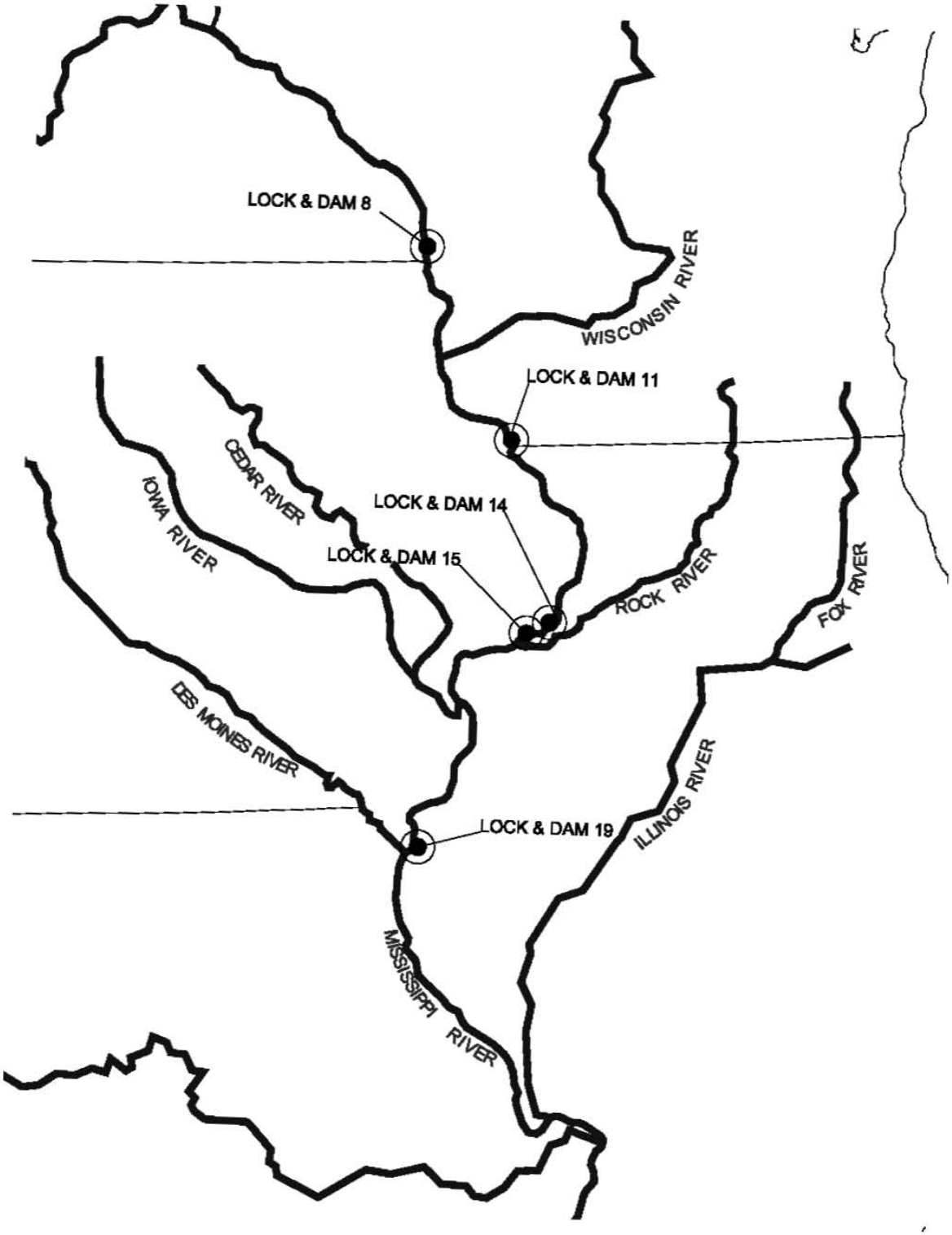

Figure 24. Locations of selected locks and dams on the Mississippi River.

Participation of Others

Federal Regulations

The USFWS began a process in 2002 to determine if it will list black carp as an injurious wildlife species. A similar process was initiated in 2003 to determine if bighead and silver carp should be listed as injurious wildlife species (see Regulations and Proposed Changes). If listed, it would be illegal to import these species into the country or to ship them between states. As of December 2004, the USFWS has not designated any of the three species as injurious wildlife.

National Asian Carp Management Plan

The USFWS has formed an Asian Carp Work Group to develop an Asian carp management plan that will cover bighead, silver, and black carp. Jay Rendall, Minnesota's Invasive Species Program Coordinator, is a member of that group. The Work Group's goal is to provide the draft of the plan to the federal ANS Task Force in 2005.

Illinois Barriers I and II

The original demonstration barrier (Barrier I), which became operational in 2002, continues to function though one of its electrodes is corroding. The Corps conducted safety testing in December 2004 to define safe operation guidelines for barges.

Construction of the second barrier (Barrier II) began in October 2004. The construction timetable anticipates the barrier will be turned on for its trial run in February 2005.

The USFWS (Pam Thiel, personal communication) reported that in 2004 no Asian carps were collected in the Chicago Sanitary and Ship Canal (the waters that connect the Mississippi River basin with the Great Lakes basin), nor in the Des Plaines River where a bighead carp was captured near Channohan in 2002. Therefore, Asian carps still appear to be about 21 miles below Barrier I and 50 miles from Lake Michigan. However, bighead carp, silver carp, and grass carp were frequently caught by crews in the Illinois River near La Salle and Peru, about 100 miles from Lake Michigan.

Future Needs

- Support efforts to maintain two effective barriers to prevent Asian carp passage in the Illinois Waterways.
- Seek funding for one or more dispersal barriers in the Mississippi River to prevent Asian carp from moving into Minnesota waters.
- Evaluate potential to re-establish St. Anthony Falls as a natural barrier.
- Evaluate potential to prevent spread of Asian carp in Minnesota's major tributaries to the Mississippi River including the St. Croix, Minnesota, Zumbro, Cannon, and Root rivers.

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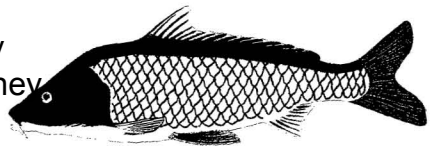
Nedwell J, J M Lovell, and M Pegg. January 2005. The Hearing Abilities of the Paddlefish (*Polyodon spathula*) and the Lake Sturgeon (*Acipenser fulvescens*). Subacoustech Report Reference: 611R0303.

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 caused many wetlands and wetland areas around lakes to dry up and set the stage for an explosion of aquatic vegetation and invertebrates. The early wetland drainage efforts also provided connections into many wetlands and shallow lakes previously inaccessible to fish. 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 would prey on young carp.

Common carp are a carrier of a new disease in the state, spring viremia of carp. All C*yprinids* (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 25).

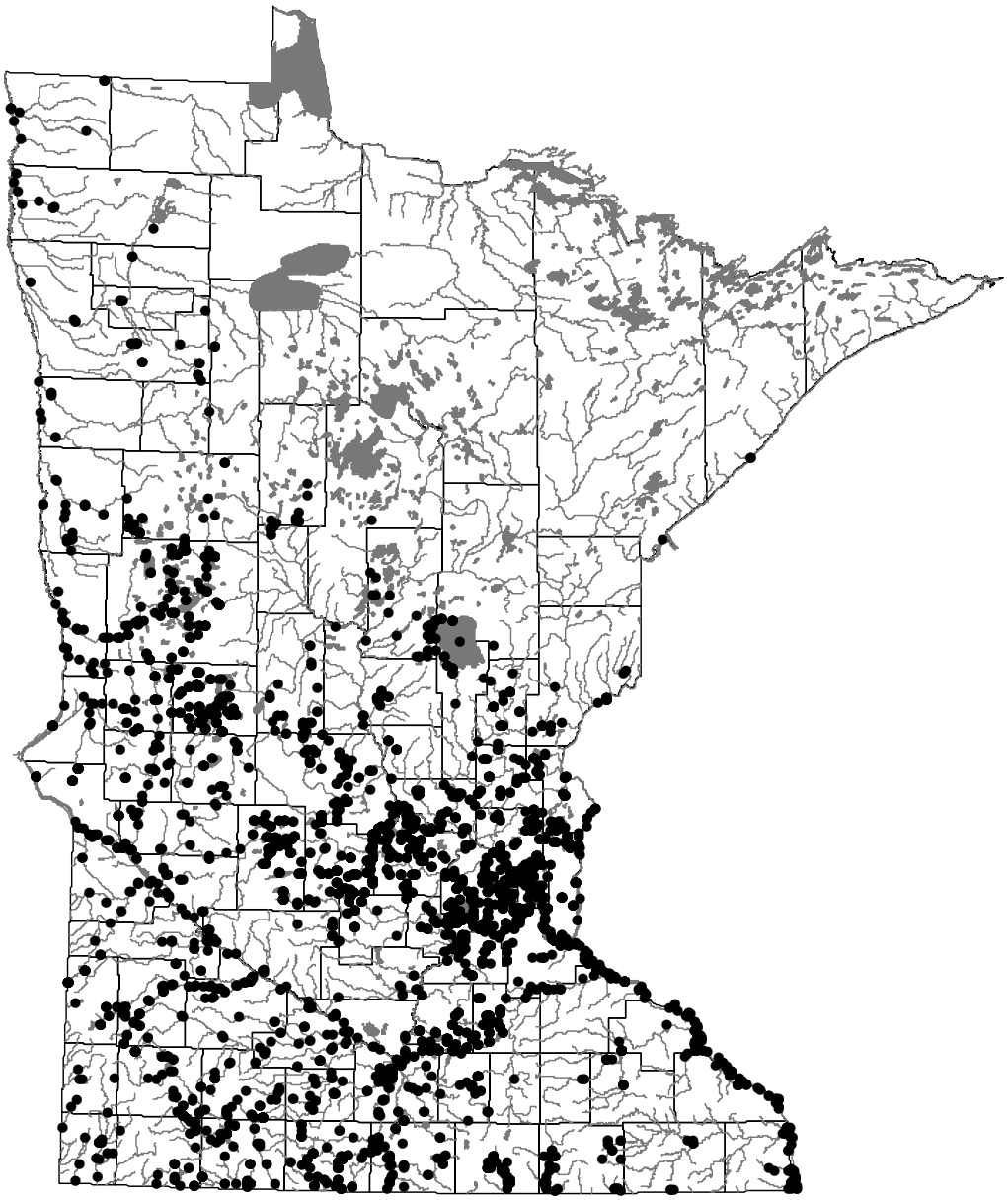


Figure 25. Distribution of common carp in Minnesota as of December 2004.

Progress in Management of Common Carp - 2004

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 60 shallow lakes by DNR Wildlife staff in 2004. 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 600 managed fishing lakes by DNR Fisheries. The results of those surveys will be available in June 2005.

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 DNR Wildlife in 2004.

Remove carp from priority lakes
A large project was conducted by DNR Wildlife at Howard and Mud lakes, shallow lakes near Carlos Avery Wildlife Management Area, to remove common carp, bullheads, and other zooplankton-eating fish. The lake was treated with Rotenone in October 2004 to kill the fish in the lake.

A similar treatment was conducted in Lake Christina in 2003. One year following application of the fish-killing agent, researchers from the Department of Natural Resources, North Dakota State University, and the University of St. Thomas are noting some positive trends in water quality and habitat conditions on the lake.
Water level drawdowns were conducted by DNR Wildlife on more than 20 shallow lakes to eliminate carp and restore aquatic vegetation.

Research

Research to identify pheromones to attract or repel carp is being conducted at the University of Minnesota, with Dr. Peter Sorenson as the project leader, in cooperation with DNR Wildlife. A report on his initial common carp research was submitted to DNR this year (Sorenson and Sherman, 2004). The report states that both visual and pheromonal cues could be employed to enhance trapping success during carp control efforts and that when employed together they have great potential. Using a large square tank with small traps, Dr. Sorenson found that male goldfish were attracted by a F-prostaglandin pheromone, that the sight of other fish was also attractive, and that when the pheromone was introduced in the presence of spawning fish, especially strong attraction was noted. His preliminary experiments using a laminar flow tank also found mature male carp to be attracted to the prostaglandin pheromone. Sorenson suggests further research to identify spawning requirements of common carp in the laboratory and field are needed, however, to guide how to incorporate these findings into a control program.

A project entitled “Developing Pheromones for Use in Carp Control” that was recommended by the Legislative Commission on Minnesota Resources (LCMR) and was subsequently funded by the Legislature continued this research at the University of Minnesota in FY 04-05. In addition to the $100,000 of state funds, the U.S. Fish and Wildlife Service (USFWS) contributed $75,000. It is hoped that the findings from the pheromone research will allow development of an integrated approach to carp management.

In 2004, the LCMR recommended additional funding of $500,000 to continue Dr. Sorenson’s research on common carp management during FY 06-09. The DNR is a partner on the proposed project and will contribute staff and equipment from DNR

Fisheries and $60,000 from the Invasive Species Program. The aim of this proposal is to develop a basic understanding of two aspects of carp biology which can be meaningfully targeted (pheromonally-mediated aggregation and spawning), and a statistical model to explore how to best target different life histories of carp, thereby establishing the foundations of an integrated control program (Sorenson, 2004).

Effectiveness

Common carp management has been only moderately effective in all types of waters within Minnesota. Nevertheless, 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 2004, participation on common carp management projects included Ducks Unlimited, Minnesota Waterfowl Association, USFWS, DNR 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 of common carp from high-priority affected waters and/or the construction of barriers to limit natural dispersal.
- Monitor the new disease, spring viremia of carp, to determine how widespread it is in Minnesota and consider new limitations on live carp shipments.

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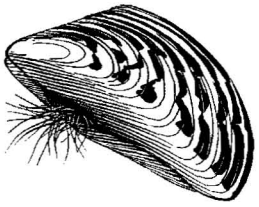
Management of Zebra Mussels

Introduction



Issue

The zebra mussel (*Dreissena polymorpha*) is a small striped invasive 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.

Goal

- Prevent the spread of zebra mussels to uninfested waters within Minnesota.

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 Ossawinnamakee, and Pelican Brook immediately downstream of Lake Ossawinnamakee (Figure 26).

Progress in Management of Zebra Mussels - 2004

Monitoring

Scuba divers in Lake Zumbro found significant settlement of zebra mussels again this year, occurring later in the season than previous years. Populations of zebra mussels in the lake are well established and continued reproduction and recruitment can be expected. Veliger sampling in Lake Ossawinnamakee showed increasing numbers of veligers in the lake, suggesting successful reproduction in this new population. Divers on one location in the lake found numerous zebra mussels of different size classes attached to rocks and wood on the lake bottom. Diving and sampling in Kimball Lake,

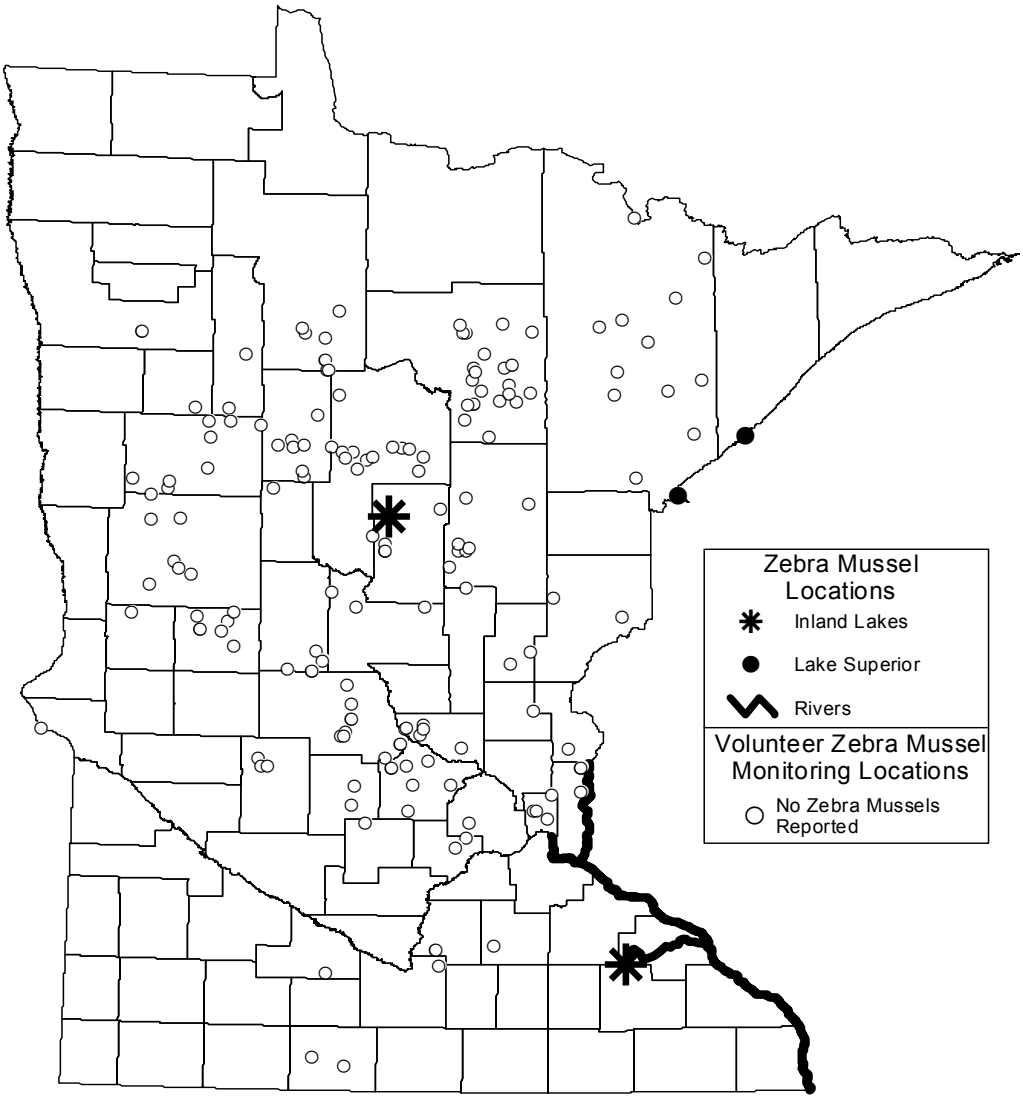


Figure 26. Zebra mussel and volunteer zebra mussel monitoring locations in Minnesota as of November 2004.

upstream of and connected to Lake Ossawinnamakee by a small creek, found no evidence of zebra mussels.

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. Reports to date from volunteers monitoring their lakeshore areas have not found any zebra mussels in any other waters of the state.

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 office by DNR biologists. No zebra mussels were found on the slides

examined for 2004, suggesting that this invasive 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

Lake Ossawinnamakee is located approximately 120 miles from the nearest zebra mussel location and presents a risk of movement to other waters in this area by boaters who may not have previously boated in zebra mussel infested waters. Watercraft inspection efforts were increased on the lake and the Brainerd area (see Watercraft Inspections and Awareness Events). Public awareness efforts were increased substantially in this area.

Zebra mussels in Lake Ossawinnamakee present two significant challenges for preventing spread. First, a small creek connects the lake with Kimball Lake, the next lake upstream from Ossawinnamakee (Figure 27). Boat traffic moving between the lakes could spread zebra mussels, particularly boats which may be moored during the summer in Lake Ossawinnamakee. To address this possible pathway, the DNR installed six large boulders in the upstream end of the creek. These rocks, while not preventing the flow of water through the channel, prevent boat movement into or out of Kimball Lake. Additionally, the DNR Brainerd Area Fisheries manager worked with the Crow Wing County Board of Commissioners, who unanimously passed an ordinance prohibiting boat traffic through the creek. While preventing boat traffic through the creek, these actions do not prevent boating on Kimball Lake, which has a public access site.

A second and more difficult challenge is that Lake Ossawinnamakee has an outlet stream (Pelican Brook), which is connected to the Mississippi River via the Pine River (Figure 27). This natural water movement pathway could permit transport of veligers from the lake eventually to the Mississippi River north of Brainerd. In an attempt to prevent downstream spread of the veligers, the DNR contracted to have copper sulfate applied weekly during the summer to the bay (Muskie Bay) feeding the outlet stream. Sampling of veligers in this treatment area and the main lake basin suggested that the copper had eliminated or significantly reduced veliger numbers in the bay. Additionally, fall sampling in Pelican Brook failed to collect any attached zebra mussels in the outlet area, despite their scattered presence in this area in the spring. While this treatment was effective as a short-term control measure, toxicity to other aquatic life and metal accumulation in sediments would prevent this from being used as an annual operational control option. The DNR is seeking technical assistance to assess viable long-term control options for this pathway.

Research

The DNR contracted with the U. S. Army Corps of Engineers Experimental Waterways Research Station to conduct laboratory studies to determine copper toxicity to veligers. Results from this study suggest that the levels of copper used in the treatments should have been highly toxic to veligers, and dosage may even be able to be reduced slightly.

While copper is effective, toxicity issues make this a short-term measure. The DNR is seeking an outside contractor to assess potential long-term control measures that could be implemented on the stream to prevent movement of veligers and other life stages.

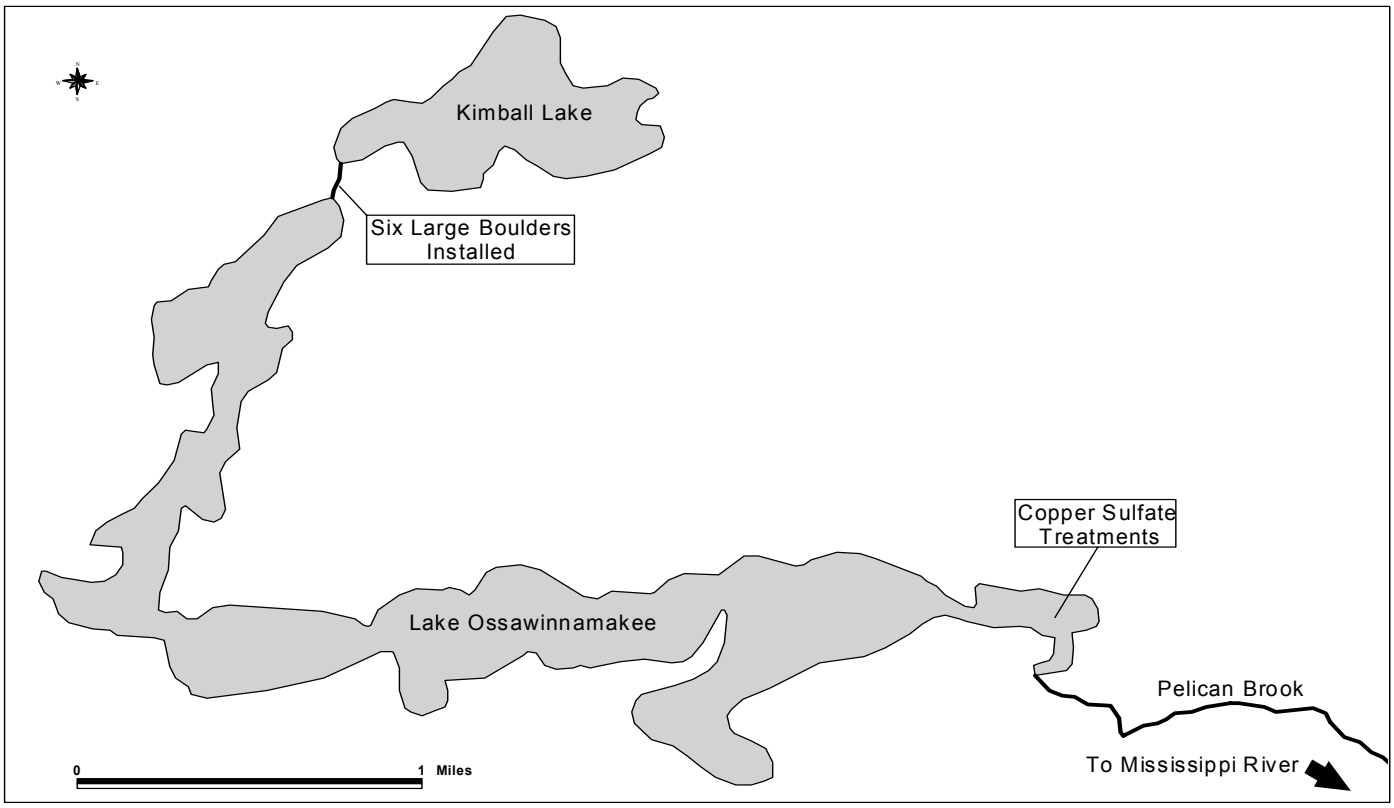


Figure 27. Lake Ossawinnamakee, Kimball Lake, and Pelican Brook.

Effectiveness of Management

Minnesota still only has two inland lakes that contain this invasive. Movement to inland waters in Minnesota has been much slower than in other Midwest states. However, the infestation in the Brainerd lakes area puts this invasive in a heavily used vacation and recreation area. Public awareness efforts were intensified in 2004 and will continue in an effort 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 approximately 200 infested inland waters. Unlike Minnesota, these states do not have statutes that prevent movement of aquatic plants, which 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 of zebra mussels 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 U.S. Fish and Wildlife Service. 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 invasive than could be conducted by the Invasive 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.

Other Invasive Animal Species in Minnesota

Introduction

Numerous invasive wild animals exist in the state. The previous chapters described species for which there were ongoing efforts. The species described in this chapter exist in the state, but there are no ongoing efforts by the DNR to manage them in the wild. They are included because they are or have been of interest within the state. In addition to the information presented on rusty crayfish, spiny waterflea, *Daphnia lumholtzi,* round and tubenose goby, Eurasian collard-dove, and mute swan in this chapter, Table 27 presents a summary of other invasive animal species in Minnesota.

Rusty Crayfish

The rusty crayfish (*Orconectes rusticus*) is an invasive 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 invasive 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 lakes or rivers. Researchers in Wisconsin are examining management of crayfish predators (specific fish species) to attempt to manage numbers of this invasive in natural lakes; however, this research is still preliminary. A recent report on crayfish control (*Investigation of Crayfish Control Technology)*, M. W. Hyatt, Arizona Game and Fish Department) looked at varying methods of control and came to the conclusion that non-specific biocides might work in very limited circumstances, but no other control method (manual removal, trapping, predator management) would eliminate crayfish. With the lack of any selective or even effective control methods, the Invasive Species Program does not conduct any active management of rusty crayfish.

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 Division of Ecological Services. 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 invasive 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 invasive can prevent predation by small larval fish as well as other aquatic animals. Some species of larger fish have been shown to feed heavily on the spiny waterflea. This invasive 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 desiccation 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. Researchers at the University of Minnesota-Duluth sampled selected lakes in the northeastern area of the state, and confirmed spiny waterflea in four lakes: Flour, Greenwood, McFarland and Pine lakes, all in Cook County. With the connections among many lakes in this area, it is very likely that the spread to other lakes may occur (or have already occurred) through natural movement. The resting eggs or viable adults can be carried through connections into other water bodies.

Fisheries staff in the Duluth area are currently working on completing a research study examining *B. longimanus* populations in Island Lake. The Aquatic Invertebrate Biology staff is assisting in laboratory work for this study.

Daphnia lumholtzi

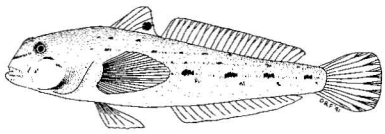
Daphnia lumholtzi is an invasive cladoceran native to the subtropical regions of Africa, Asia, and Australia. This species was first reported in North America in 1990 from a small reservoir in eastern Texas and shortly thereafter from a reservoir in southwest Missouri. Since its first sightings, it has 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.

D. lumholtzi were first found in reproductive densities in Lake Pepin in 2003. However, none were collected in standardized set sampling in 2004. Zooplankton samples have been collected from Lake Pepin since the early 1990s as part of the Long Term River Monitoring Program. 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^{o} 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. 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. 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. Cooler temperatures, increased flow from heavy precipitation, and other climatic conditions may have contributed to the lack of this invasive in Lake Pepin in 2004. Future sampling may help determine if this species will ever become a major component in the zooplankton community or sporadically occur under ideal conditions.

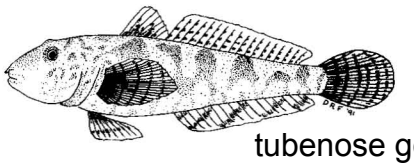
Round and Tubenose Goby

The round (*Neogobius melanostomus*) and tubenose (*Proterochinus marmoratus*) gobies (Figure 28) 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.



round goby



tubenose goby

Figure 28. The round and tubenose goby.

In 1995, the round goby was discovered in the Duluth/Superior Harbor. Since then, the population has steadily increased according to bottom trawl data from U.S. Geological Survey (USGS) (Lori Evrard, November 23, 2004). Wisconsin DNR surveys have shown a decrease in population within the St. Louis estuary, possibly due to the late spring and relatively cool summer, coupled with a slow expansion of submersed aquatic vegetation beds in which the tubenose goby seem to prefer and could have a seasonal advantage over the round goby (Dennis Pratt, November 10, 2004). The round goby has documented negative impacts on mottled sculpin reproduction (Janssen and Jude, 2001) 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.

The tubenose goby was first discovered in the St. Louis River estuary in 2001. It was originally thought to be less invasive than the round goby and recent surveys by the Wisconsin DNR and USGS actually show an increase in tubenose goby population, especially within the last couple of years (Table 25) (Lori Evrard, U.S. Geological Survey, November 23, 2004). It should be noted that the trawling data from USGS suggests that the tubenose goby population is still significantly lower than the round goby.

Table 25. Number of round and tubenose gobies captured using a seine at nine sites (Dennis Pratt, Wisconsin DNR, November 10, 2004).

	1998	1999	2000	2001	2002	2003	2004
Round Goby	14	25	316	18	148	1,836	487
Tubenose Goby	0	0	0	1	10	175	589

References Cited

Janssen, J and Jude, D.J. 2001. Recruitment Failure of Mottled Sculpin *Cottus bairdi* in Calumet Harbor, Southern Lake Michigan, Induced by the Newly Introduced Round Goby *Neogobius melanostomus*. J. Great Lakes Res. 27(3):319-328.

Eurasian Collared-dove

The Eurasian collared-dove (*Streptopelia decaocto*), a bird native to the Indian subcontinent and Turkey, was first described as a new, non-native bird species in the state in the annual report for 1999. The bird has been observed in 18 Minnesota counties from 1999 to 2003: Big Stone, Blue Earth, Brown, Carver, Chippewa, Dakota, Freeborn, Houston, Lyon, Kandiyohi, Martin, Pennington, Pipestone, Renville, Rock, Roseau, Stearns, and Yellow Medicine.

In 2004, Eurasian collared-doves were reported for the first time in the town of Marietta in Lac qui Parle County and Appleton in Swift County. They were reported again in Chippewa, Houston, Lyon, and Renville counties. Mating and nesting birds were reported in two counties. In December 2004, a flock containing 15 collared-doves was reported in downtown Benson in Swift County. The birds are likely in other Minnesota counties and will continue spreading throughout the state.

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.

Mute Swans

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. Populations of mute swans have established in numerous states. These populations have originated from release or escape of individuals from captive flocks.

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 invasive species* in Minnesota Rules 6216.0260. It is illegal to release mute swans into the wild under the game farm and regulated invasive species statutes.

Unconfined mute swans were reported in Minnesota in 2004 and in previous years. Monitoring mute swans in the wild is a strategy necessary to help DNR respond to birds that may establish naturalized populations. During 2004, the DNR recorded six reports of wild or escaped mute swans in the state. A total of 11 birds were reported in the wild in three counties (Table 26). Sources of the reports include: conservation officers, birders, calls from the public, and other DNR staff who observed unconfined birds. In 2004, of concern was a pair of mute swans that successfully nested at Big Carnelian Lake.

The DNR's goal for mute swan management is to avoid the establishment of naturalized populations of mute swans in Minnesota. Recent federal court decisions that required the United States Fish and Wildlife Service (USFWS) to protect non-native, invasive, and injurious birds under the Migratory Bird Treaty Act (MBTA) prevented the DNR from controlling mute swans for the past two years. This limitation may be removed in 2005. In mid-November 2004,

Table 26. Unconfined mute swans reported in Minnesota counties during 2004.

County	Number of swans	Month Reported
Olmstead	1	December
Rice	3	April
Washington	7	June
Total for all counties	**11**	

Congress passed an omnibus spending bill that included language to remedy the problem. The legislative remedy defines native species, which means that only those migratory birds that are native or otherwise listed by USFWS will be covered under the MBTA. This will exclude non-native species, such as mute swans. The Secretary of Interior is directed to publish, within 90 days of the bill, a list of all non-native human introduced species to which the MBTA does not apply.

In the future, the DNR has the following 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.

Table 27. Other invasive and non-native species which have been found wild in Minnesota.

Species	Status	Legal Status	Last report to include info on this species
Earthworms (various genera)	Continued public education has focused on preventing the release of earthworms.	Unlisted	2003
Eurasian swine (*Sus scrofa)*	No new reports of escaped Eurasian swine in 2004.	Prohibited	2002
Three spine and four spine stickleback (*Gasterosteus aculeatus* and *Apeltes quadracus)*	In Lake Superior.	Unlisted	2000
Red deer *(Cervus elaphus)*	No new escapes since 1999.	Unlisted	1999
Sika deer (*Cervus nippon)*	Several escapes in past years. No reports in 2004.	Unlisted	2001
Fallow deer *(Dama dama)*	Several escapes in past years. No reports in 2004.	Unlisted	2001
Ruffe (*Gymnocephalus cernua)*	No new water bodies since 1988.	Prohibited	2002

Appendix A - Invasive Species Program Staff

Title / Area of Responsibility	Name	Phone	E-mail
Invasive Species Program Coordinator - rulemaking, legislation, state representative on regional aquatic invasive species committees or panels and federal invasive 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 invasive aquatic plants	Chip Welling	651-297-8021	chip.welling@dnr.state.mn.us
Invasive Species Biologist - technical assistance for management of milfoil, curly-leaf pondweed, and other invasive aquatic plants	Wendy Crowell	651-282-2508	wendy.crowell@dnr.state.mn.us
Invasive Species Biologist - technical assistance for management of milfoil, flowering rush, and other invasive aquatic plants	Nick Proulx	651-284-3589	nick.proulx@dnr.state.mn.us
Invasive Species Biologist - invasive species issues in northern portions of the state	Dan Swanson	218-833-8645	dan.swanson@dnr.state.mn.us
Invasive Species Ecologist - invasive species issues in northern portions of the state; purple loosestrife database management	Rich Rezanka	218-833-8646	richard.rezanka@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	Vacant	651-284-3586	
Aquatic Invertebrate Biologist - zebra mussels, rusty crayfish, and other invasive aquatic invertebrates	Gary Montz	651-297-4888	gary.montz@dnr.state.mn.us
Conservation Officer - statewide enforcement of invasive species regulations for aquatic plants and wild animals	Cathy Hamm	651-772-7906	cathy.hamm@dnr.state.mn.us
General Information		651-296-2835	

Appendix B - Other State Contacts for Invasive 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 invasive 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 Invasive 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

Minnesota Department of Agriculture - Invasive Species Programs

The MDA is responsible for the state's 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

Invasive Species Unit	Teresa McDill	651-296-8448
Terrestrial Invasive Species Program	Peter Dziuk	651-296-3343

Agricultural 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 that 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 - JeanneCiborowski, MDA - Integrated Pest Management Coordinator, Ag Development Division, 651-297-3217.

Gypsy Moth Program Advisory Committee - Kimberly Thielen-Cremers, MDA - Invasive Species Unit, Agronomy and Plant Protection Division, 651-297-2428.

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: Teresa McDill, MDA - Invasive Species Unit, Agronomy and Plant Protection Division, 651-296-8448 and Jay Rendall, DNR Invasive Species Program, Ecological Services Division, 651-297-1464.