Invasive Species of Aquatic Plants and Wild Animals in Minnesota

Annual Report 2008

for the year ending December 31

Minnesota Department of Natural Resources
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Submitted to
Environment and Natural Resources Committees of the Minnesota House and Senate

This report should be cited as follows:
Invasive Species Program. 2009. Invasive Species of Aquatic Plants and Wild Animals in Minnesota: Annual Report for 2008. Minnesota Department of Natural Resources, St. Paul, MN.

Total cost to produce this report: preparation $4,600; printing $872 for 100 copies; $750 for printing 1,000 copies of the Summary

Preface

Each year, by January 15, the Department of Natural Resources (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. 6, 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, 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 2008

Invasive Species Program Expansion

With more invasive species issues facing the state and a heightened level of concern, the 2007 Minnesota Legislature increased the funding for invasive species from $2.4 million to $4.9 million annually. The increase in funding has allowed the Invasive Species Program to restructure to build capacity for the future, react quickly to new threats, and provide more support to local organizations and governments, DNR field staff, and others trying to manage invasive species. The DNR is expanding activities focused on both aquatic and terrestrial species. Specific areas include:

1) Prevention efforts
    a. expanded enforcement by DNR conservation officers;
    b. expanded the DNR watercraft inspection program;
    c. initiated a new prevention grant program.
2) Manage aquatic invasive species
    a. increased funding for management grants;
    b. added new field staff to work with lake associations and others on management efforts.
3) DNR's ability to monitor and manage invasive terrestrial plants growing on state lands and minimize the potential movement of invasive species associated with DNR activities.

<u>Enforcement</u>

A significant portion of the funding increase was allocated/used for expanded enforcement efforts. To accomplish this, an equivalent of 4.5 full time positions were added (nine officers who spend approximately half their time on invasive species) to the Division of Enforcement. The officers split their time between invasive species and wetland enforcement issues. Eight of the officers are responsible for distinct work areas in the state (Figure 1). The officers (called Water Resource Enforcement Officers) will take the lead in coordinating invasive species enforcement activities in their work areas. This includes developing a targeted plan for enforcement efforts, working with the local conservation officers on enforcement activities unique to their patrol areas, carrying out special investigations, and taking advantage of educational opportunities. Eight Water Resource Enforcement Officers began their duties on April 30, 2008. This included five officers who were promoted and began their duties as Water Resource Enforcement Officers and three existing wetland officers also began to change their focus as they transitioned into the new job description. This first season saw the officer's transition into their new positions and start to learn the invasive species issues in their work areas.

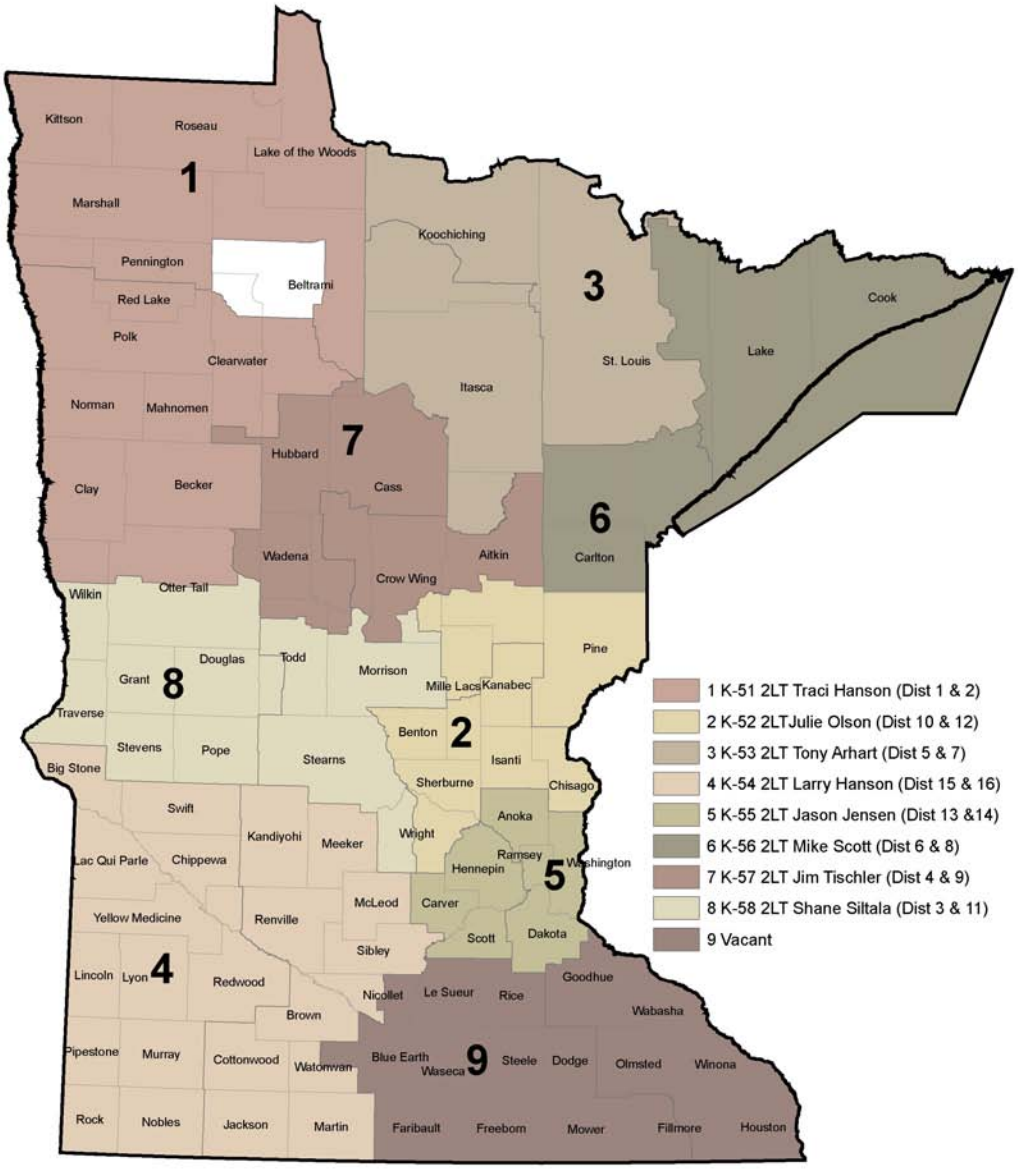

Figure 1. Water Resource Enforcement Officer Patrol Areas

Prevention Grants

In 2008, the DNR began providing grants to local groups and governments to help prevent the spread of aquatic invasive species, especially zebra mussels and spiny waterfleas into Minnesota waters. Grants were provided to help local entities (lake associations, coalitions of lake associations, local citizen groups, and local units of government (e.g., conservation districts, lake improvement districts, watershed districts, and counties) implement locally focused prevention efforts and to dove-tail those efforts with other ongoing statewide aquatic invasive species prevention efforts. One example of a statewide prevention effort is the Stop Aquatic Hitchhikers! campaign that is being implemented by the DNR, Minnesota Sea Grant, Wildlife Forever, and the U.S. Fish and Wildlife Service. In total, $50,703 of grants was awarded to 12 grantees during 2008. The grant funded portions of the grant proposals were capped at $10,000. In 2009, the DNR plans to increase the total prevention grant amount available to $100,000.

Watercraft Inspection Program

In 2008, the number of DNR watercraft inspectors was increased from 50 to 75 who 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. Watercraft inspectors logged more than 35,000 inspection hours (up from 24,000 hours in 2007) with a total of 49,300 watercraft/ trailers inspected. In 2008, nine local entities received grants for additional hours of watercraft inspection. Each grantee agreed to pay for a certain number of watercraft inspection hours with an equal match in hours from the DNR. This cooperative effort helped local entities to increase inspection hours in their areas and increase invasive species awareness.

Management of aquatic invasive species

The Invasive Species Program hired four additional invasive species specialists to work at the local level with lake associations, lake improvement districts, and local units of government on prevention and management efforts. This increases the total number of invasive species specialists in DNR field or regional offices to six.

Grant funding for the management of curly-leaf pondweed and Eurasian watermilfoil increased to $400,000, up from $300,000 in 2007. Funding was used for nuisance control of Eurasian watermilfoil and pilot lake-wide treatments of curly-leaf pondweed and/or Eurasian watermilfoil. Grant funding for management will increase again in 2009.

Zebra Mussel News

Mille Lacs Lake zebra mussel population undergoes dramatic increase

Zebra mussels were first collected in Mille Lacs Lake in August 2005. Dive surveys by Fisheries biologists documented 140 attached adult mussels in 2007. In 23 dives this season, biologists counted over 24,000 mussels with this invasive found at every dive site around the lake, except at the outlet to the Rum River. A commercial launch removed from the lake had over 1,000 young mussels attached to its hull. Water samples collected from around the lake had veligers in every sample in August and September, as well as half of the samples in July, compared to a single veliger found in 2007 samples. These data show a dramatic increase in reproduction and population levels of zebra mussels in this major angling destination. The numbers seen raise

concern about the potential of this lake to spread this invasive to other inland lakes via trailered boats, sale of docks or other gear by lakeshore residents, or water movement.

Zebra mussels spread far downstream in Mississippi River

Since the discovery of zebra mussels in Rice Lake on the Mississippi River just north of Brainerd in fall 2005, DNR Invasive Species Program staff have been monitoring/tracking their spread downstream. Sampling in 2006 and 2007 found some isolated mussels a few miles downstream of the dam in Brainerd. However, this season reports from the public and staff documented small settled zebra mussels below the dam in Little Falls. Shoreline surveys in the impoundment above the dam recorded numerous sites with hundreds of attached mussels of different sizes. This suggests that the zebra mussels have moved at least this far downstream, and have established another large reproducing population in this impoundment on the river. Unconfirmed reports from the public have put zebra mussel sightings as far downstream in the river as Sartell. This rapid movement suggests that zebra mussels soon may become abundant from Brainerd all the way downstream to existing dense populations in Lake Pepin and beyond. Mississippi River boaters may be unaware of the high numbers and need to exercise care in cleaning their watercraft and emptying water to prevent further spread. Also, power plants, water utilities, and other water-using industries will likely need to undertake new prevention and maintenance in response to increasing zebra mussel populations in the river upstream of the Twin Cities.

Figure 2. Zebra mussels attached to native mussel in Lake Mille Lacs.

Three Asian Carp Species Caught in Mississippi River

In November of 2008, A Wisconsin licensed commercial fishermen caught five Asian carp in seines in Pool 8 of the Mississippi River that extends from La Crosse, Wisconsin to Reno, Minnesota (Figure 3). Three species of Asian carp were found: one silver carp, at least one and likely two bighead carp, and two grass carp. The catch of the 6-pound, 24-inch silver carp in the Minnesota-Wisconsin border waters represents a large extension of the range for that species in the Mississippi River. The previous northernmost confirmed report of a silver carp was near Clinton, Iowa—more that 150 miles downstream. It is likely that high water in many rivers south of Minnesota in 2008 appears to have enabled northward range expansions of the Asian carp species. Lock and dam structures are generally barriers to upstream migrations of fish, but when floodwaters overtop the dams, fish can swim past them and move upstream.

Figure 3. A silver carp caught in Pool 8 of the Mississippi River in November 2008.

Status of Invasive Species in Minnesota: 2008

Aquatic Plants

Eurasian watermilfoil was discovered in 12 additional water bodies during 2008. The total number of milfoil infested water bodies is 215.

Purple loosestrife was found in 21 new sites in 2008, bringing the total number of known infestations to 2,379.

Curly-leaf pondweed is known to occur in 759 lakes in 70 Minnesota counties.

Flowering rush was found in two additional lakes–Lake Tetonka and Upper Sukatah in LeSueur County.

Brazilian elodea was found in Powderhorn Lake in Minneapolis in 2007 and was treated with an herbicide. No plants were found in Powderhorn Lake in 2008.

Wild Animals

Zebra mussels are currently found in eight inland lakes, isolated areas of Lake Superior, the Mississippi River from Crow Wing County to the Iowa border, the St. Croix

River from Stillwater downstream, Pelican Brook and the Zumbro River downstream from Lake Zumbro (see hot topics for more information).
No new **New Zealand mudsnail** infested waters were discovered in the state in 2008.
Spiny waterflea continues to spread along Minnesota-Canada border waters (Figure 4).
Chinese and banded mystery snails are being reported in Minnesota waters—more than 80 occurrences of the Chinese mystery snail and 50 occurrences of the banded mystery snail have been reported.
Mute swans were found at five locations in 2008. A total of six birds were reported in the wild.

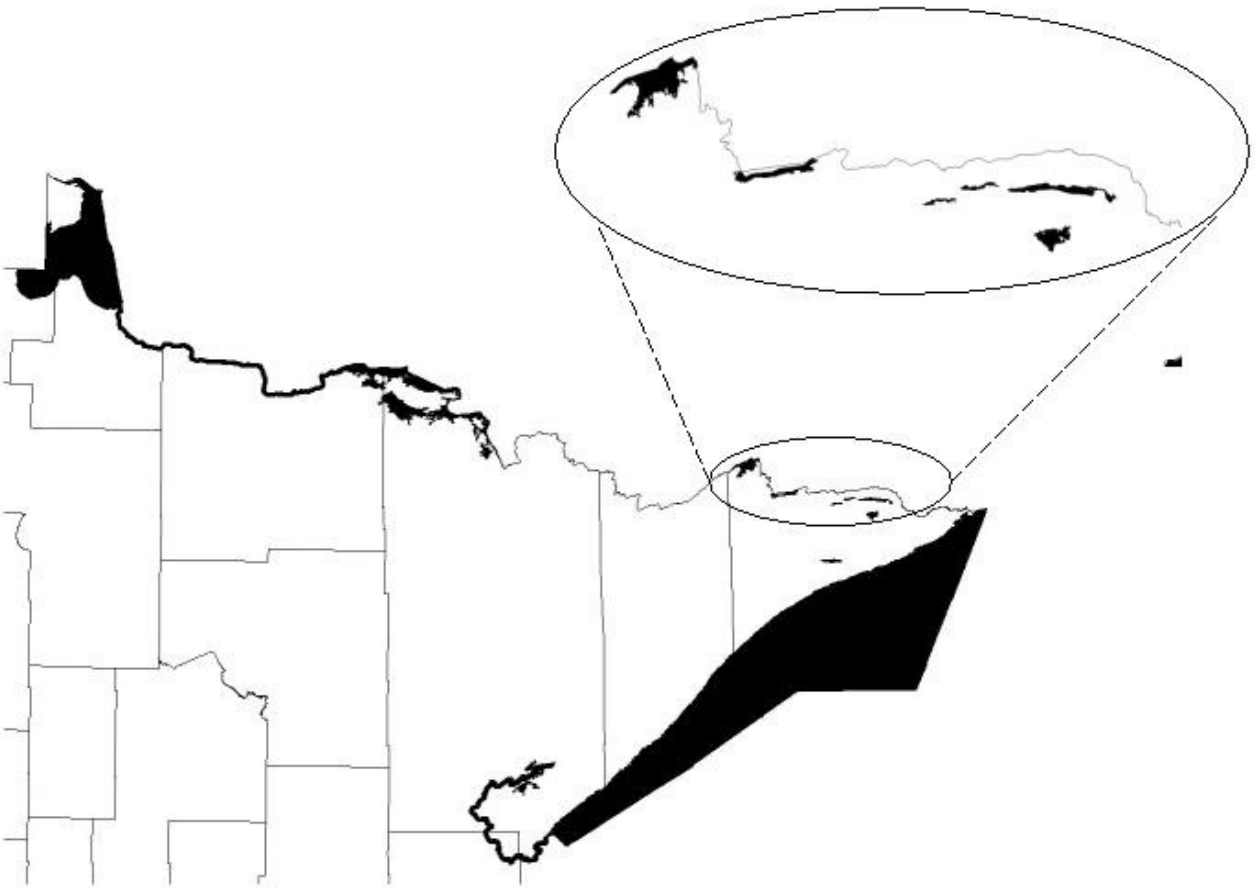

Figure 4. Spiny waterflea infested rivers and lakes in Minnesota as of November 2008.

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 are a threat to 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.

Program Goal Highlights

1. Prevent introductions of new invasive species into Minnesota

Keeping new invasive species out of Minnesota is a high priority for the environment and the state's economy. New introductions are costly to manage and may become perpetual problems.

Regulations

Regulations help prevent activities or practices that carry a high risk of introduction. In 2008, the legislature made two technical changes to portions of Minnesota Statutes 84D that clarify: 1) a trailer or watercraft can be placed in the waters of the state with aquatic vegetation for shooting or observation blinds only if attached in or on a watercraft; and 2) a trailer, a watercraft, or plant harvesting equipment may not be placed in waters of the state if it has aquatic plants attached.

The legislature also passed legislation requiring the operator of a vessel that is designed, constructed, or adapted to carry ballast water in state waters of Lake Superior to conduct ballast water management operations of the vessel according to a ballast water management plan that meets the requirements prescribed by the Minnesota Pollution Control Agency.

State statutes now allow the designation of infested waters via DNR Commissioner's Order instead of rulemaking. Outdated permanent rules that listed infested waters are in the process of being repealed through the process for eliminating obsolete rules.

Education

Education efforts explain the risks posed by invasive species and the steps that people and businesses can take to prevent new introductions. New education efforts, including training sessions, presentations, and informational materials, were offered to the public and bait dealers to help raise awareness about aquatic invasive species.

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. After an invasive species becomes established in our lakes and rivers, a primary means for its spread to other waters is the unintentional transport on boats, trailers, and other recreational equipment.

Watercraft inspections
In 2008, approximately 73 watercraft inspectors worked through the summer providing information to the public. Inspections began in late April and continued through mid-October in order to reach waterfowl hunters. Within this 25-week period, watercraft inspectors logged 35,000 inspection hours, inspected 49,300 watercraft, and distributed more than 8,200 Invasive Alert Tags. In addition, inspections were conducted at 34 fishing tournaments.

The Watercraft Inspection Program also worked cooperatively with eight 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 Invasive Species Program provided training, equipment, and supervision. The Lake Minnetonka Conservation District (LMCD) worked with the Invasive Species Program for the seventh year. Inspectors spent an additional 1,846 hours on four Lake Minnetonka accesses because of the funding provided by the LMCD.

Enforcement
Conservation officers spent 4,163 hours enforcing the invasive species laws and rules. Statewide, there were 22 civil citations, two criminal citations, and 18 written warnings issued to individuals for violation of invasive species laws. Conservation officers assisted with training approximately 20 local authorities in and around the Lake Minnetonka area. This training was given to meet the training requirement that Peace Officers need in order to issue civil citations (see hot topics for more information).

3. Reduce the impacts caused by invasive species

Grant program for control of curly-leaf pondweed or Eurasian watermilfoil
The DNR increased funding for its pilot project grant program for lake-wide control of curly-leaf pondweed or Eurasian watermilfoil. Grants totaling $230,000 was given to 14 lakes under this program for control efforts or for the collection of pre-treatment data. In addition, $105,000 in grants was given to 22 lakes to control nuisance populations of Eurasian watermilfoil. Legislation passed in 2007 requires that all applications for grants to manage invasive plants in public waters have a workable plan for improving water quality and reducing the need for additional treatment. Grants also may not be made for chemicals that are likely endocrine disruptors. These requirements will be included for grants given in 2008 and 2009.

Coordination and Cooperation Among Groups that Manage Invasive Species

The successes achieved in preventing and managing invasive species result from cooperation among various organizations. Management of curly-leaf pondweed, Eurasian watermilfoil, and purple loosestrife involves cooperation with local lake associations and units of government. Efforts to prevent new introductions into Minnesota often involve the participation of DNR staff in state and regional groups such as the Minnesota Invasive Species Advisory Council (MISAC) and the Mississippi River Basin Panel on Aquatic Nuisance Species. These partnerships help to develop uniform messages in educational products and ensure information sharing about new and existing invasive species. MISAC held the first statewide invasive species conference on October 26-29 in Duluth. More than 400 participants attended conference that

focused on aquatic and terrestrial invasive species issues. MISAC members, including the DNR, provided sponsorship, coordination and presentations for this highly successful conference.

Revenue and Expenditures

Funding for the Invasive Species Program includes a $5 surcharge on watercraft registered in Minnesota and a $2 surcharge on non-resident fishing licenses (which makes up the Invasive Species Account), appropriations from the general fund account, Environment and Natural Resources Trust Fund as recommended by the Legislative-Citizen Commission on Minnesota Resources, and local contributions. These funding sources generated $3,014,000 for invasive species prevention and management activities for the 2008 fiscal year.

Aquatic invasive species spending for fiscal year 2008 is shown in Figure 5. The Management/Control and Inspections/Enforcement categories account for 64% of aquatic invasive species spending. These two spending categories along with expenditures for Education/Public Awareness activities, reflect the importance the Department places on efforts to prevent the spread of invasive species and to help manage the problems those species cause once they become established.

In addition, the Invasive Species Program received federal funds from the U.S. Fish and Wildlife Service and the U.S. Forest Service for a variety of research projects.

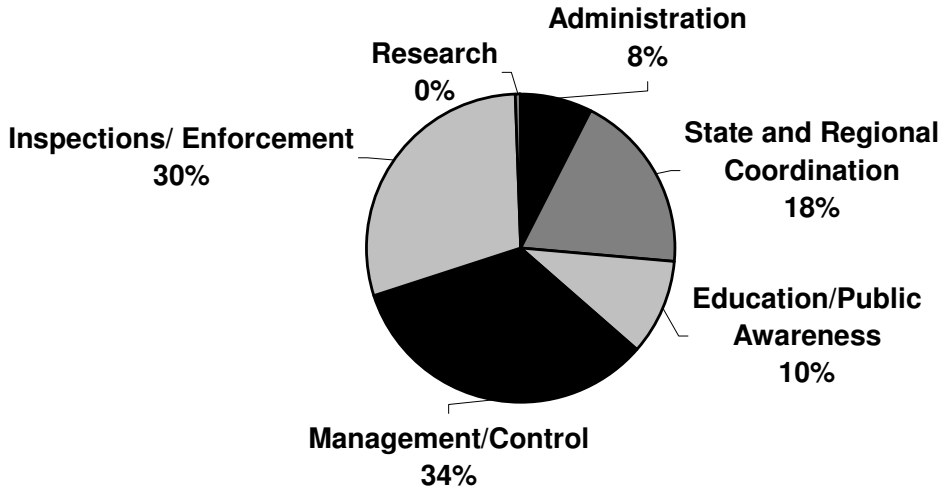

Figure 5. Aquatic Invasive Species Program spending from the Invasive Species Account and General Fund in FY08 by major categories.

Introduction

Overview of DNR's Invasive Species Program

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 are a threat to the state's natural resources and local economies that depend on natural resources.

To address the problems caused by invasive species, the 1991 Minnesota Legislature directed the Minnesota Department of Natural Resources (DNR) to establish the Invasive Species Program and to implement actions to prevent the spread and manage invasive species of aquatic plants and wild animals. Single species programs preceded this comprehensive program. In 1987, the DNR was designated the lead agency for control of purple loosestrife, and in 1989, the DNR was officially assigned a coordinating role for Eurasian watermilfoil control (Minnesota Statutes 84D.02, Subd. 2).

The three primary goals of the DNR 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.

The DNR Invasive Species Program, addresses many invasive species that are present in Minnesota such as Eurasian watermilfoil, purple loosestrife, zebra mussels, and spiny waterfleas (see Appendix A). The 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 and Risk Management). Prevention efforts are often undertaken in collaboration with other states, agencies, and partners with similar concerns.

Most of the Invasive Species prevention and management activities are conducted or directed by staff from DNR's Division of Ecological Resources-Invasive Species Program (See Appendix B). In addition, the Invasive Species Program hires about 75 students during the summer to inspect boats at public water accesses and help implement management activities. Staff from the DNR divisions of Fish and Wildlife and Enforcement, as well as the Bureau of Information and Education, also contribute significantly to the implementation and coordination of invasive species activities. In total, the equivalent of over 20 full-time positions are focused on invasive species work.

The Program has begun to address terrestrial plant species on DNR managed lands. Within the DNR, our goal is to enhance the ability of field staff to effectively manage terrestrial invasive plants on DNR managed lands. Key strategies include: 1) coordinate inventories of public lands for invasive species; 2) gather, maintain, and share knowledge of integrated pest management (chemical, mechanical, and biological

control) for invasive terrestrial plants; 3) fund management efforts on state-managed lands; and 4) develop or improve management practices through research (i.e., biological control).

With invasive species issues continuing to grow and a heightened level of concern, the 2007 Minnesota Legislature increased the funding for invasive species from $2.4 million to $4.9 million annually. The increase in funding has allowed the Invasive Species Program to restructure to build capacity for the future, react quickly to new threats, and provide more support to those trying to manage invasive species. The DNR is expanding activities focused on both aquatic and terrestrial species. Specific target areas include:

4) expand grants to help groups manage invasive aquatic plants;
5) expand enforcement efforts by DNR conservation officers;
6) expand watercraft inspection program;
7) expand efforts to prevent the introduction of invasive aquatic invertebrates;
8) expand DNR's ability to monitor and manage invasive terrestrial plants growing on state lands and minimize the movement of invasive species associated with DNR activities;
9) expand DNR efforts to identify activities that have a high risk of moving invasive species and work with the groups/businesses involved to reduce risk; and expand public awareness efforts.

Many of these program expansions are underway including, 1) hire additional invasive species specialists to work at the local level with lake associations, Lake Improvement Districts, and local units of government on prevention and management efforts; 2) hire nine new conservation officers who will work approximately half time on invasive species issues; 3) increase the number of watercraft inspectors from 50 to 75; and increase funding for prevention and management of aquatic invasive species. You can read about these efforts in detail in the following chapters of this report.

Other DNR Support

Staff from the DNR divisions of Fish and Wildlife and Enforcement, and the Bureau of Information and Education contribute significantly to the implementation and coordination of invasive species activities.

Pesticide enforcement specialists from Ecological Resources and Aquatic Plant Management Specialists in DNR Fisheries assist with the management of various invasive plants including purple loosestrife, Eurasian watermilfoil, curly-leaf pondweed, and flowering rush. In addition to these staff, other individuals from the Division of Fish and Wildlife and the Division of Ecological Resources contribute by providing biological expertise, assisting with control efforts, conducting inventory and public awareness activities, and providing additional avenues for public input.

The Division of Enforcement plays a key role in the prevention and containment of invasive species. Conservation officers are responsible for enforcing the state regulations regarding invasive species of aquatic plants and wild animals. The Water Resource Enforcement program acts as the lead on invasive species enforcement within the Division of Enforcement to coordinate enforcement activities, including

scheduling, executing, and reporting on enforcement activities related to invasive species. A chapter describing enforcement activities is included in this report (see Enforcement).

Staff from the Bureau of Information and Education provide support for the Invasive Species Program's public awareness activities (see Education and Public Awareness).

Other State Invasive Species Control Programs

The DNR and the Minnesota Department of Agriculture (MDA) administer prevention and control programs for other invasive 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 bark beetles. Once an invasive forest pest becomes established in the state, DNR Forestry becomes responsible for management of the species. The DNR's Forest Health Protection Team prepares a separate annual report.

The MDA is the lead regulatory agency to address terrestrial invasive species, i.e., noxious weeds, gypsy moth, emerald ash borer, sudden oak death, under authority in Minnesota Statutes, Chapter 18G,H, J and Chapters 18 and 21. 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 Aquatic Invasive Species Information Center in Duluth. The Center promotes education and outreach to prevent the spread of aquatic invasive species in the state.

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 County Agricultural Inspectors Advisory Committee, and the Weed Integrated Pest Management Group.

The DNR Invasive Species Program and others in the state participate in multiple regional and federal activities regarding invasive species. Participation on panels, such as the Mississippi River Basin Panel on aquatic nuisance species, helps keep Minnesota informed of regional and federal efforts regarding invasive species and provides a voice for Minnesota interests.

Additional regional groups that the DNR is involved with include, but not limited to:

- St. Croix River Zebra Mussel Task Force (see Appendix B);
- National garlic mustard biocontrol working group; Midwest Invasive Plant Network;
- Council of Great Lakes Governors Aquatic Invasive Species Task Force;
- National Asian carp work group that drafted a national Asian Carp Management and Control Plan.

Development of a Statewide Invasive Species Management Plan

Several state, federal, and private entities are in the process of developing a state invasive species plan for aquatic and terrestrial invasive species. While the MDA and DNR are mandated to have invasive species response plans, several other agencies

and organizations are interested in helping implement the plan and are reviewing the plan framework to determine which of the actions they can help implement. A combined plan will provide a common structure for coordinating and guiding invasive species detection and response efforts, and encourage input from partners. Efforts to complete a statewide invasive species management plan were on hold for much of 2008 due to other invasive species demands. Completing the draft for public review and finalizing the plan will be resumed in early 2009.

Expenditures

Funding Sources

Funding for activities conducted by the Invasive Species Program comes from a variety of state, federal, and local sources. The 2007 Legislature passed legislation that made significant changes in both the level and the sources of state funds for Invasive Species Program activities. Those funding changes are described below; most of the program changes that result from the new funding will be implemented by the December 2008.

State Funds

The primary funding source is a $5 surcharge on the registration of watercraft in Minnesota. The surcharge on Minnesota watercraft generates sufficient funds to allow an annual appropriation of approximately $1,200,000. The 2007 Legislature established a new $2 fee on non-resident fishing licenses that will generate approximately $173,000 in FY08 and $400,000 in FY09 (the first full year of non-resident license fees collection). The amount of general fund appropriations was also increased (additional $970,000) for aquatic and terrestrial invasive species prevention and management. In addition, the 2007 Legislature created an "Invasive Species Account" in which all watercraft surcharge and non-resident fishing license proceeds are held.

Prior to 2008, the Legislature appropriated additional funds from "regular" watercraft license receipts. The "Surcharge" column in Table 1 includes both surcharge and non-surcharge appropriations from the Water Recreation Account. Funding was expanded by the 2006 Legislature; an additional $550,000 from the general fund was appropriated.

Table 1. State and local funding (in thousands of dollars) received by the Invasive Species Program, fiscal years 2003, 2004, 2005, 2006, 2007, 2008 and 2009.

Fiscal Year	Surcharge[2]	Invasive Species Acct	General Fund	Legislative Citizen Commission on Minnesota Resources[1]	Local Contributions	Total
2003	1,191			45	11	1,247
2004	1,582			55	19	1,656
2005	1,641			54	17	1,712
2006	1,795			100	42	1,937
2007	1,795		550	100	53	2,498
2008	53	1,349	1,520	100	45	3,014
2009	53	2,142	2,740	100		

[1] State appropriations, as recommended by the LCCMR, from the Environment and Natural Resources Trust Fund or the Minnesota Resources Fund or both.
[2] Includes funds appropriated directly to the Division of Enforcement for invasive species work.

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-Citizen Commission on Minnesota Resources (LCCMR) (Table 1). Currently, the LCCMR recommended additional funding for garlic mustard and buckthorn biocontrol research during the FY06/07 and FY08/09 bienniums.

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 2. 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 2. Recent proposals submitted by the Invasive Species Program that received federal funding.

Category	Federal Fiscal Year[1] Grant Awarded	Calendar Year(s) Used	Grant Amount (1000s of $)	Source
Implement St. Croix management plan for aquatic nuisance species				
	2004	2005	71	USFWS
	2005	2006	73	USFWS
	2006	2007	46	USFWS
	2007	2008		USFWS
Research on biological control of European buckthorn				
	2003	2004-05	50	USEPA
Research on biological control of garlic mustard				
	2007-09	2007-09	75	USFS
	2003-06	2004-07	225	USFS
	2006	2006	10	USFWS
	2007-08	2008-09	75	USFS
Terrestrial invasive plant management				
	2005	2005-07	200	USFWS

[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 2007, eight local groups provided funding so that the number of watercraft inspections on specific lakes could be increased. See Watercraft Inspections and Awareness Events for a more detailed account of these cooperative efforts.

Timeframe

This report covers activities in calendar year 2008, which includes the last half of the Minnesota fiscal year 2008 (FY08), January 1-June 30, 2008, and the first half of fiscal year 2009 (FY09), July 1-December 31, 2008. To provide a comprehensive review of expenditures and to meet the report's January 15, 2009 due date, we report on expenditures that were incurred in FY08 (July 1, 2007-June 30, 2008).

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, State and Regional Coordination, has been added to cover a variety of program-wide or "big-picture" activities that do not fit easily into the reporting categories required by statute. Expenditures within each category are subdivided to reflect the program activities described in the following chapters.

Administration

Administration includes *Support Costs* assessed by the Division of Ecological Resources for general office supplies, office rent, telephones, postage, workers' compensation fees, computer support fees, and the state accounting system fees. Administration also includes *Clerical* costs and *Administrative Support* costs that fund administrative staff that work for the divisions of Fish and Wildlife and Ecological Resources. This category also includes charges assessed by the Department to cover operational support costs. Staff leave time (time used for holidays, sick leave, and vacation) has been apportioned across all categories based on the proportion of staff time invested in that category.

State and Regional Coordination

This category includes a variety of activities and expenditures. *State coordination* includes general program planning, preparation of state plans and reports (including this document), and general invasive species coordination with a wide variety of groups. This category includes the work of program staff as well as various managers in the Division of Ecological Resources who periodically work on invasive species issues. For example, program staff and managers meet with groups such as Minnesota Waters and the Lake Minnetonka Conservation District to discuss state activities and to coordinate efforts. Program staff are also members of state-level coordinating groups, such as the Minnesota Invasive Species Advisory Council, 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 2008 include: a Mississippi River Basin Panel on Aquatic Nuisance Species (ANS) meeting, participation on conference calls associated with the Council of Great Lakes Governors ANS Initiative, and a regional workshop focused on Promoting Regional ANS Cooperation and Coordination. "Training, supervising, related work" represents a variety of work activities that staff participate in to improve their skills, direct co-workers, or help on other projects. 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 or curly-leaf pondweed 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, better risk assessment tools, and to 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 2008 (FY08) Expenditures

Expenditures on aquatic invasive species activities during FY08 (July 1, 2007-June 30, 2008) totaled $2,532,000. Expenditures from the "Invasive Species Account," the largest single source of funding, are listed along with spending from other accounts (Table 3). Grants received from various state or federal funding sources, such as LCCMR recommended appropriations and the USFWS, are other examples.

As is shown in Table 3, $686,000 was spent on terrestrial invasive species management and research activities. That work was funded exclusively from the general fund and by grants from other organizations. Accomplishments for terrestrial invasive species management activities are found in the proceeding chapters.

The $1,345,000 of Invasive Species Account expenditures during FY08 (Table 3) were less than the $1,349,000 appropriated by the Legislature (Table 1). The remaining unspent FY08 funds will be available for spending in FY09.

Figure 6 provides a broad outline of how the funding was spent from the "Invasive Species Account" and the general fund for aquatic invasive species. Within Figure 6, the Management/Control category ($800,000) and Inspections/ Enforcement category ($705,000) represent two largest segments of the budget; these two categories accounted for 64% of aquatic invasive species expenditures in FY08. The focus on those two categories, plus Education/Public Awareness which represents an additional 10% of FY08 spending, reflects the priority the Department places on efforts to prevent the spread of invasive species and to help manage the problems those species cause.

Eurasian watermilfoil and curly-leaf pondweed are the two invasive species that received the most focus based on dollars spent. FY08 spending targeted specifically at Eurasian watermilfoil was $197,000; $327,000 was spent on curly-leaf pondweed. This is a substantial increase from 2007. Spending also substantially increased for enforcement and watercraft inspections related to prevention efforts. Individual chapters of this report provide details on the activities accomplished with those funds.

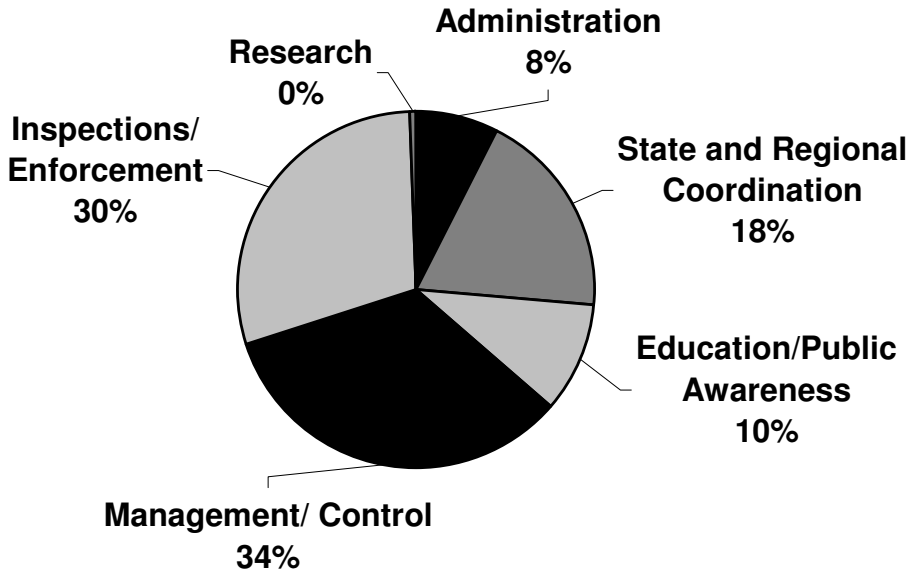

Figure 6. Aquatic Invasive Species Program spending (Invasive Species Account and General Fund only) in FY08 by major categories.

Fiscal Year 2009 (FY09) Future Expenditures

Since this report is due in the middle of FY09, projected expenditures for that fiscal year are not reported. A comprehensive review of FY09 expenditures will be provided in the 2009 Annual Report.

The expansion of funding from the 2007 Legislature will allow substantial increases in a number of invasive species activities in FY09. The Department intends to expand activities focused on both aquatic and terrestrial species. Specific target areas include:

1) expand grants to help groups manage invasive aquatic plants;
2) expand enforcement efforts by DNR conservation officers;
3) expand watercraft inspection program;
4) expand efforts to prevent the introduction of invasive aquatic invertebrates;
5) expand DNR's ability to monitor and manage invasive terrestrial plants growing on state lands and minimize the movement of invasive species associated with DNR activities;
6) expand DNR efforts to identify activities that have a high risk of moving invasive species and work with the groups/businesses involved to reduce risk; and
7) expand public awareness efforts.

These new efforts will be described in detail in next year's report.

The chapters that follow describe, in detail, the activities that were conducted during calendar year 2008 with FY08 and FY09 funds.

Table 3. Invasive species related expenditures in fiscal year 2008 (FY08) (in thousands of dollars).

Categories of Expenditures	Invasive Species Account FY08	General Fund FY08	Other Funding Sources FY08
Administration			
Division Support Costs			
Regional Representation			
Clerical			
Administrative Support			
Subtotal	**56**	**123**	**6**
State and Regional Coordination			
State coordination			
Support regional/federal activities			
Training, supervision, related work			
Equipment and services			
Other			[3]2
Subtotal	**268**	**178**	
Education/Public Awareness			
Radio spots, TV, Web site development			
Other			
Subtotal	**57**	**180**	[1,3]86
Management/Control			
General	135	71	--
Eurasian watermilfoil	101	93	--
Purple loosestrife	46	--	--
Zebra mussel	8	--	--
Curly-leaf pondweed	74	253	--
Flowering rush	8	--	--
Other aquatic invasive species	11	--	--
Terrestrial invasive species	--	208	[3]206
Subtotal	**383**	**625**	**206**
Inspections/Enforcement			
Watercraft inspections	569	9	[1]53
Enforcement - access checks	--	72	[1]53
Prevention - laws/risk assessments	2	--	**--**
Subtotal	**571**	**81**	**106**
Research			
General	3		--
Eurasian watermilfoil	3		--
Purple loosestrife	<1		--
Other aquatic species	4		[1]20
Terrestrial Invasive Plants	--	18	[1,2,3]254
Subtotal	**10**	**18**	**274**
Total	**1345**	**1205**	**680**

[1]Other DNR funding, [2]LCCMR funding, [3]federal funding
*Subtotals are rounded to the nearest thousand

Prevention and Containment

Introduction

Issue

Two key elements in addressing invasive species are: preventing introductions of new invasive species; and containing existing invasive species infestations to avoid their spread to other locations. They fit into the overall approach to invasive species of:

- Prevention,
- Early Detection and Rapid Response,
- Containment, and
- Management.

Goals

The state goals related to these elements are below.

> *"Seek to prevent the introduction of new invasive species in Minnesota"*
>
> *"Continue to contain infestations where eradication is not possible"*

Progress in Prevention and Containment - 2008

Several prevention and containment activities are addressed in other chapters of this report: Regulations, Enforcement, Watercraft Inspections and Awareness Events, and Education and Public Awareness. A few of the prevention highlights in those chapters include:

- Hiring nine new conservation officers that work 50% of their time on invasive species;
- Expanding the watercraft inspection efforts by increasing from 50 to 75 inspectors;
- Identifying and designating additional infested waters;
- Expanding the Stop Aquatic Hitchhikers! campaign in the state with partners such as Minnesota Sea Grant, Wildlife Forever, and the U.S. Forest Service.

Some prevention and containment activities that are not covered in other chapters are discussed below.

Early Detection and Rapid Response

In August 14, 2008, the DNR Invasive Species Program received a report of water hyacinth on the shore of Crookneck Lake in Morrison County by a person conducting an aquatic vegetation survey. On August 18, 2008, DNR staff inspected the shoreline of Crookneck Lake and found that water hyacinth (*Eichhornia crassipes*) was growing at the location where it had been reported (Figures 7 and 8). DNR staff contacted the property owner and asked if he knew that water hyacinth was along his shoreline. The property owner acknowledged that he had planted it there several weeks earlier. The property owner was told that since it was an invasive aquatic species, either he should remove the plants from the shoreline or DNR would remove the water hyacinth. The owner asked the DNR to remove the plants (Figure 9).

Figure 7. Water hyacinth growing on the northeast shore of Crookneck Lake, Morrison County, August 18, 2008.

Figure 8. Water hyacinth on Crookneck Lake shore, August 18, 2008.

Figure 9. Water hyacinth hand pulled, bagged, and removed from Crookneck Lake, Morrison County, August 20, 2008.

Prevention Grants

In 2008, the DNR began providing grants to local groups and governments to help prevent the spread of aquatic invasive species, especially zebra mussels and spiny waterfleas into Minnesota waters. Grants were provided to help local entities (lake associations, coalitions of lake associations (COLAs), local citizen groups, and local units of government (e.g., conservation districts, lake improvement districts, watershed districts, and counties) implement locally focused prevention efforts and to dove-tail those efforts with other ongoing statewide aquatic invasive species prevention efforts. One example of a statewide prevention effort is the "Stop Aquatic Hitchhikers!" campaign, which is being implemented by the DNR, Minnesota Sea Grant, Wildlife Forever, and the U.S. Fish and Wildlife Service. In total, $50,703 of grants was awarded to 12 grantees during 2008 (Table 4). The grant funded portions of the grant proposals were capped at $10,000.

The four types of grants or partnership projects eligible are described below:

Watercraft Inspections - DNR Watercraft Inspectors

This is a cooperative hiring program where the local organization provides funding for salaries (at $12/hour) and the DNR hires watercraft inspectors to work at local water accesses. The DNR provides/grants an equal amount of inspection hours (up to the maximum grant amount) to those funded by the local entity. The cooperating organization provides input into scheduling the hours of inspection. For example, if a local group provides $2,000 for local inspections, which is 166 hours of inspection at $12/hour, then DNR provides an additional 166 hours at local accesses. DNR will also recruit, hire, and schedule the inspectors, and provide supervision, insurance, and social security costs.

Watercraft Inspections - Non-DNR Watercraft Inspectors

Local government units (LGU) can hire watercraft inspectors for work at local waters. DNR will train the inspectors and provide grant funds for 50% of the inspection costs.

The LGU must recruit, hire, and schedule the inspectors, and provide supervision, insurance, social security and potential unemployment costs. There were no participants in this type of grant during 2008.

Public Awareness - Projects with standard designs or audio/video provided
DNR provides newspaper, TV, and radio ads, and billboards and gas pump ad designs that include local grantee names/logos. Grantee provides 50% of ad costs and makes all arrangements. Grantees who used billboards coordinated with DNR and Wildlife Forever on billboard placement.

Public Awareness - Customized Public Awareness Projects
Grants from DNR provide 50% of the cost to develop and implement local prevention projects. Grantees and DNR staff work on local projects with bait dealers, local marinas, or dock haulers, or develop new literature and signage. Grantees can provide their half of project costs through work hours necessary to accomplish the project and/or funds to produce new informational products.

Proposals were evaluated and grant amounts determined based on whether they met the following criteria:

- were focused on zebra mussels and/or spiny waterfleas;
- were located at or near infested waters or high use waters;
- were located in high use or popular traveler destination areas;
- was a combined effort of local groups who applied for the grant (e.g., COLA level, multi-lake or multi organization projects).

Table 4. Summary of Prevention Grants awarded in 2008.

Local Entity	Grant Awarded	Grant Types	Specific Grant Activities
Big Sandy Lake Association	$3,468	DNR Watercraft Inspectors	
Big Watab Lake Association	$1,224	DNR Watercraft Inspectors	
CMSCWD	$2,313	DNR Watercraft Inspectors Custom Products	
Gull Chain of Lakes Association	$4,625	DNR Watercraft Inspectors	
Hubbard County COLA	$8,820	Standard Public Awareness Custom Products	Billboards, signs at resorts Resort cards and packet, Custom road signs
Lake Minnetonka Conservation District	$9,500	DNR Watercraft Inspectors	
Friends of Lower Hay Lake Association	$1,700	DNR Watercraft Inspectors	
Lake Minnetonka Association	$1,280	Custom Products	Wallet size lake map with message
Pelican Lake Property Owners Association (PLPOA)	$9,500	DNR Watercraft Inspectors Custom Products	
Pelican Group of Lakes Improvement District (PGOLID)	$4,128	DNR Watercraft Inspectors Custom products	Brochure
Pike Lake Association	$2,295	DNR Watercraft Inspectors	
Sportsmen's Club of Lake Vermilion (SCLV)	$1,850	Standard Public Awareness	Billboard

In 2009, DNR will expand the total prevention grant amount available to $100,000. A request for proposals will call for new proposals to be submitted to DNR by February 1, 2009. Grants for 2009 will be awarded by March 1, 2009.

Infested Waters Permits

Minnesota Rules, Chapter 6216 prohibit the diversion and transport of water from designated infested waters except by permit. In 2008, there were several requests to transport infested water and to divert infested waters. The following entities obtained infested waters permits in 2008 from the DNR Invasive Species Program:

- Center for Drug Design, University of Minnesota - for research;
- FLW Outdoors - for a fishing tournament weigh-in;
- Frankie's Marine - for a fishing tournament weigh-in;
- Heartland Chevrolet Dealers - for a fishing tournament weigh-in; and
- St. Paul Regional Water Services - for the St. Paul water supply.

Other applications were reviewed and potential permits discussed by Invasive Species Program staff and DNR Division of Waters staff. The types of pumping and screening requirements in the permits are still being worked on with the following applicants:

- Powderhorn Lake - for pumping water out of a milfoil and brittle naiad infested lake to lower the water level;
- Snail Lake Improvement District - for pumping water into Snail Lake from a zebra mussel infested lake to raise the water level; and
- Union-Sarah Lake Improvement District - for pumping water out of milfoil infested lake to lower the water level.

Prohibited Invasive Species Permits

State law prohibits the possession, transport, sale, purchase, and import of prohibited invasive species except by permit. In 2008, several permits were issued to entities that did research or control of prohibited invasive species in the state. Permits, with conditions to avoid spread, were issued to the following:

- Dow Corning Corporation Environmental Services - zebra mussel;
- University of Connecticut - brittle naiad;
- University of Minnesota - curly-leaf pondweed, Eurasian watermilfoil, purple loosestrife, sea lamprey;
- University of Minnesota Duluth - round goby;
- USDA Forest Service - purple loosestrife; and
- Xcel Energy Environmental Services - zebra mussels.

Permits to Harvest Bait from Infested Waters

Under state statutes and rules, the commercial harvest of bait from infested waters is prohibited, except by permit. DNR Fisheries issued permits to bait dealers who attended training in the past three years and passed a written test in the current year. Permits are issued with several conditions to prevent the transfer of invasive species from infested waters including a requirement that nylon tags must be attached to equipment used in infested waters and it may not be used in non-infested waters.

Boat Wash Evaluation

The DNR, on occasion, receives inquiries about installing boat washing stations at public water access sites to reduce the risk of introduction and transport of aquatic invasive species (AIS) by recreational activities. Boat washing is a general term for the use of high-pressure water spray to remove invasive species from the exterior of boats, trailers, and equipment. Boat washes/sprayers can be a useful tool for removing invasive species, but this is only one step in prevention.

Changing behavior to emphasize “inspections and removal” is the highest priority (e.g. getting people to take action to **inspect** their boat, trailer, and equipment and **remove** any plants, animals, and mud from inside and outside boats, trailers, and equipment, **dispose** of unwanted bait in the trash, **wash then dry** boat, tackle, downriggers, trailer, and other recreational equipment to remove or kill harmful species that were not visible at the water access). This is important because often AIS are inside boats or personal watercraft impellors, and on anchors or anchor lines, fishing lines, lures, downriggers that may not be cleaned by some types of boat washing systems.

Currently, the feasibility and effectiveness of boat washes at water accesses is unknown. To gain more information, the DNR may consider one or two pilot boat wash projects on public water accesses owned or managed by the DNR. These projects would be allowed for the purpose of evaluating the feasibility, costs, and use of boat washes for preventing AIS spread. Length of trial could last up to three years. Requirements and standards for a pilot boat wash have been developed by the DNR. The cost to install a boat wash at a public access that meets the standards set by the DNR could range from $10,000-$30,000. Any group proposing the boat wash would be responsible for all costs to install and maintain the boat wash. To date, only one lake association has shown interest, but has chosen not to proceed at this time.

Pilot Removal and Draining Station - Lake Ossawinnamakee

In 2008, representatives from the Brainerd area lake associations encouraged the DNR to develop a pilot project at the public water access on Lake Ossawinamakee. The purpose of the project was to make it much more apparent to boaters that they should take actions at the access for prevention and containment purposes. This is important because the lake is a designated infested water and contains Eurasian watermilfoil and zebra mussels. During the first half of 2008, DNR staff worked with local representatives to plan the modifications to the access (Figures 10 and 11). The following changes were made to determine the response by boaters:

- removed outdated signs;
- installed a new *Stop Aquatic Hitchhikers* sign in a location where entering vehicles would see it;
- moved an existing kiosk to a new location and changed the sign in the kiosk to create a focal point for a ”removal and draining station” for boaters leaving the access;
- installed a disposal bin for boaters to place unwanted bait, aquatic plants, and zebra mussels;
- placed concrete slabs in the pavement to make the removal and draining station more evident to exiting vehicles.

Following the completion of these steps, a local conservation officer reported that boaters were stopping at and using the removal and draining station including the disposal bin.

Figure 10. Signs for entering vehicles at public water access at Lake Ossawinnamakee.

Figure 11. Disposal bin and kiosk at the removal and draining station at Lake Ossawinnamakee.

Education and Public Awareness

2008 Highlights

- Funding for public awareness projects was provided to lake associations and other local groups through a new DNR Prevention Grant Program.
- Outdoor media was used to raise awareness about current invasive species threats. Billboards and advertising placards were placed at 29 locations along key travel corridors, targeting motorists traveling to west central and northern Minnesota.
- The Minnesota Invasive Species Advisory Committee held the first statewide conference on invasive species in Duluth to increase understanding of invasive species issues and management.

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, aquarium owners, 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 - 2008

Similar to previous years, 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, educational displays and exhibits, informational signs at public water accesses, and training.

Radio

Radio was used 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, Fourth of July, and Labor Day. The stations were selected for their listener profiles which correspond with those of boat owners. In addition, paid ads and public service announcements were aired on Minnesota News Network, reaching 57-affiliate stations throughout greater Minnesota in May, July, and August.

In late summer, ads were placed in the Duluth market, Brainerd Lakes area, Twin Cities, and southeastern Minnesota (Rochester and Winona) where zebra mussel infestations occur. Ads were also placed on stations in Baudette and International Falls to raise awareness about spiny waterfleas and other invasive threats along Minnesota's northern border waters.

In addition, public service announcements (PSAs) were made available to Minnesota radio stations along with communication encouraging program managers to play the announcements. The PSAs are available 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). The PSAs were distributed throughout the spring and summer boating season and into fall for the waterfowl season.

Television

Paid television advertising was used this year in the Duluth market during July and August to remind viewers of the continuing concerns about invasive species in the area. The 30-second ad features a DNR conservation officer alerting boaters and anglers about the threat of zebra mussels, round gobies, and New Zealand mudsnails and the steps they can take to help prevent the spread of these invasives. The ad aired during morning and evening newscasts leading into popular outdoors segments including "Sportsman's Notebook," "Gone Fishin'," "Up North," and "Pro's Pointers."

A second version of the spot was created to air in other markets where zebra mussels and Eurasian watermilfoil are a primary concern. This version was shown throughout the summer and early fall on "Minnesota Bound," a popular half-hour program that appeals to both outdoor enthusiasts and general audiences. The ad also aired in the LaCrosse area to reach viewers in southeastern Minnesota/southwestern Wisconsin.

In addition, spots concerning zebra mussels and Eurasian watermilfoil were scheduled on metro area cable stations to coincide with a variety of outdoor programs.

Newspapers and informational materials

A newspaper advertising campaign also was completed in 2008. 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 daily newspapers in targeted areas of the state including Brainerd, Duluth, Rochester, Twin Cities, and Winona in spring and summer. The ads also ran in several specialty newspapers reaching boaters, campers, anglers, outdoor enthusiasts, and tourists.

Newspaper coverage continued in the Mille Lacs and Aitkin newspapers to keep attention on the discovery of zebra mussels in that area of the state. In addition, ads were placed in newspapers covering northern Minnesota including Baudette, International Falls, and Warroad to help raise awareness about the continuing spread of spiny waterfleas along the U.S.-Canadian border waters.

Watercraft inspectors, DNR creel census clerks, conservation officers, bait dealers, and the National Park Service continued to distribute a 4- x 6-inch card informational card,

which was developed to raise awareness about spiny waterflea infested waters in northern Minnesota.

Distribution of the *Help Stop Aquatic Hitchhikers* brochure continued this year. The publication provides information about actions that recreationists can take to help minimize the spread of aquatic hitchhikers. Distribution efforts are ongoing to sport and outdoors shows, special events, and information kiosks. The brochure was also distributed to 10 travel information centers located at Albert Lea, Beaver Creek, Dresbach, Fisher's Landing, Grand Portage, Moorhead, St. Cloud, St. Croix, Thompson Hill (Duluth), and Worthington. The centers are a primary information source for motorists traveling to key recreation destinations in Minnesota.

The 2008 *Minnesota Fishing Regulations* included a section on invasive aquatic species. Descriptions and illustrations of several invasive species were included in the booklet along with a summary of invasive species laws and other pertinent information. 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 invasive plants and animals. The guide is updated annually and was distributed this year to more than 300,000 boaters.

Information about invasive species also was included in the 2008 edition of the *Explore Minnesota Fishing Guide*, a publication of Explore Minnesota 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.

Watercraft inspectors, conservation officers, and other groups helped distribute information cards that provide references to state laws at zebra mussel infested waters.

Outdoor media

DNR partnered with Wildlife Forever, U.S. Forest Service, USFWS, Hubbard County Coalition of Lake Associations, Sportsmen's Club of Lake Vermilion, and Minnesota Sea Grant to develop and post billboards with the "Stop Aquatic Hitchhikers!" message at 15 locations on key state travel routes to and from lake areas.

The DNR also purchased advertising space at gas stations and convenience stores in 14 locations along several main travel routes to northern Minnesota. The purpose of the advertising campaign was to raise awareness about spiny waterfleas and how to prevent their spread in this important recreation area.

News releases

News releases alerting the public about 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.

DNR Web site
The DNR's Web site pages covering invasive species and related information are updated regularly (www.dnr.state.mn.us/eco/invasives.html) to provide the most current information available on invasive species issues. In addition to profiles of many invasive species, 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, lists of invasive species and infested waters, as well as 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 at the Minnesota State Fair and other events to discuss invasive species issues and also distribute literature and information. DNR watercraft inspectors staffed the display throughout the State Fair providing a venue for visitors to ask specific questions about invasive species while visiting the exhibit. The display was updated recently to include a new, three-sided kiosk with information for water gardeners and aquarium owners, tips for preventing the transport of nuisance species, and updates on new areas of concern. An estimated 800,000 people visit the DNR's exhibits at the Minnesota State Fair each year.

DNR staff also participated at various outdoor, boating, and fishing events including the Minnesota Green Expo, Minneapolis Boat Show, Northwest Sportshow, and Farm Fest. Staffing events such as these provides an opportunity to educate the public about invasive species issues as well as to provide a variety of informational materials that people can take home with them for reference.

As a collaborative effort among partners, Minnesota Sea Grant led design of two new floor displays this year for use at various shows. The displays incorporate messages about how to stop the spread of invasive species and builds on ongoing information and education efforts. In July, 1,200 visitors were reached during Lake Superior Days (Duluth) at an educational booth, co-hosted by Minnesota Sea Grant and Minnesota DNR watercraft inspectors. The displays were also used at several county fairs in northeast Minnesota.

Special Events
The DNR, Minnesota Sea Grant, and Brainerd Lakes area lake associations provided invasive species information to attendees of the Minnesota Governor's Fishing Opener, held at Breezy Point Resort in May. Species identification cards, brochures, and promotional items were part of an information packet that was distributed to participants.

Grants
A new grant program was established to help local entities throughout Minnesota develop programs or products with the goal of raising public awareness about preventing the introduction and spread of invasive species, and, in particular, zebra mussels and spiny waterfleas. Lake associations, local government units, and citizen groups were eligible to apply for the grants, which were awarded on a dollar-for-dollar match basis. (see Prevention).

Exhibits

Underwater Adventures

Visitors to the Underwater Adventures aquarium at the Mall of America in Bloomington can learn about Invasive species. The exhibit includes a large silver carp model, a "Habitattitude" message about not releasing unwanted pets into the wild, and a continuous loop video on Asian carp.

Minnesota Zoo

An update of the Minnesota Trail at the Minnesota Zoo provided an opportunity to add invasive species messages and a silver carp model to the exhibit. Education trunks were also provided for ongoing educational events at the Zoo.

Cabela's

An educational exhibit and supporting Traveler Information System (TIS) was established at the Cabela's store in Owatonna in late 2005. The DNR worked with the USFWS, Pacific States Marine Fisheries Commission, and Minnesota Department of Transportation on this project.

The exhibit features three major components: a habitat diorama of aquatic invasive species, including painted depictions or replicate mounts of zebra mussels, silver and bighead carp, snakehead, goby, ruffe, spiny waterflea, sea lamprey on lake trout, Eurasian watermilfoil, curly-leaf pondweed, and water chestnut seeds; a large plasma screen TV displaying DVD footage of invasive species information and imagery; and an interactive computer kiosk with a field guide of aquatic invasive species, what we can do to prevent their spread, and what agencies are doing to address the problems.

Boat washing program

The DNR worked on a collaborative effort with Minnesota Waters, Minnesota Bass Federation, Minnesota Sea Grant, and other local partners in the Brainerd lakes area for the fourth consecutive year. The region is a popular vacation and fishing destination and the risk of spreading aquatic invasive species from one body of water to another is extremely high. Patterned after a similar effort in South Dakota, the project was designed to encourage boaters to wash and dry their boats before entering or upon leaving a body of water.

Area car wash owners were contacted to find out if they would be willing to participate in the program and promote their facilities as boat and trailer wash stations. The facilities first had to meet specific criteria required by the DNR to ensure that they were suitable for washing boats and recreational equipment.

A collateral piece listing the participating car wash facilities along with a location map was produced and distributed to local convenience stores, bait shops, travel information centers, and sporting goods retailers. The publication explains why it is important to wash boats and trailers and provides step-by-step instructions for removing invasive species from recreational equipment.

Public water accesses

DNR watercraft inspectors completed more than 35,000 hours of inspection (see Watercraft Inspections and Awareness Events), providing boaters with information and tips on ways to reduce the spread of invasive species. In addition to the expanded efforts of watercraft inspectors, conservation officers spent more than 900 hours educating boaters about public access regulations (see Enforcement).

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. 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 2006, 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 Minnesota 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 at that time: 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 invasive species and results show that this investment is producing significant increases in public awareness and preventive actions taken. In another 2000-2001 survey question, 99% of Minnesota boaters said they were very likely or somewhat likely to take precautions.

In 2006, 99% of Minnesota boaters and anglers surveyed at locations where watercraft inspectors work said that they would be influenced by the Stop Aquatic Hitchhikers campaign to take action in the future to prevent the spread of aquatic invasive species (AIS). Of these, 89% said they would be "very likely" and 10% said they would be "somewhat" influenced by the campaign. Similarly in 2007, 99% said they would take action in the future, however, a slightly higher percentage (92%) were "very" influenced to take action. Comparatively, 94% of Iowa and 98% of Wisconsin boaters and anglers surveyed in 2006 said they would be influenced to take action, however, the percentage of boaters and anglers grew by about 15% from "somewhat likely" in 2006 to "very likely" in 2007. Together, these results strongly indicate that the Stop Aquatic Hitchhikers! Threats campaign not only can raise awareness, it can change behavior, thereby, working to prevent the spread of AIS.

Participation of Others in Public Awareness Activities

"Stop Aquatic Hitchhikers!" Campaign

Public awareness initiatives continue to build upon efforts to extend and evaluate the national "Stop Aquatic Hitchhikers!" *c*ampaign along key invasion corridors in Minnesota, Wisconsin, and Iowa. A federal grant from the National Oceanic and Atmospheric Administration/Sea Grant and funds from other federal and state sources enabled several collaborators including the Minnesota, Iowa, and Wisconsin DNRs, Wisconsin Sea Grant, Cabela's, Wildlife Forever, Crystal Pierz Marine, Minnesota Arrowhead Association, Minnesota Waters, and Minnesota Rivers Council to implement a multi-media campaign in 2006 and 2007. The campaign featured the "Stop Aquatic Hitchhikers!" logo and prevention messages on highway signs, billboards, display panels at rest areas, television, radio, and newspaper ads, kiosks at retail outlets, gas pump toppers, lawn banners, windshield tags, and stickers. A face-to-face and self-administered survey during 2006-2007 has been evaluated and indicates that the campaign changed boater awareness and behaviors.

National "Habitattitude" Campaign

*"*Habitattitude*"* is a national public education campaign launched in fall 2004 to prevent the release of unwanted aquarium fish and plants into the environment by aquarists and water gardeners. The government-industry-academia coalition was formed in partnership with the Pet Industry Joint Advisory Council, the USFWS, and the National Oceanic and Atmospheric Administration's Great Lakes Sea Grant Network, led by Minnesota Sea Grant. The campaign's logo and "don't release" message are appearing on fish bags, new aquaria, brochures and other print media, news releases, newsletters, and ads in hobbyist magazines across the country. The campaign's Web site www.habitattitude.net provides resources to campaign partners and consumers. The DNR became a partner on the campaign in late 2005. The Invasive Species Program and MinnAqua Program are two DNR entities that are involved in campaign efforts in Minnesota along with Minnesota Sea Grant and Region 3 of the USFWS.

Minnesota Sea Grant has worked to broaden the campaign partnership in the state. Joining Minnesota Sea Grant and the USFWS are the Minnesota DNR, the Minnesota Pollution Control Agency, the University of Minnesota Extension Service, the Minnesota Nursery and Landscape Association, the Great Lakes Aquarium, the Lake Superior Zoo, and the City of Duluth's Environmental Advisory Council. Results of a 2005 consumer

survey suggest that public education can prevent the release of unwanted aquarium fish and plants, resulting in environmental protection.

In 2008, Minnesota Sea Grant promoted the campaign at 11 presentations, displays, events, and through print materials. At the 2008 Minnesota Green Expo, Minnesota Sea Grant, Extension, Water Resources, Minnesota DNR, USFWS, and the Minnesota Nursery and Landscape Association promoted a *Wise Water Ways!* educational booth. Over 625 professionals from garden centers, nursery, turf, and landscape design businesses visited the booth.

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.

Minnesota Invasive Species Advisory Council

The Minnesota Invasive Species Advisory Council (MISAC) produced a 2009 invasive species wall calendar highlighting 12 non-native invasive species that are potential threats in Minnesota. The publication contains information about each of the featured species such as keys to identification, means of spread, and impacts. This is the fifth year MISAC has produced the calendar, which was distributed to natural resource, agricultural, highway, and other professionals throughout the state. The project was a cooperative effort of MISAC members to raise awareness of all types of invasive species and to direct the recipients to the Council's Web site at www.mda.state.mn.us/misac/ where they can obtain further information. The DNR is a member and co-chair of MISAC.

MISAC also held the *Minnesota Invasive Species Conference 2008* (MNISC 2008) in Duluth on October 26-29. It was co-chaired by the University of Minnesota Sea Grant Program and the Minnesota Chapter of the Soil and Water Conservation Society . The event brought together for the first time terrestrial and aquatic invasive species issues in a statewide conference forum in Minnesota. Its purpose was to improve local management and minimize the impacts of terrestrial and aquatic invasive species in Minnesota by *Acting Locally to Protect Our Legendary Lands and Waters*. Over 120 presentations by experts covered 67 invasive species, including 44 terrestrials and 23 aquatics, many of which are already here and causing economic and environmental impacts. Although billed as a statewide conference, over 435 people attended, including people from eight other states and Ontario. Non-technical and technical workshops for the public and professionals were well attended. Topics ranged from earthworms and gypsy moths to aquatic topics such as lake vegetation management. A trade and educational expo showcased business products and services, educational exhibits, and a poster session. The *Restore the Balance Youth Program* poster and essay contest was hosted by the Great Lakes Aquarium. Awards were presented to three very deserving youths from the Duluth/Cloquet area for their excellent posters (see http://www.minnesotaswcs.org/Invasives.htm).

The first Carol Mortensen Invasive Species Management Award 2008 was presented to Dr. David Ragsdale, University of Minnesota. Bonnie Harper-Lore, Federal Highway Administration, was presented the Lifetime Achievement Award.

According to the conference evaluations, it was very successful:

- 96% thought the conference achieved its goals;
- 96% said they gained an understanding of invasive species issues;
- 93% of conference participants and 98% of workshop participants plan to implement knowledge gained at the conference, with dozens of participants providing specific examples; and
- 94% of conference participants and 98% of workshop attendees think that outcomes will improve local management and minimize the impacts of terrestrial and aquatic invasive species in Minnesota (and beyond).

MISAC plans to host more conferences in the future. Comments received during the event will be used to guide future content.

Wildlife Forever

Wildlife Forever continued to be a key partner to raise awareness in 2008. They lead a cooperative effort to place Stop Aquatic Hitchhikers! billboards in Minnesota and other states as well as Stop Aquatic Hitchhikers! panels in the Minneapolis-St. Paul airport.

Traveling Trunks

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. Educators can obtain the trunks from several organizations including 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.

Minnesota Sea Grant

The University of Minnesota Sea Grant Program provides leadership and expertise in outreach, education, and research programs concerning aquatic invasive species (AIS). The program has served as a liaison between interest groups, communities, businesses, industry, agencies and task forces across Minnesota and beyond. Several highlights of Minnesota Sea Grant's outreach and research activities in 2008 related to aquatic invasive species in Minnesota are listed below:

- In 2008, Sea Grant promoted the Stop Aquatic Hitchhikers! campaign at 23 presentations, displays, events, and through print materials. Sea Grant co-chaired an AIS session at the *Making a Great Lake Superior Conference* (Duluth), and provided two presentations, a poster, and display featuring the campaign.
- Sea Grant staff provides leadership on state, regional and national task forces including the Minnesota Invasive Species Advisory Council, the Great Lakes Panel on ANS (new at large member for 2008), St. Croix River AIS Task Force, the Council of Great Lakes Governors' Clean Boats Everyday Initiative, the Lake Superior AIS Prevention Project Team, and the ANS Task Force's Communication, Outreach, and Education Committee.
- Sea Grant promoted the AIS-Hazard Analysis and Critical Control Point Program (AIS-HACCP) based on a grant from the Great Lakes Protection Fund that involved all seven Great Lakes Sea Grant programs. In 2008, Sea Grant

conducted a nationwide assessment of HACCP efforts and found that nationally, an estimated 1,035 plans are in place by businesses and agencies.

- Sea Grant played a key role as co-chair of the Minnesota Invasive Species Conference in 2008. Many Sea Grant staff provided assistance before and during the conference.
- Staff worked with the University of Minnesota Extension and Water Resource Center to revise shoreland education resource materials and sponsor workshops. Invasive species issues were featured in several editions of the *From Shore to Shore* newsletter.
- Sea Grant educates youths about AIS by promoting and distributing lesson plans, traveling resource kits and curricula to teachers and educators. Several youth education events included: River Quest (Duluth), Earth Day (Cloquet), and Proctor High School Early Earth Day, St. Michael's Lakeside Elementary School (Duluth), and Girl Scouts North Shore Day (Duluth). Working with Michigan Technological University through the Upper Peninsula Center for Science, Mathematics and Environmental Education, Sea Grant continued to help design and implement the Great Lakes Maritime Transportation K-12 Education Program for Teachers, Students, and Communities. Staff assisted with coordination of the program and supplied technical information on invasive species and maritime transportation issues. The goal of the program is to generate additional information for educational modules, teaching trunks, and a Web site that could be used by both teachers and students throughout the Great Lakes states to learn more about the opportunities and issues involved in Great Lakes maritime transportation.
- Sea Grant staff provided assistance and direction to the U.S. Coast Guard (USCG) Ninth District's Prevention Division in organizing and facilitating a workshop to discuss vessel ballast water management plans and best management practices with respect to the intra-lake movement of AIS and diseases, especially slowing or preventing the spread of viral hemorrhagic septicemia virus (VHSv). The goal was to develop an integrated rapid response protocol to address a VHSv outbreak within the Great Lakes. Over 40 participants attended the *Great Lakes Ballast Water Management Workshop* in Cleveland, January 2008, representing leaders from six Great Lakes state agencies, six U.S. federal agencies, two Canadian provinces, Transport Canada, Environment Canada, science, academia, and domestic and international shipping interests. Outcomes resulted in a new collaborative detection and notification process for AIS or diseases at state and regional levels. The USCG will leverage resources to better communicate with the maritime industry of developing problems. The maritime industry, in collaboration with state and federal agencies, will revise its ballast water best management practices.
- Sea Grant partnered on the *Great Ships Initiative*, which will test vendor-produced technologies for controlling AIS via ballast water discharge. From a research facility in Superior, Wisconsin, test results concerning the efficacy of treatment systems will be used internationally. Sea Grant will continue to provide outreach support in 2009.
- Sea Grant communications co-led production of *Lake Superior Ballast Water Research,* Superior Science News Radio Show mp3 file (7:16). Several articles about ballast water were published in various regional newsletters and periodicals.

- Since its creation in 2005, Sea Grant has supported the *Sugarloaf Learning Cart,* a traveling cart with a summer field naturalist who interacts with residents and tourists at attractions and state parks along the North Shore. In 2008, the naturalist reached 1,100 people about AIS and Lake Superior at events from Duluth (Canal Park) to Grand Marais. The program is operated by the Sugarloaf North Shore Stewardship Association in partnership with Minnesota Sea Grant, the Western Lake Superior Sanitary District, and Minnesota State Parks in Lake and Cook counties.

Future needs for public awareness in Minnesota

- Maintain spending on paid public awareness radio/TV spots and newspaper ads to reinforce high awareness of invasive species by watercraft users.
- Continue to make public awareness of zebra mussels in Minnesota near Brainerd, Twin Cities, the northern border waters, 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 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 invasive species available through 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

Enforcement of Minnesota's invasive species regulations is key to reducing the risk of their spread into and throughout Minnesota. Enforcement activities in general are geared towards changing behavior. Enforcement is key to changing the behavior of those who may intentionally or unintentionally move invasive species.

The vast majority of prevention efforts have targeted recreational boaters who may unintentionally spread invasive species through movement of watercraft, fishing equipment, and water from infested lakes. Boater behavior is not fully impacted by education alone. Enforcement of invasive species regulations can be an additional incentive, due to legal and monetary consequences, to obey invasive species laws.

It has become clear that recreational boating, however, is not the only pathway in which aquatic invasive species are spread. Movement of docks and boatlifts, bait industry activities, as well as aquatic plant and fish sales are only a few of the other pathways in which invasive species may spread. Targeted enforcement of all major pathways can help prevent the spread of invasive species

For many years, the DNR's Division of Enforcement has played a key role in this effort. With the continued spread of invasive species and the threat of new species that may enter Minnesota, Enforcement will play a continued vital role in the DNR's prevention efforts.

The primary goals of the DNR's Enforcement activities are to prevent the spread of invasive species into and within Minnesota. Key activities include:

- Reducing the risk of spread by trailered boats
- Quickly responding to reports that invasive non-native wild animals have escaped from captivity
- Responding to complaints of water appropriation and movement of equipment involving infested waters or prohibited species, without the proper permits.
- Investigating other pathways of spread such as food markets, bait dealers, aquatic plant dealers, etc.
- Training local law enforcement to enforce invasive species laws.

The Division of Enforcement develops an annual statewide Invasive Species Enforcement Plan. These annual work plans describe, in detail, the responsibilities of each enforcement district in meeting various responsibilities, including invasive species, and ensure that appropriate work activities and levels are accomplished. Plans are revised as funding and issues change.

Progress in Enforcement Efforts - 2008

Expanded enforcement

Beginning in 2008, the DNR's budget for aquatic invasive species increased from $2.4 million to $3.9 million annually. A significant portion of the increase was targeted for expanded enforcement efforts. To accomplish this, an equivalent of 4.5 full time positions were added (nine officers who spend approximately half their time on invasive species) to the Division of Enforcement. The officers split their time between invasive species and wetland enforcement issues. Eight of the officers are responsible for distinct work areas in the state (Figure 12). The officers (called Water Resource Enforcement Officers) will take the lead in coordinating invasive species enforcement activities in their respective work areas. This includes developing a targeted plan for enforcement efforts, working with the local conservation officers on enforcement activities unique to their patrol areas, carrying out special investigations, and taking advantage of educational opportunities. The eight Water Resource Enforcement Officers began their duties on April 30, 2008. Five of these officers were promoted and began their duties as Water Resource Enforcement Officers on April 30, and three existing wetland officers also began to change their focus as they transitioned into the new job description. This first season saw the officers transition into their new positions and start to learn the invasive species issues in their work areas.

Initial efforts Include:

- Officers received a call of a large boat being brought to a marine outlet on Lake Minnetonka. The hull of the vessel was covered with zebra mussels. The vessel had been moved from a marina on the lower St. Croix River. The driver transporting the boat was aware of the transportation regulations, but did not think that they applied to zebra mussels that were apparently dead. The driver of the transport vehicle and the marina operator who shipped the vessel were issued warnings.
- Officers responded to a bridge construction site on the Mississippi River in St. Cloud. The construction company was in the process of launching work barges whose hulls were completely covered with zebra mussels. The construction company was issued two civil citations for transporting zebra mussels.
- Water Resource Enforcement Officers and local officers worked with DNR Watercraft Inspection staff at two accesses on Lake Minnetonka in August on an "Information and Education" detail. The focus of the detail was to speak to boaters and make them aware of the Division of Enforcement's presence as well as to increase awareness to transportation of aquatic vegetation. During the four-hour detail, well over 300 boaters were checked and spoken to at two different accesses.
- Water Resource Enforcement Officers assisted with training approximately 20 local authorities in and around the Lake Minnetonka area. This training was given to meet the training requirement that Peace Officers need in order to issue civil citations.
- Conservation officers responded to bait harvest from infested waters on Rainy Lake. Officers responded to a call to the Turn In Poachers line regarding anglers illegally taking bait from waters infested with spiny waterfleas. The anglers, from

Illinois and Iowa, were each fined $485 for illegally trapping and netting minnows from the Rainy River. The groups' nets were seized and destroyed to prevent the spread of spiny waterfleas to other bodies of water in both Minnesota and the anglers' respective states.

- Conservation officers continue to carry the message regarding invasive species prevention and enforcement through a variety of forums. Officers spoke to local lake associations and sports groups, and staffed booths at local fairs and specialty shows. Conservation officers presenting to youth firearm safety classes routinely address the issue of transportation of aquatic vegetation.

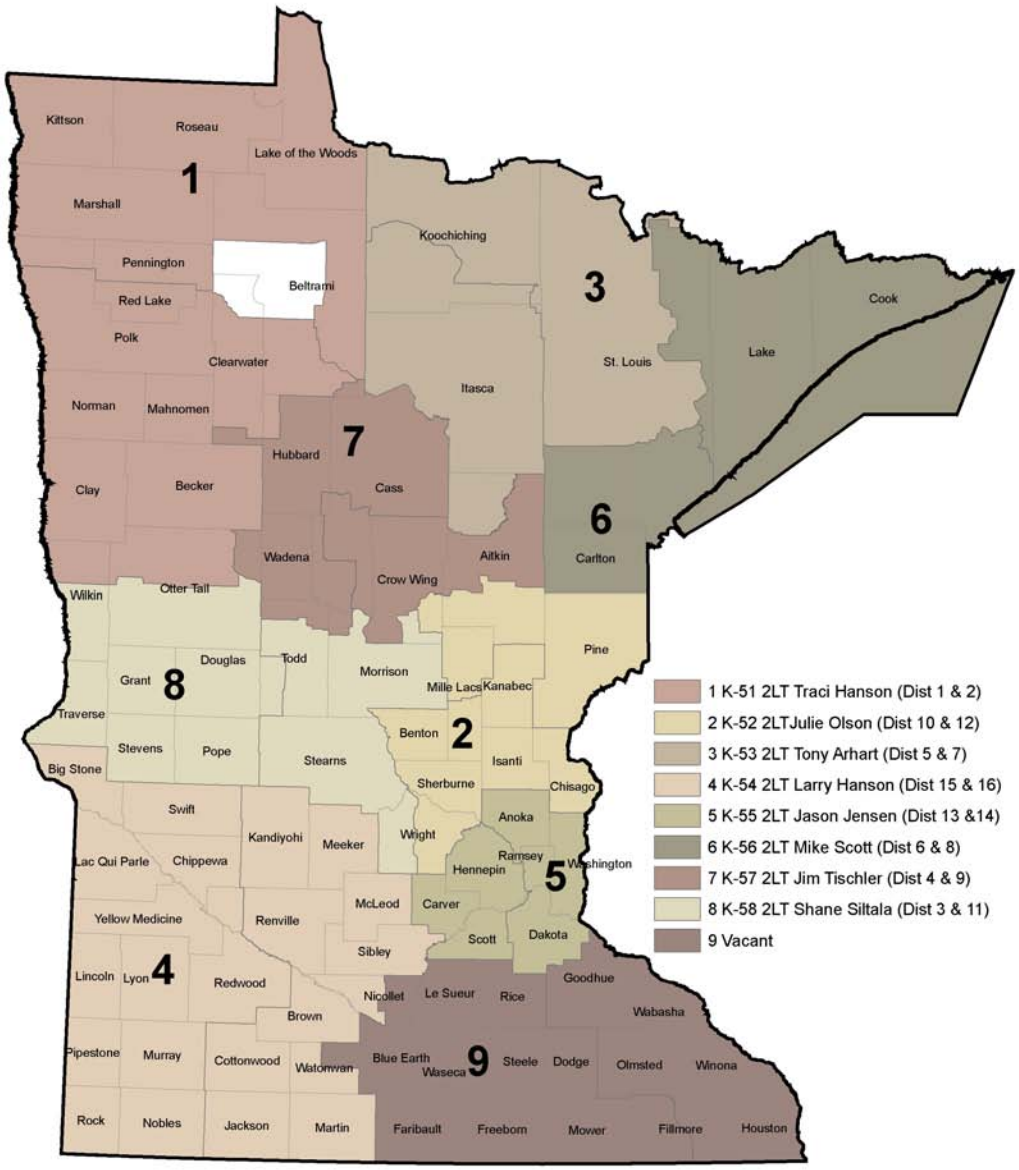

Figure 12. Water Resource Enforcement Officer Patrol Areas.

Summary of activities

In the time period from January 1, 2008, through the present, Minnesota conservation officers worked 4,163 hours of invasive species enforcement. Related to that, officers worked 1,482 hours of aquatic plant management enforcement. This is mentioned simply due to the related nature of the activities.

As a comparison, in 2007, conservation officers worked a total of 3,222 hours of invasive species enforcement. This is noteworthy because in 2007, officers statewide were given training on invasive species enforcement and also were given extra overtime to work exclusively on invasive species enforcement during a 14-day period in June. These two events accounted for a large portion of the hours worked. In 2008, neither of these events occurred, yet there was a 30% increase in invasive species work.

From January 1 through November 4, 2008, conservation officers took the following enforcement actions:

- 22 civil citations were issued for violation of invasive species regulations.
- Two criminal citations were issued for violation of invasive species regulations.
- 18 written warnings were issued for violation of invasive species regulations.
- Countless contacts were made with the public for education and inspection of equipment.
- Related to invasive species enforcement, officers wrote 109 criminal citations and 61 written warnings for violations of aquatic plant management regulations.
- Local police departments and sheriff's departments continue to enforce invasive species rules. The exact number of warnings and citations issued is unknown.

Enforcement at water accesses

Minnesota conservation officers spent 974.99 hours (FY 08) enforcing public access regulations. Although the focus of these hours is varied, the officers spent much of the time speaking to the public, educating them on invasive species issues.

Responding to escaped non-native animals

In 2008, conservation officers responded to several situations where mute swans were found in the wild (see Management of Mute Swans). Officers responded quickly and efficiently to handle these situations. There were approximately 30 reports to conservation officers of escapes of non-native deer and elk and other non-native wild animals. Local officers and the Board of Animal Health responded to these incidents.

Goals for 2009

The Division of Enforcement believes that enforcement and education play a critical role in reducing the spread of invasive species. A large part of this effort is educating the public. For 2009, Water Resource Enforcement Officers are developing plans that are geared to education enforcement of invasive species law that will be customized to the geographic areas they patrol. These plans will focus on both species and activities that are unique to each area. The officers will then coordinate with both the Invasive Species Specialist and local officers to accomplish these goals.

Participation of Others

Conservation officers continue to work with lake associations and other user groups to assist in spreading the word about controlling the spread of invasive species. Officers will work closely with the watercraft inspectors to determine the accesses that will afford the best opportunities for educating the public.

Officers are working with other department staff to develop a training schedule for local officers. These additional officers in the field who can observe violations and take enforcement actions is a force multiplier that greatly enhances the ability to detect violations.

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 by entities outside of Minnesota that have reviewed invasive species regulations. 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.

It is the DNR's responsibility to designate *infested waters* (see M.S. 84D.03). Water bodies are designated infested if they contain specific invasive species such as Eurasian watermilfoil, flowering rush, New Zealand mudsnail, ruffe, round goby, spiny waterfleas, white perch, or zebra mussels. The current *infested waters* lists are found in the *State Register*. The most current list of infested waters was published on July 14, 2008.

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.

In 2007, the Minnesota Pollution Control Agency (MPCA) joined with the DNR to address the ballast water issue spurred by a Federal District Court ruling in late 2006 that vacated federal exemptions of vessel discharges from National Pollutant Discharge Elimination System (NPDES) permitting. In 2008, the MPCA became involved in developing and implementing vessel discharge (e.g. ballast water) regulations for the state.

Goals

- 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.
- Continue to adopt rules, or use other means that designate additional infested waters, prohibited invasive species, regulated invasive species, and unregulated non-native species.

Progress in Regulations - 2008

Federal

At the national level, the following are key regulatory areas: 1) reauthorization of the National Invasive Species Act; 2) national ballast water regulations; and 3) potential designation of injurious wildlife. Progress, or lack of progress, during 2008 on these areas is described below:

- The National Invasive Species Act of 1996 was not reauthorized in 2008 due to disagreement on appropriate ballast water regulatory authorities (state versus federal; EPA vs. USCG). As a result, legislation that would strengthen federal ballast water regulations and further address prevention and management of aquatic invasive species at the Federal level is still pending. There is no clear resolution of the quandary regarding the appropriate regulatory authority for ballast discharge, so hopes are not high for legislation in the coming session of Congress. However, the USCG and the EPA regulatory processes under NISA 96 and the CWA, respectively, are progressing. It is hoped that a Coast Guard proposed rule-making detailing ballast treatment requirements and processes will be promulgated within six months.

- Senate bill S. 2766 ("the Clean Boating Act of 2008") was passed by Congress and signed into law (P.L. No. 110-288) on July 29, 2008. The law provides that recreational vessels shall not be subject to the requirement to obtain an NPDES permit to authorize discharges incidental to their normal operation. It instead directs the U.S. Environmental Protection Agency (EPA) to evaluate recreational vessel discharges, develop management practices for appropriate discharges, and promulgate performance standards for those management practices. It then directs the Coast Guard to promulgate regulations for the use of the management practices developed by EPA and requires recreational boater compliance with such practices.

- Senate bill S. 3298 was passed by Congress and signed into law (P.L. No. 110-299) on July 31, 2008. The federal law generally imposes a two-year moratorium during which time neither EPA nor states can require National Pollutant Discharge Elimination System (NPDES) permits for discharges incidental to the normal operation of vessels of less than 79 feet and commercial fishing vessels of any length. It also directs EPA to conduct a study of vessel discharges and issue a report to Congress within 15 months. Among other things, the moratorium does not apply to ballast water.

- In 2008, EPA proposed two draft NPDES vessel permits and accompanying fact sheets that provide a detailed explanation of the permits' contents. As proposed, a draft Vessel General Permit (VGP) issued in June 17, 2008, would have covered all commercial and non-recreational vessels and those recreational vessels longer or equal to 79 feet, and a proposed Recreational General Permit (RGP) covered recreational vessels less than 79 feet in length. However, due to the enactment of the Clean Boating Act of 2008, which now excludes recreational vessels from NPDES permitting, their RGP will not be finalized. In addition, due to P.L. 110-299, which places a two-year moratorium on NPDES permitting of

commercial fishing vessels and all other commercial vessels that are 79 feet or less in length, the VGP will be revised to reflect that new law. In August 2008, the Court granted EPA an extension until December 19, 2008, for issuance of the VGP.

- Also in 2008, EPA requested that the MPCA submit a Clean Water Act Section 401 certification for its proposed vessel discharge general permit, which should include any additional conditions necessary to assure compliance with requirements of state law and applicable provisions of the Clean Water Act. The MPCA submitted its 401 Certification of EPA's proposed permit in a letter dated November 19, 2008: PDF Document 401 certification letter.

State Statute Changes

The Legislature passed legislation in 2008 that was related to invasive species:

1. House File 3838 (SF3306) was introduced by Representative Berns and was incorporated into Senate File 2651 which was passed and signed into law. The final language made two technical changes to portions of Minnesota Statutes 84D that clarify: 1) a trailer or watercraft can be placed in the waters of the state with aquatic vegetation for shooting or observation blinds only if attached in or on a watercraft; and 2) a trailer, a watercraft, or plant harvesting equipment may not be placed in waters of the state if it has aquatic plants attached. (See Appendix D for the actual language in state statues).

2. Representative Hanson and Senator Rest introduced bills (HF 2963 / SF 2517) to address ballast water discharges in Lake Superior. Ballast water related language from those bills was incorporated into Senate File 3056 and signed into law. The new language added to Minnesota Statutes, Chapter 115 included:
   - definitions for many terms related to ballast water;
   - a requirement for the operator of a vessel that is designed, constructed, or adapted to carry ballast water in state waters of Lake Superior to conduct ballast water management operations of the vessel according to a ballast water management plan that meets the requirements prescribed by the MPCA;
   - a requirement for vessels to have a ballast water record book;
   - direction to the DNR to cooperate to the fullest extent practicable with the Great Lakes Panel on Aquatic Nuisance Species to ensure development of standards for the control of invasive species that are broadly protective of the state waters of Lake Superior and other natural resources;
   - a requirement for the commissioner of MPCA to serve as the alternate Minnesota representative to the Great Lakes Panel;
   - encouragement for MPCA to consult with the departments of commerce, agriculture, natural resources, and any other agency that MPCA determines to be necessary to develop and implement an effective program for preventing the introduction and spread of invasive species through ballast water

   (See Appendix D for the complete language added to state statutes).

DNR Permanent Rules
State statutes now allow the designation of infested waters via DNR Commissioner's Order instead of rulemaking. Outdated permanent rules that listed infested waters are in the process of being repealed through the process for eliminating obsolete rules.

MPCA Rules and Permits
The MPCA began working on a ballast water program in early 2007 using a dual track approach: 1) to encourage a federal regulatory solution that is protective of Minnesota waters, and 2) to have a ballast water general permit in place by October 1, 2008, if federal action was not completed by that date. Since no federal action that effectively and comprehensively protects Minnesota's water resources is in place nor is such action anticipated in the near-term, the MPCA used its existing state authorities to issue a five-year Ballast Water Discharge General Permit (Permit) on September 24, 2008, that helps to mitigate the introduction and spread of invasive species via ballast water. In addition, the Permit is the vehicle for implementing state legislation enacted in 2008 (see State Statute Changes above) that requires the MPCA to approve ballast water management plans of vessels.

The Permit from MPCA is now required for transit through, or discharge of, ballast water to Minnesota waters of Lake Superior from vessels at least 50 meters in length with a ballast water capacity of at least eight cubic meters or 2,113 gallons. This applies to both seagoing and Great Lakes-only vessels.

The Permit allows transit and discharge if the vessel meets the terms and conditions of the Permit. The Permit requires existing vessels discharging into Minnesota waters to meet the International Maritime Organization's (IMO) Ballast Water Convention biological performance standards by January 1, 2016, and is consistent with the IMO's implementation schedule for the size of ships that travel to Minnesota.

Due to the lack of federal action that effectively protects Minnesota's water resources and the directive of the Minnesota State Legislature, the MPCA concluded that a state permit is necessary at this time. However, strong federal action that is protective of Minnesota's waters remains an objective of the MPCA and DNR. To that end, the MPCA and DNR continue to work with federal entities working on ballast water regulation and work with other states through existing Great Lakes groups such as the Great Lakes Aquatic Nuisance Species Coalition and Great Lakes Panel to develop a strong regional approach should federal action not be completed.

On April 21, 2008, the Ramsey County District Court in Minnesota found the agency's rule exempting vessel discharges from NPDES permitting invalid with respect to ballast water discharges into Lake Superior and ordered the rule vacated as of October 1, 2008. To comply with the order, the MPCA is modifying Minn. R. 7001.1030, subp. 2(A) that exempts persons who discharge sewage or effluent from a vessel. This rule change is consistent with recent federal court decisions, which declared EPA's exemption as unlawful. Minnesota Statute 14.388 (Good Cause Exemption) allows the agency to use an expedited rulemaking process to comply with a court order. The MPCA is using this process to comply with the court's order. The notice of rule repeal was published in the *State Register* on September 29 for a five-day comment period that ended on October 6, 2008.

DNR Commissioner's Orders
Two Commissioner's Orders were issued in 2008 to designate infested waters. The first order was published in the *State Register* on May 5, 2008. The second was published on July 14, 2008.

Future needs for Regulations and Proposed Changes

- Support the reauthorization of NISA and designations of injurious wildlife such as the bighead carp.
- Use species evaluations and current literature to propose appropriate designations that will protect Minnesota's environment from the introduction of invasive species.
- Work with staff members at the MPCA who regulate wastewater to inform licensees about laws regarding transport of water from infested waters and also contact marinas statewide regarding invasive species laws.
- Provide assistance to the MPCA regarding state ballast water regulations.

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 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 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 - 2008

Complete required hours of watercraft inspection

In 2008, approximately 73 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 nearly 35,000 inspection hours. A total of 49,300 watercraft/ trailers were inspected.

During the inspection season, inspections were conducted at 34 fishing tournaments and continued through October in order to reach waterfowl hunters. Inspectors distributed more than 8,200 Invasive 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 5 and Figure 13). 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 spent in Region One had gradually increased from 2001 to 2006 and then rapidly increased in the last two years (Table 5 and Figure 14). This increase is due to the discovery of the spiny waterflea in the northern border waters and the addition of a new crew to the northwest area of the state in 2008. Region Two had an increase in inspections in 2008 (Table 5). This can be attributed to the spiny waterflea infestation along the northern border waters and the International Falls crew that was added to the program in 2007. Region Three inspections increased from 2006 and 2007 and Region Four inspections remained stable from the previous year (Table 5).

Table 5. Number of watercraft inspections conducted by watercraft inspectors in 2002, 2003, 2004, 2005, 2006, 2007, and 2008. (*Totals are rounded values*).

Year	DNR Region				Total
	1	2	3	4	
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	50,000
2005	1,500	8,300	39,500	5,800	55,000
2006	1,900	9,900	25,600	3,200	41,000
2007	3,100	7,900	25,700	4,900	42,000
2008	5,400	10,100	29,400	4,100	49,000

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 10,000-hour mandate (M.S. 84D.02, Subd. 4). During 2008, inspections on uninfested waters represented about 26% of the total inspections (12,800 inspections) and approximately 36% of the inspection hours (13,300 hours). Due to an increased number of cooperative contracts for additional inspections at several uninfested water bodies and

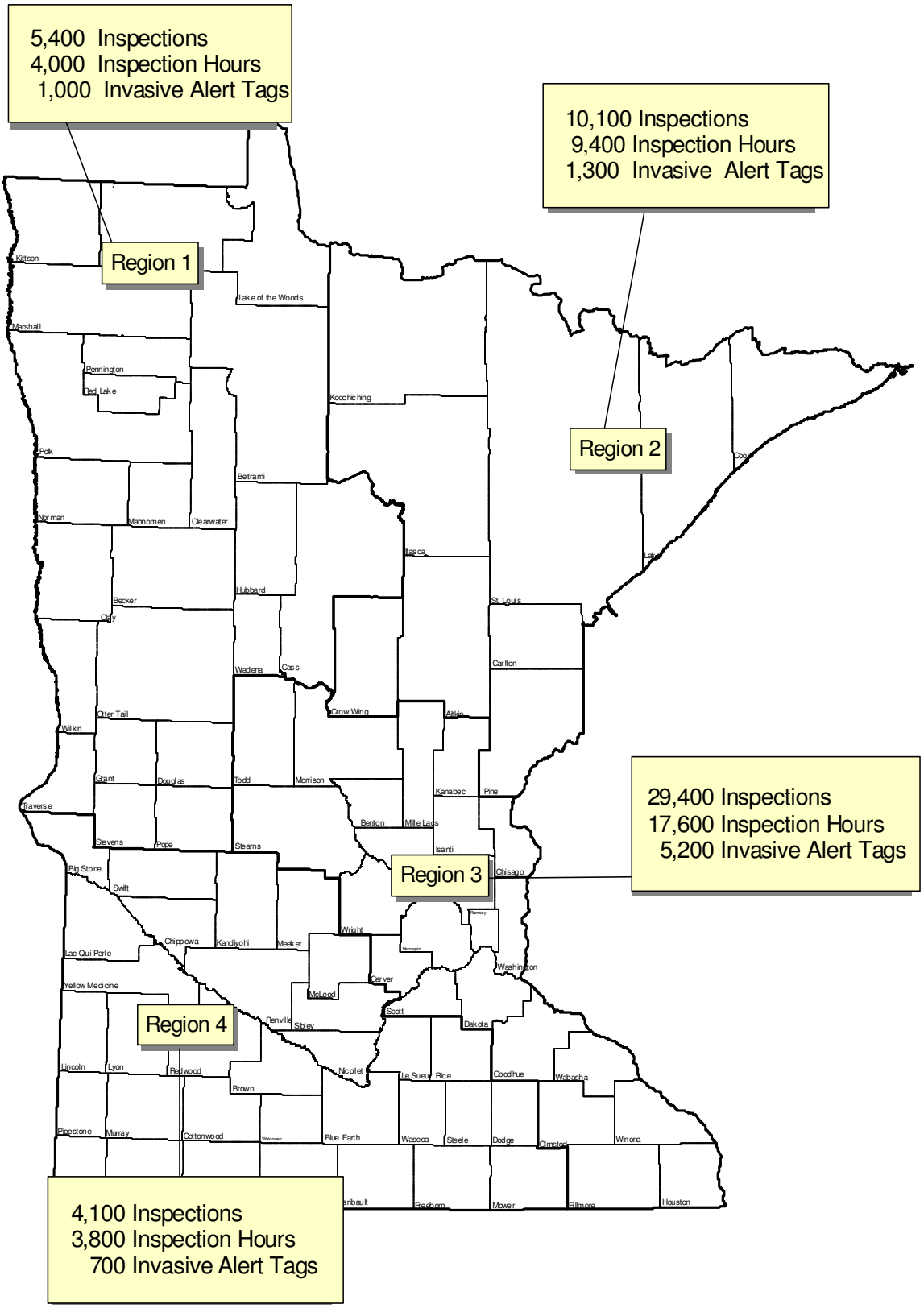

Figure 13. DNR watercraft inspections at public water accesses in 2008.

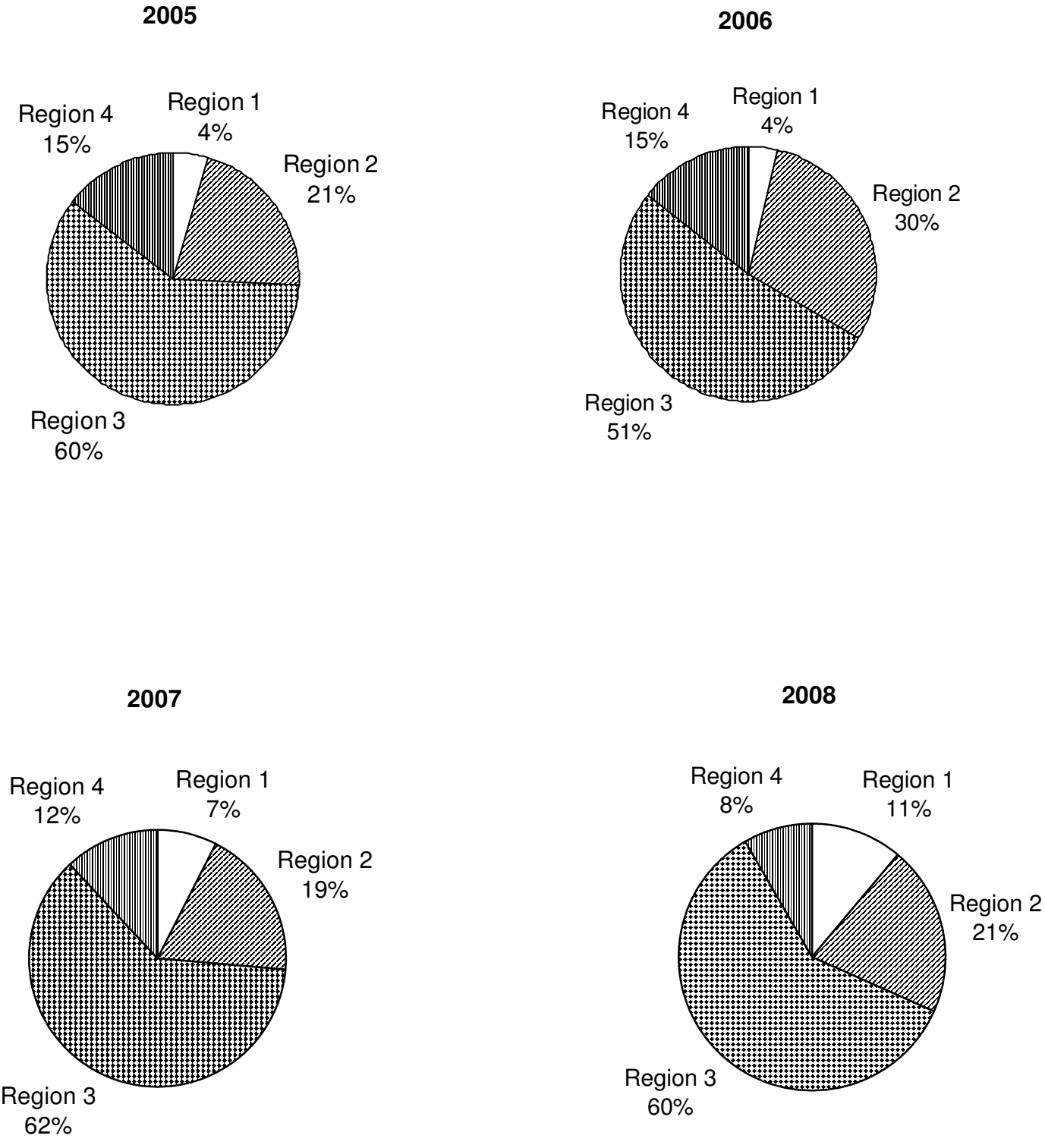

Figure 14. Percent of the state's total watercraft inspection hours spent in each region in 2005, 2006, 2007, and 2008.

prevention grants that started in 2008, both the number of hours and inspections at uninfested waters have increased since 2006.

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 or groups that desired to hold "Invasive Species Awareness Events", have cooperatively hired with us or received a grant for watercraft inspection hours.

Although the program has broadened to include inspections at uninfested waters, the majority of the inspections are still done at infested water bodies. With the population of zebra mussels in Lake Ossawinnamakee increasing since their discovery in 2003 (see Management of Zebra Mussels) and the 2005 discovery of zebra mussels in Lake Mille Lacs, it has remained very important to maintain a high level of public awareness effort in the Brainerd area.

Several years ago spiny waterflea were discovered in Saganaga Lake; now over a dozen large lakes in northern Minnesota have been confirmed as infested. Recent reports include Caribou, Gunflint, and Devil Track lakes in Cook County, and Crane, Kabetogama, Little Vermillion, Sand Point, and Lake of the Woods as well as the Rainy River (see Other Invasive Animal Species in Minnesota). Due to the infestation of spiny waterfleas along the northern border of the state, a new crew, which spans multiple counties, was formed in 2007 in order to educate watercraft users about the spiny waterfleas and the actions they could take to prevent the spread of this invasive specie. This crew continued to work along the boarder in the 2008 season with a goal of increasing inspections in this area.

Increase public awareness

Each boater contacted by a watercraft inspector is asked a standard series of questions. These surveys 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 91%, down from 95% in 2007. Boaters from other states using Minnesota water bodies had a lower response at 79%, down from 89% in 2007. These decreases in the number of individuals who were already aware of invasive species when they were inspected may be due to program expansions that have been made in the 2008 season. An increase in inspections in the northern border waters along with the addition of a northwest crew most likely increased the number of inspections with watercraft users who had not been inspected in the past and may not have heard about invasive species.

The range of percentages of watercraft users who were aware of the invasive species laws for each Minnesota county where at least 100 inspections had been done varied from 51% (in Otter Tail County) to 97% (in Benton County). Of those who said they were not familiar with the laws, 3% (62 out of 2,075) had invasive species or vegetation on their watercraft when they entered the access. In contrast, slightly more than 1%

(455 out of 27,909) 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, 12% said they were not familiar with the invasive species laws. In contrast, of those with a year 2008 decal, 884 out of 14,054 boaters or slightly more than 6% said they were not familiar with the laws. This suggests that the Watercraft Inspection Program is successful at educating boaters about Minnesota's 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 2008, 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 at the invasive species display at the Minnesota State Fair. 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. Thirteen volunteer trainings were conducted during the season; trainees included Bay Lake Association, Lake Belltaine Association, Potato Lake Association, Little Sand Lake Association, the Whitefish Property Owner's Association, North Long Lake Association, Crooked Lake Association, Lake Andrusia and Cass Lake Associations, the Aitkin County Lakes and Rivers Association, Upper Mission Lake Association, the staff of the Breezy Point Resort boat landing, and Roosevelt Lake Association. The Watercraft Inspection Program also gave talks for multiple lake associations and schools.

In 2008, the DNR Invasive Species Program offered prevention grants to local entities for the purpose of helping them to implement locally focused prevention efforts. Nine local entities received grants for additional hours of watercraft inspection. The grantees are: the Lake Minnetonka Conservation District, Gull Lake Association, Carnelian Marine St. Croix Watershed District, Pike Lake Association, Pelican Group of Lakes Improvement District, Friends of Lower Hay Lake Association, Big Watab Lake Association, Big Sandy Lake Association, and the Pelican Lake Property Owner's Association. Each grantee agreed to pay for a certain number of watercraft inspection hours with a match from the DNR. This cooperative effort helped local entities increase inspection hours in their areas and increase invasive species awareness.

The Watercraft Inspection Program also worked with four lake associations and citizen groups to increase inspection hours in their areas through cooperative agreements. 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 seventh year in addition to the grant they received. Inspectors spent an additional 1,846 hours on four Lake Minnetonka accesses because of the funding provided by the LMCD. The Washburn Lake Association increased

inspection time at its access by 216 hours. The Bay Lake Association worked cooperatively with the DNR for the fifth year and increased inspection hours at its access by 200. The Otter Tail Lake Association worked with the DNR for the third year and increased its hours by 182. This was the first year that the Roosevelt and Lawrence Area Lakes Association completed a cooperative agreement with the DNR for an additional 41 hours of inspection.

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 15). 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 15% of the watercraft checked by watercraft inspectors were found with vegetation.

Transportation of Other Invasive Species

Two watercraft were found to have zebra mussels on them prior to entering a water body. The watercraft were inspected at the St. Louis River and Rice Lake; both of these water bodies are infested with zebra mussels. Nine watercraft were found to have attached zebra mussels when inspected leaving the Mississippi, St. Croix and St. Louis rivers, Rice Lake, Lake Ossawinamakee, and Lower Prior Lake. All of the water bodies except for Prior Lake are infested with zebra mussels. This demonstrates a clear risk of zebra mussels being moved on boat hulls or on plants caught on trailers if boats are not properly cleaned. Anglers who “catch” zebra mussels off the bottom and discard them in the bottom of their boats can also move them.

Eight watercraft were also found to have spiny waterflea attached when exiting the St. Louis River, Lake Superior, and McQuade Lake. In each of these cases, the watercraft owner would have been asked to dispose of the invasive species before leaving the access.

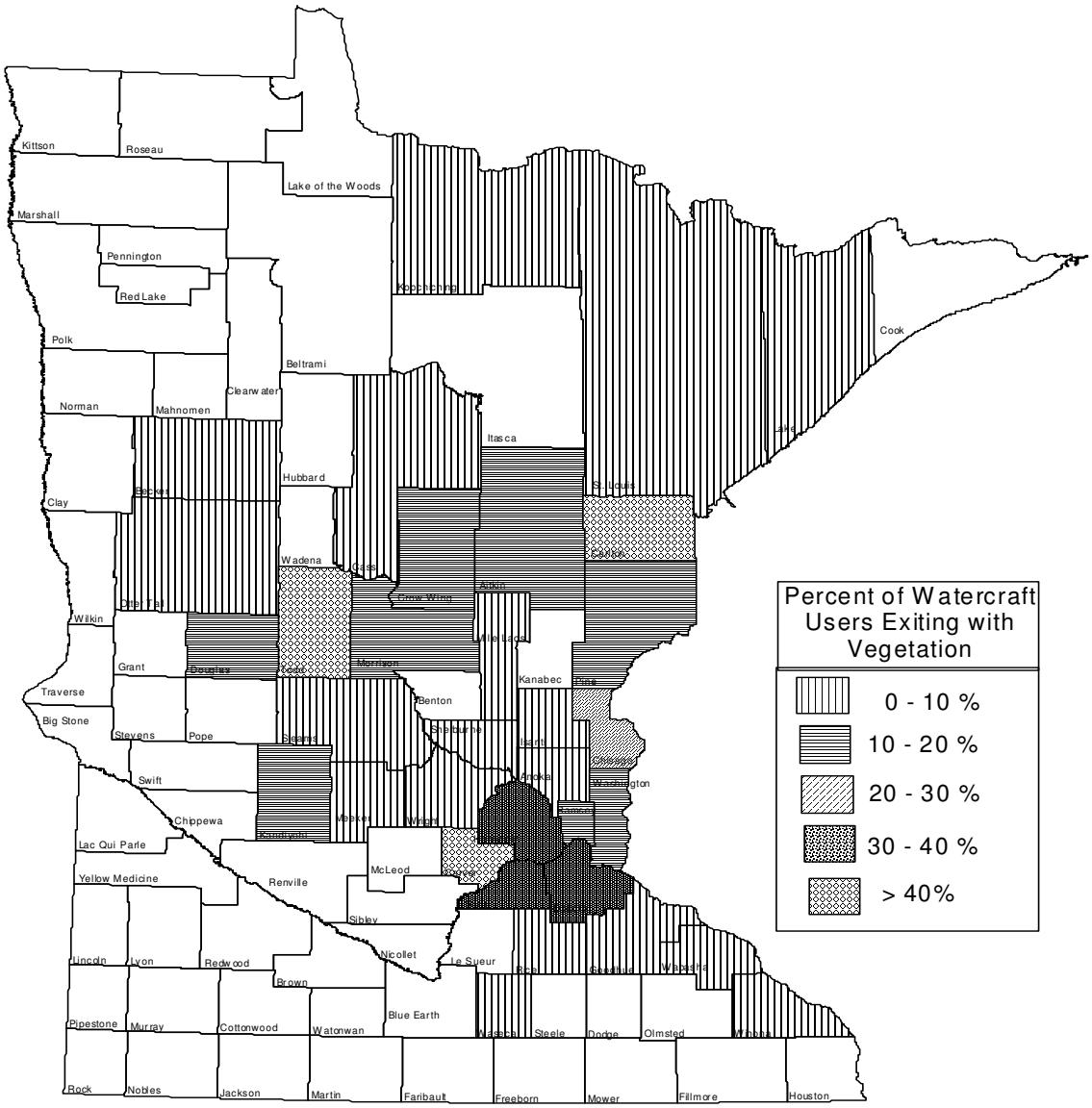

Figure 15. Percentage of exiting watercraft with attached vegetation prior to inspection and cleaning (in counties where more than 100 boats were inspected upon leaving an access).

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 16). 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 13 years now and have been well received by the public. The approximately 34,000 decals distributed during the 2008 boating season also remind boaters to inspect their boats when inspectors are not present.

Future needs and recommendations for watercraft inspections

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

Figure 16. Decal provided to boaters by DNR watercraft inspectors in 2008.

Risk Assessment and Risk Management

2008 Highlights

- Permanent Rules that classify new regulated and prohibited species were adopted.
- Water bodies known to have flowering rush, brittle naiad, and Brazilian waterweed were designated as infested.
- DNR staff from nine divisions completed work on developing discipline guidelines to meet the DNR's Operational Order to reduce the movement of invasives through DNR activities.
- DNR staff helped the Minnesota Pollution Control Agency water monitoring unit review its activities and provided guidance on how to prevent the spread of invasive species.

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 that 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 implement new and/or different management strategies.

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 curly-leaf pondweed led the Invasive Species Program to propose the species be classified as a *prohibited invasive*, to support research on new management methods for curly-leaf, and to investigate whether repeated lake-wide treatments of curly-leaf pondweed could provide ecological benefits (see Management of Curly-leaf Pondweed).

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 and risk management recommendations

No risk assessments of individual species were done in 2008. 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. To date, the Invasive Species Program has completed risk assessments on 48 species (Invasive Species Program, 2005, 2006). These risk assessments have been used to guide risk management activities and are part of a process for deciding on risk management activities.

Risk assessment of pathways of invasive species introduction, spread, and risk management recommendations

Designation of infested waters

In order to help prevent the movement of invasive species from one water body to another, waters of the state can be designated as infested. This designation limits how water can be appropriated from the infested water body. An updated list of infested waters can be found at http://files.dnr.state.mn.us/eco/invasives/infestedwaters.pdf.

Review of Minnesota Pollution Control Agency activities

In 2008, DNR staff were asked to provide guidance on preventing the spread of invasive species to the Water Monitoring Section of the Division of Environmental Analysis and Outcomes at the Minnesota Pollution Control Agency (MPCA). DNR staff attended a section meeting and presented information about the invasive species that occur in Minnesota, and how they are usually spread. There was an in-depth discussion following the presentation about various methods of water monitoring and how to best prevent the spread of various invasives during those activities. Written literature about how to prevent the spread of invasive species and a GIS coverage of invasive species locations in the state were also provided to help them plan their activities.

Following this meeting, DNR worked with MPCA staff that are drafting a standard operating protocol to prevent the spread of invasive and/or harmful species or pathogens during their lake and stream sampling activities.

Implementation DNR Operational Order to reduce the spread of invasives

In 2007, The DNR developed an Operational Order to provide policy and direction related to prevention and management of invasive species. The scope of the operational order includes all DNR activities that relate to movement of terrestrial and aquatic invasive species. The purpose of the Op Order is to:

1. Prevent or limit the introduction, establishment, and spread of invasive species.
2. Implement site-level management to limit the spread and impact of invasive species.
3. Ensure that DNR resource management activities comply with the forest certification Corrective Action Request concerning invasive species.

These three goals are addressed by:

- Requiring Divisions and Bureaus to develop discipline guidelines to implement this operational order

- Providing policy and procedures for prevention and management of invasive species including:
    - Intentional movement of equipment
    - Intentional movement of organisms, organic, and inorganic materials
    - Identifying invasive species and implementing management strategies to reduce impact at the site level
    - Monitoring and reporting new invasive species infestations.

All DNR Divisions and Bureaus were responsible for ensuring the discipline guidelines are developed by May 30, 2008. A team of aquatic and terrestrial experts developed the divisional guidelines for the Division of Ecological Resources. All DNR Divisions and Bureaus have completed the development of guidelines to implement the Operational Order. The Operational order directs "what" needs to be done and the discipline guidelines provide direction on "how" to meet the Operational Order policies.

Currently, Divisions and Bureaus are initiating training for staff on their guidelines so they can be implemented more completely in 2009.

Prevention of spread of invasive species through aquatic plant and pet 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 and animals represents a significant pathway for the introduction of invasive species into Minnesota waters (Maki and Galatowitsch 2004). The risk that invasive species will make their way into natural waters, either by accidental escape or by deliberate introduction of aquarium or water garden plants or animals, poses a threat to Minnesota lakes, rivers, and wetlands.

The discovery of water hyacinth, *Eichhornia crassipes*, a non-native, invasive species of aquatic plants on the shore of one Minnesota lake is evidence that the risk of invasion resulting from horticultural activities is significant (see Prevention and Containment).

Incidents such as this demonstrate the continued need for pubic education, both to aquatic plant sellers and consumers. Because of this ongoing need, in 2008, DNR staff continued to distribute educational materials, and work with aquatic plant sellers to help interrupt this pathway of invasive species introduction.

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

Risk Assessment

- Continue to identify non-native species that may be likely to enter or have already entered Minnesota and evaluate their potential to cause problems if they become established in the wild.
- Continue to identify pathways that 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, regulations, 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

2008 Highlights

- The DNR increased funding for the grant program for pilot projects for lake-wide control of curly-leaf pondweed or Eurasian watermilfoil for ecological benefits. Grants totaling $230,000 were given to 14 lakes under this program in 2008.
- Legislation passed in 2007 requires that all applicants for grants to manage invasive plants in public waters have a workable plan for improving water quality and reducing the need for further treatment. In addition, this law states that grants may not be made for chemicals that are likely endocrine disruptors. These criteria were incorporated into the 2008 grant offer.

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 759 Minnesota lakes in 70 of the 87 counties (Figure 17). Unlike most native plants, curly-leaf pondweed plants remain alive through the winter 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 can result 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 mid-summer 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). 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.

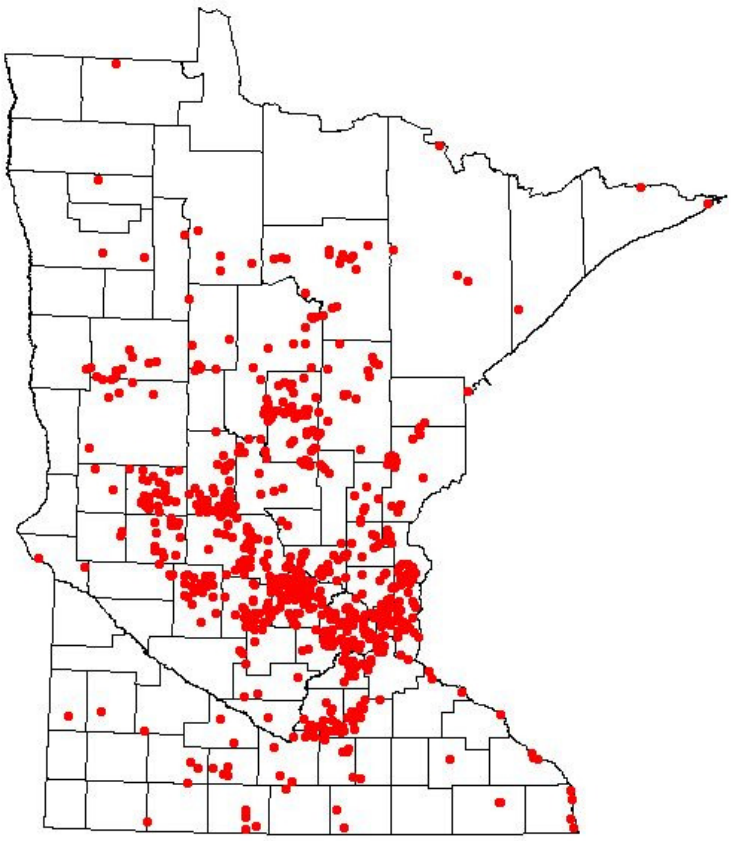

Figure 17. Curly-leaf pondweed locations in Minnesota as of November 2008 (compiled from reports from DNR Fisheries, Wildlife, and Ecological Resources staff).

Goals

The DNR has two goals for 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 both enforcement and public awareness to 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 participate in pilot projects and research to improve the management of curly-leaf pondweed.

Prevention of spread

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). DNR conservation officers also helped prevent

the spread of curly-leaf pondweed through enforcement of state laws that make it illegal to transfer aquatic plants on public roads (see Enforcement).

Progress in Management of Curly-leaf Pondweed - 2008

Management of nuisances caused by curly-leaf pondweed

Lake residents and lake associations who do routine management of curly-leaf pondweed to reduce nuisance areas using both herbicides and mechanical harvesting undertake the majority of curly-leaf pondweed management done in Minnesota. Past research supported by the DNR indicates that endothall herbicide used at low rates early in the spring is more effective than treatment with diquat at preventing turion production in the treated areas, and reducing impacts to native plants (Netherland et al. 2000, Poovey et al. 2002). As a result, many of the routine treatments with herbicides are now done with a low rate of endothall herbicide in early spring.

During 2008, DNR staff actively supported efforts to manage nuisance levels of curly-leaf pondweed by providing technical assistance to lake groups working to manage the plant. Technical assistance included conducting lake vegetation surveys, guidance on the best management practices for controlling curly-leaf pondweed, and assistance in writing Lake Vegetation Management Plans (LVMPs).

Technical Assistance

Surveys of lake vegetation

In 2008, DNR staff from the divisions of Ecological Resources and Fish and Wildlife conducted three types of lake vegetation surveys in support of curly-leaf pondweed management: point-intercept surveys, surveys of buried turions, and mapping of matted areas of curly-leaf. Point-intercept surveys provide an estimate of the distribution and frequency of occurrence of curly-leaf pondweed and native plants (Madsen 1999). These surveys were used to describe the distribution and abundance of plant species in surveyed lakes. They were also used, in some cases, to determine if curly-leaf management activities were effective and to see if curly-leaf management caused any damage to native plant communities. Turion surveys were used to determine if successive years of treatment were causing a depletion of curly-leaf pondweed turions in the lake sediments. Mapping was used to determine where curly-leaf pondweed formed dense mats and how those mats were interfering with recreational use of the lake. These efforts served as the basis for evaluation by local residents and the DNR to the extent and severity of the problems caused by curly-leaf pondweed in these lakes, and were used to help determine the best management strategy for the lakes.

Best management practices for controlling curly-leaf pondweed

Staff of the Invasive Species Program 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 2008, staff attended many lake association and technical meetings to discuss the control of curly-leaf pondweed.

The DNR recommends that herbicide treatments of curly-leaf pondweed be done according to the following guidelines:

Treatments should be done with an endothall-based herbicide such as Aquathol K. Treatment of areas more than one acre in size should be done at a low rate, 0.75 to 1.0 ppm endothall with 1.5 ppm used for areas less than one acre in size. Treatments should be done when water temperatures are between 50 and 60 degrees F, and are increasing. While treatment areas can be estimated from surveys in the year before treatment for the purpose of obtaining a permit, actual areas that will be treated should be based on pre-treatment plant surveys conducted in April, in the year of treatment.

These guidelines are based on research that has been done in Minnesota on early-season treatments with endothall (Netherland et al. 2000, Poovey et al. 2002, Invasive Species Program 2006, Skogerboe et al. 2008) and guidance from United Phosphorous Inc. (formerly CerexAgri), the manufacturer of endothall-based herbicides such as Aquathol K.

Lake vegetation management plans

DNR staff worked with lake groups and local units of government to develop LVMPs. LVMPs contain a description of the condition of the lake and plans to address identified problems. The purpose of an LVMP is to develop agreement on goals for the aquatic plant community, identify issues, design methods to reach those goals, and to design methods to evaluate whether the goals are being reached or not. DNR staff worked on several LVMPs for lakes with curly-leaf pondweed in 2008. Many of the lake vegetation surveys described above were conducted to evaluate the results of curly-leaf management allowed by an LVMP or to help with the development of an LVMP.

Repeated lake-wide treatments of curly-leaf pondweed for ecological benefits: Pilot projects

Lake-wide treatments are those that attempt to treat all, or almost all, of the curly-leaf pondweed in a lake. These treatments usually involve the use of endothall herbicide. Exposure of plants to endothall for approximately 12 to 24 hours can provide high levels of control of curly-leaf pondweed (Netherland et al. 2000, Poovey et al. 2002). Whole-lake treatments are those that apply herbicide to the whole lake. These treatments usually involve the use of fluridone herbicide. Exposure of plants to 4 ppb fluridone for at least 56 days can provide high levels of control of curly-leaf pondweed (Poovey et al. 2008).

In order to provide long-term reduction of curly-leaf pondweed, an infested lake must be treated for several years in a row. This is so that the bank of turions will be depleted. Even with repeated treatments, it does not appear to be feasible to completely eradicate curly-leaf pondweed from a water body (Invasive Species Program 2006). This may be due to survival of some plants or turions, or germination of seeds (Newman et al. 2006). Research done by the U.S. Army Engineer Research and Development Center (ERDC) indicates that at least three years of repeated treatments, and possibly four, are needed to significantly reduce the frequency of curly-leaf pondweed in a lake (Skogerboe et al. 2008).

The four main goals of repeated lake-wide or whole-lake treatments are:

1. Reduce the interference with lake use caused by curly-leaf pondweed.

2. Reduce the frequency and abundance of curly-leaf pondweed for long periods of time.
3. Increase the frequency and abundance of native, submersed aquatic plants.
4. Reduce peaks in concentrations of phosphorous and associated algal blooms.

Increases in the frequency or abundance of native submersed plants and reductions in levels of phosphorus and algae, which should increase water clarity, are considered ecological benefits.

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 can be issued by the DNR. Variances have been issued for pilot projects, which control 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.

Pilot lake-wide treatments funded under DNR grant program

DNR staff working with lake residents, lake associations, and local units of government, have participated in several pilot projects in which herbicides are used to control curly-leaf pondweed lake-wide. In 2006 the DNR established a grant program "Pilot projects to control curly-leaf pondweed or Eurasian watermilfoil on a lake-wide (or bay-wide) basis for ecological benefits" to help fund these projects (www.dnr.state.mn.us/grants/habitat/lakewide.html). In 2008, for the first time since this program was established, funding was made available for both lake-wide and also bay-wide pilot projects. Funding under this grant program will be available in 2009.

The purpose of offering these funds was to allow a limited number of well-planned and well-monitored projects to go forward in order to determine if ecological benefits could be obtained by lake-wide or bay-wide control of curly-leaf pondweed or Eurasian watermilfoil. The effects of funded projects have been and will be carefully monitored in order to determine how and where to use a lake-wide treatment approach in the future. In 2008, this grant program made $230,000 available for lake-wide control of curly-leaf pondweed or Eurasian watermilfoil. The maximum amount available to any one project was $30,000 (Table 6).

Forty-three project proposals were submitted for grants under this program for 2008. Fourteen projects (Table 6) were selected to receive a grant. Project proposals were ranked by the grant selection committee based on potential benefit to the aquatic environment, possible negative impacts of the proposed treatment, size of the project, the quality of pre-treatment data available, and, in the case of curly-leaf pondweed treatments, the ability of applicants to continue lake-wide treatment in the future without grant funds. In addition, projects were chosen that were located in different parts of Minnesota.

Lake-wide curly-leaf pondweed treatments were done either with fluridone herbicide at 4.0 ppb or with endothall herbicide at 0.75-1.0 ppm. A combination of 0.75 ppm-1.0 ppm endothall herbicide and 0.25- 0.5 ppm triclopyr herbicide was used to treat the Eurasian watermilfoil and curly-leaf pondweed in Silver and Kohlmans lakes, and in Grays, Phelps, and Carmen's bays of Lake Minnetonka. All treatments were done in late April or early May, when water temperatures were between 50 and 60 degrees F.

Table 6. Pilot program - projects granted funding for lake-wide or bay-wide control of curly-leaf pondweed (CLP) or Eurasian watermilfoil (EWM) or both in 2008

County	Lake or Bay Name	Amount granted in 2008	Total cost of treatment	Percent of total cost funded by DNR	Type of Treatment	Years of treatment	Target plant(s)
Sherburne	Rush and Julia*	$10,000	$13,533	74%	endothall	3	CLP
Morrison	Crookneck**	$10,000	$4,977	100%	endothall	3	CLP
Ramsey	Kohlmans	$10,000	$37,554	27%	endothall/ triclopyr	1	EWM and CLP
Ramsey	Silver	$10,000	$58,254	17%	endothall/ triclopyr	2	EWM and CLP
Hennepin	Weaver***	$10,000	$16,300	61%	endothall	4	CLP
Todd	Osakis (three northern bays)	$15,000	$39,750	38%	endothall	2	CLP
Meeker	Clear	$20,000	$22,748	88%	endothall	2	CLP
Isanti	Long	$20,000	$67,010	30%	endothall	2	CLP
Hennepin	Medicine****	$20,000	$39,715	50%	endothall	3	CLP
Wadena	Blueberry	$25,000	$32,176	78%	endothall	2	CLP
Crow Wing	Lower Mission	$25,000	$57,884	43%	endothall	3	CLP
Hennepin	Minnetonka (Grays, Carmen, and Phelps bays)	$25,000	$148,130	17%	endothall/ triclopyr	1	EWM and CLP
Lincoln	Benton	$30,000	$107,332	28%	fluridone	4	CLP

* Julia and Rush are part of the Briggs-Rush-Julia chain of lakes. Both lakes had lake-wide treatments for curly-leaf pondweed as part of one treatment plan. They were granted $10,000 towards those treatments.

** Only $4,977 was spent on Crookneck Lake, the total cost of the project.

*** Weaver was treated in 2005, 2006, and 2007 with fluridone herbicide

****Medicine was treated in 2005, 2006, and 2008. It was not treated in 2007, even though they were offered a grant, because the cooperator did not want to pursue treatment due to low levels of curly-leaf pondweed in April 2007.

Monitoring of pilot lakes

In order to be accepted into the grant program there had to be adequate pre-treatment data available on the lake proposed for treatment so all of the lakes included in the grant program for pilot lake-wide treatments had previous aquatic vegetation surveys. As part of the grant program, all of the funded lakes had aquatic vegetation surveys done in May, June, and late summer, as well as water clarity monitoring, and turion sampling in early fall. In several cases other quality parameters, such as total phosphorus, were also monitored.

Surveys of Aquatic Vegetation

Most of the aquatic plant monitoring of pilot project lakes has been done by Dr. Ray Newman and his graduate students at the University of Minnesota (U of M). The DNR is providing $212,000 to the U of M to monitor changes in the aquatic plant community and sediment turion levels of Lower Mission, Weaver, Crookneck, Fish, Julia, and Rush lakes and three untreated reference lakes from 2006 through 2009, and Blueberry, Silver, Long Lake, and Clear Lake from June 2008 through 2009. Their work includes surveys for plant community characteristics three times per year using the point-intercept method (Madsen1999). Lakes were surveyed in April, May, late June, and late August. Surveys in April or early May were done before or within one week of treatment (prior to any treatment effects). Plant biomass samples were collected on each sample date in order to estimate curly-leaf and native plant abundance. Turion density was determined for each lake once per year in early fall using sediment samples.

Surveys not done by the U of MN were done by DNR staff, private consultants from Blue Water Science, and Fortin Consulting paid by the DNR, and ERDC researcher John Skogerboe. Dr. Newman and his graduate students along with Invasive Species Program staff are analyzing data from these surveys.

Results of repeated lake-wide treatments

The following are preliminary results of data collected during 2004 through 2007 on several lake-wide treatment lakes. Caution should be exercised in interpretation of these results. These data are not the result of a randomized and replicated study; a limited number of lakes were monitored; the abundance of curly-leaf pondweed can vary widely from year to year in the absence of control; and data were collected by different groups and have not been completely analyzed. Further data analysis will be done as the pilot projects continue.

Effects on curly-leaf pondweed

All treatments reduced curly-leaf pondweed during the year of treatment. In the three lakes that were treated for two years, frequencies of curly-leaf pondweed in April of the following year were reduced. In two lakes, the average density of turions in the lake sediments decreased, while the average density of turions was not significantly changed in the third lake. Comments from lake residents, aquatic plant surveys, and DNR staff observations indicate that the treatments were generally successful in controlling curly-leaf pondweed in the years of treatment. The notable exception was Blueberry Lake, which had persistent curly-leaf pondweed in one area of the lake, despite treatment of that area in 2008. The failure in this one area may be related to water flow into the area.

Effects on native plants

The frequencies of native plants appeared to substantially increase in three of seven lakes, did not change in two, and substantially decreased in one lake following treatment. In one lake where frequency of native plants increased, maximum depth of colonization by submersed plants also increased. Otherwise, there did not appear to be correlations between frequencies and maximum depths of colonization.

The frequency of native plants increased in Lower Mission, Julia, and Rush lakes after two years of treatment (Table 7). In Lower Mission Lake this increase was due in part to a large increase in the frequencies of coontail (*Ceratophyllum demersum*) and muskgrass (*Chara* spp.)(James Johnson, University of MN, unpublished data). The increase in the frequency of native plants in Julia Lake was due in part to a large increase in the frequencies of muskgrass, Canadian waterweed (*Elodea canadensis*), and Southern naiad (*Najas guadalupensis*) (James Johnson, unpublished data). The increase in the frequency of native plants in Rush Lake was due in part to a large increase in the frequency of Canadian waterweed.

There was little change in the frequency of native plants in Medicine, Crookneck, and Benton lakes (Table 2). Crookneck Lake had a very high initial frequency of native plants, and following treatment, native plant distribution has almost reached 100%. Lake Benton had a very low initial frequency of native plants, which has persisted in the years of treatment.

Table 7. Frequency of native aquatic plants [excluding free-floating plants] in the area less than or equal to 15 feet depth (the legally defined littoral zone). Data collected by various investigators[1].

Year	Lower Mission	Medicine	Crookneck	Julia	Rush	Weaver	Benton
N (sample points)	213	200 - 220	199	106	112	104	518-537
Sample month(s)	Jun	Sept	Jul/Aug	Aug	Aug	Aug	Jul/Aug
-2						70	
-1	67		93	17	13	84	4
1	98	63	99	48	31	53	3
2	93	64	99	51	50	75	3
3		67				44	2

In Weaver Lake, the frequency of native plants decreased (Table 4). The decrease is due almost entirely to the decrease in frequency of coontail, which declined from 82% in the year before treatment to 8% in the third year after treatment (Johnson, unpublished data). It appears that the coontail in Weaver Lake was susceptible to control by

[1] Lower Mission year -1 Perleberg (MN DNR) unpublished data, years 1 and 2 Johnson (U of M) unpublished data; Medicine Lake (all years) Vlach and Barten 2006, Crookneck year-1 Perleberg unpublished data, years 1 and 2 Johnson unpublished data; Julia and Rush lakes year-Perleberg unpublished data, years 1 and 2 Johnson unpublished data; Weaver (all years) Johnson unpublished data; Benton (all years) Crowell (MN DNR) unpublished data.

fluridone, particularly in the third year of treatment, when the coontail was likely exposed to a higher rate of fluridone than the 4.0 ppb target rate. In the third year of treatment, the lake was incompletely stratified at the time of treatment, and subsequently in the hours following treatment stratified at a shallower depth than anticipated. As a result, the initial concentration of fluridone was between 5 and 6 ppb. In 2008, the remaining curly-leaf pondweed in Weaver Lake was treated with endothall instead of fluridone.

Effects of control of curly-leaf pondweed on water clarity

It has been hypothesized that an overall reduction in the amount of curly-leaf pondweed in a lake will lead to a reduction in the internal loading of phosphorus, an associated reduction in algal levels, and an increase in mid- and late-summer water clarity. To date, data from lakes in the pilot project program have not been completely analyzed.

Water clarity as measured by observations of Secchi disk appeared to increase in two lakes and did not change in five others following treatment (Table 8). These changes were not correlated with changes in frequencies of native submersed plants.

Table 8. Mean annual June-September Secchi disk transparency (meters) in lakes subjected to lake-wide treatment of curly-leaf pondweed. Data collected by various investigators [2].

Year	Lower Mission	Medicine	Weaver	Benton	Crookneck	Julia	Rush
-1	1.9	1.6	1.7	0.5	3.0	0.7	0.5
1	1.5	1.7	4.3	0.5	2.6	0.6	0.5
2	1.9	1.5	3.2	1.3	2.7	0.5	0.4
3		1.4	2.2	0.7		0.8	0.6

Winter drawdown to control curly-leaf pondweed

Curly-leaf pondweed turions have been shown to be susceptible to freezing and/ or desiccation (Sastroutomo, 1982). In an attempt to reduce the numbers of turions of curly-leaf pondweed, winter drawdowns have been evaluated in some Minnesota lakes. For example, drawdowns on Rice Lake in Hennepin County effectively controlled curly-leaf pondweed for the summers following the drawdowns in the areas where lake sediments were exposed (McComas and Stuckert, 2000). Similar results were observed in Lake Orono in Sherburne County (Invasive Species Program, 2005) and Cleary Lake in Scott County (Vlach and Barten 2007).

Beginning in the late summer of 2008, the Nine Mile Creek Watershed District began a drawdown of two basins in the Anderson Lakes system, which straddles the border

[2] Lower Mission, (years- 1 and 1) Minnesota Pollution Control Agency Citizen Lake Monitoring program (MN PCA CLMP), unpublished citizen monitoring and Minnesota Outdoor Corps, year 2 unpublished citizen monitoring; Crookneck, Julia and Rush (years-1 and 1) MN PCA CLMP, years 2 and 3 unpublished citizen monitoring; Medicine Lake (all years) MN PCA CLMP; Weaver (years–1, 1, and 2) MN PCA CLMP, year 2 unpublished citizen monitoring; Benton (all years) Crowell (MN DNR) and Lincoln County Environmental Office unpublished data.

between the cities of Eden Prairie and Bloomington. The purposes of this project are to reduce the amount of curly-leaf in the lakes and improve water quality.

Research to improve management of curly-leaf pondweed

Evaluation conducted in Dakota County of early – spring application of low rates of endothall for selective control of curly-leaf pondweed

In 2008, Skogerboe et al. (2008) produced a technical report on the results of this long-term study. From 2000 through 2003 ERDC researchers used repeated early spring, whole-lake applications of endothall applied as Aquathol K for control of curly-leaf pondweed in two Dakota County lakes. Low levels of curly leaf pondweed persist in both treated lakes, though the plants remained below nuisance levels with small maintenance treatments (Skogerboe ERDC 2007, unpublished data).

Evaluation of low rates of fluridone to control the growth and reproduction of curly-leaf pondweed

The DNR provided $50,000 to the USAERDC to study the effects of fluridone herbicide on curly-leaf pondweed growth and turion production (Invasive Species Program 2006). The results of the first study indicated that 4 ppb fluridone is the lowest rate that will suppress plant growth and prevent turion formation (Poovey et al. 2008).

Future needs for management of curly-leaf pondweed

- Fully analyze available data from pilot project lakes.
- 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 this invasive species in Minnesota.
- Continue to provide funding for identified research needs, such as research to determine the distribution, viability, and longevity of curly-leaf turions.
- Continue public awareness efforts focused on containing curly-leaf pondweed. Opportunities include our TV and radio advertising, Watercraft Inspection Program, literature, and public speaking engagements.
- Continue to support the management of curly-leaf pondweed in the state through technical assistance and grants for pilot projects.

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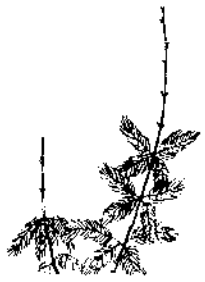
Management of Eurasian Watermilfoil

2008 Highlights



- Eurasian watermilfoil was discovered in 12 additional Minnesota water bodies during 2008. There are now 215 Minnesota lakes, ponds, rivers, and streams where the submersed aquatic invasive plant is known to be present.
- Cooperators on 22 lakes were reimbursed by the DNR for control of unavoidable nuisances caused by dense and matted Eurasian watermilfoil in public use areas of the lakes.
- Cooperators on three lakes were reimbursed by the DNR for lake-wide or bay-wide control of Eurasian watermilfoil and curly-leaf pondweed.
- Significant progress was made in improving our understanding of the ecology and management of Eurasian watermilfoil.

Issue

Eurasian watermilfoil (*Myriophyllum spicatum*) is an invasive submerged aquatic plant that was inadvertently introduced to Minnesota. Eurasian watermilfoil, hereinafter 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 DNR Invasive Species Program to manage milfoil, as well as certain other 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 2008.

Spread of Eurasian Watermilfoil in Minnesota during 2008

Milfoil was newly discovered in 12 lakes during 2008 (Table 9 and Figure 18). Five of the new lakes are located in the seven-county metropolitan area. Another four of the new lakes are located in "collar" counties, those adjacent to the seven-county metropolitan area. Two of the new lakes are located north of the Twin Cities and one is located south of the metropolitan area. Milfoil is now known to occur in 215 water bodies in Minnesota.

Identification of Eurasian watermilfoil can be difficult due to the occurrence of hybrids between the non-native invasive species and the native northern watermilfoil, *Myriophyllum sibiricum*. The appearance of hybrid watermilfoils is intermediate between that of the non-native invasive species and the native. In one case during 2008, Dr. Ryan A. Thum at Grand Valley State University in Muskegon, Michigan analyzed a sample of a suspected hybrid using molecular genetic techniques. His analysis determined that the sample is a hybrid, so the lake from which it came was added to the list of infested bodies of water.

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 9. Classification of water bodies in Minnesota with Eurasian watermilfoil during 2008.

Classification	Spring	New in Summer	Fall
Lakes eligible for management with state funds	142	9	151
Lakes ineligible for management with state funds	44	3	47
Public water but no public access	9	0	9
Not public water			
Rivers or streams	8	0	8
Total	203	12	215

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 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. In other lakes, milfoil appears to have been discovered before the invasive became abundant or widespread when it was noticed by a person with knowledge regarding identification of aquatic plants.

Many false reports of milfoil result when other species of submersed vegetation, often forming mats, attract the attention of lake users. These individuals suspect that the abundant vegetation is milfoil and report the occurrence to the Invasive Species Program. During 2008, 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.

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

The participation of the Section of Fisheries, other divisions of the DNR, outside agencies, commercial herbicide applicators, citizens, and others in reporting new occurrences of milfoil remain critical. This assistance is very important because staff 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

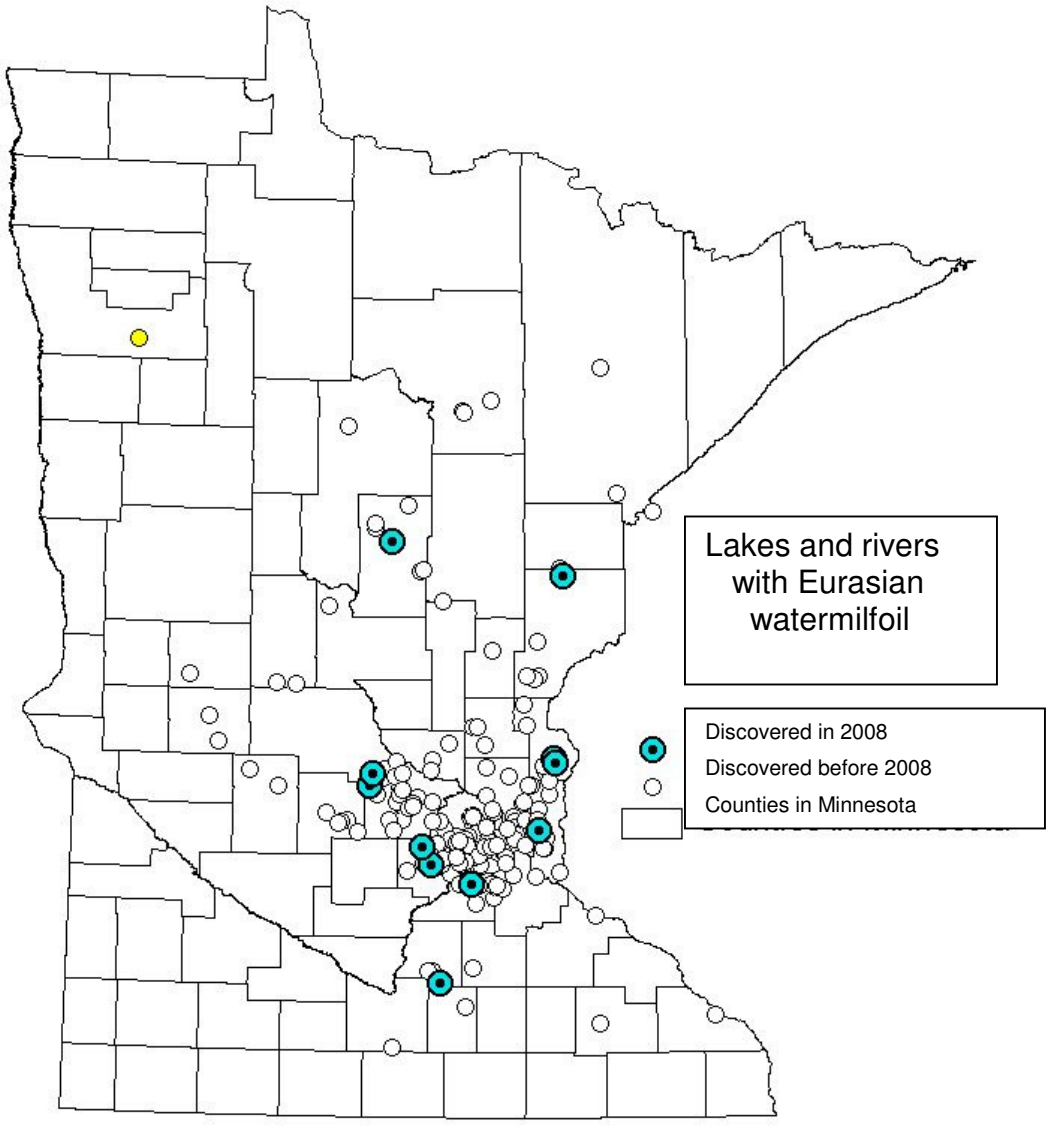


Figure 18. Distribution of water bodies with Eurasian watermilfoil in Minnesota as of November 2008.

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.

Reports of suspected occurrences of milfoil that turn out to be mistaken also have value. In the course of responding to such reports, staff 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.

Management of Eurasian watermilfoil in Minnesota during 2008

Classification of water bodies for management of Eurasian watermilfoil

In the spring of 2008, the Invasive Species Program classified the 203 bodies of water known to have milfoil (Table 9). One hundred forty-two lakes were 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).

Some lakes were 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 and effective in rivers and streams than in lakes.

Nine of the 12 water bodies that were discovered to have milfoil during 2008 were eligible for management with state funds because they have public water accesses (Table 14). Three lakes found to have milfoil in 2008 have no public water access and, consequently, are ineligible for management with state funds.

Management of Eurasian watermilfoil

During 2008, state funding and technical assistance were available from the Invasive Species Program to potential cooperators for management of milfoil. The offer of state funding is described in an announcement that is available to potential local cooperators (DNR 2008) who are expected to take the lead in 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 was application of herbicide, followed by mechanical harvesting. 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.

The DNR received applications for state funding to control milfoil from potential cooperators on 29 lakes (Table 10). Applications were reviewed by the Invasive

Species Program in relation to the standards described in the announcement that is available to potential cooperators (DNR 2008). Twenty-two of the applications were approved for funding and the applicant was reimbursed for control done in 2008. In most cases, the areas with milfoil where control was proposed in these lakes were inspected by staff of the Invasive Species Program. 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 some lakes, proposals were modified by reducing the size of the area to be treated, and subsequently approved.

On five of the lakes where applications for grants were not approved, inspections revealed that sites proposed for treatment with herbicide either did not have dense and matted milfoil or did not constitute an unavoidable nuisance for users of the lake. On two lakes for which potential cooperators submitted applications for grants, inspections found that there was control eligible for reimbursement, but the applicant did not complete the process. In one case, the applicant decided not to control the milfoil. In the other case, the applicant would not provide to the DNR a tax identification number, so the DNR could not establish a grant agreement with them. This is the first time that this has happened during the 14 years that the DNR has offered grants such as these.

Table 10. Number of Minnesota lakes where management of nuisances caused by Eurasian watermilfoil was supported with state funds in 2006-2008.

	Applications received	Applications approved and reimbursed	Applications denied or not pursued
2006	27	23	4
2007	30	28	2
2008	29	22	7

As a result, the DNR reimbursed cooperators on 22 lakes for costs of milfoil management during 2008. These reimbursements comprised a total of $105,000.

Control of Eurasian watermilfoil by the DNR at public water accesses

The Invasive Species Program initiated treatment of milfoil on four lakes either in the immediate vicinity of public water accesses operated by the DNR or in harbors on Mille Lacs and Leech lakes. The purposes of this type of control are to: 1) reduce the risk that users of the lake inadvertently transport milfoil from the lake to other bodies of water; and 2) improve access to the lake. The cost of these treatments was $17,000.

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.

Lake-wide or bay-wide or control of Eurasian watermilfoil and curly-leaf pondweed

In 2008, lake-wide or bay-wide control of Eurasian watermilfoil and curly-leaf pondweed was done on three lakes: Minnetonka in Hennepin County, plus Kohlmans and Silver, both of which are in Ramsey County. Control involved the application of two herbicides, endothall and triclopyr.

On Lake Minnetonka, bay-wide control was done in Carman, Gray's, and Phelp's bays. Early in 2008, a Lake Vegetation Management Plan (LVMP) was completed to guide this project. The project is a partnership among the Lake Minnetonka Conservation District (LMCD), the Lake Minnetonka Association (LMA), the U.S. Army Engineer Research and Development Center (ERDC), and the DNR. The LMA received a grant of $25,000 from the DNR for a "Pilot Project to control curly-leaf pondweed or Eurasian watermilfoil on a lake-wide or bay-wide basis for ecological benefits" in support of the control proposed in the LVMP. Endothall was applied at a rate to produce a concentration of 1 mg/L active ingredient (a.i.) and triclopyr at a rate to produce a concentration of 0.25 to 0.5 mg/L a.i. The lower rate of triclopyr was to be used for treatments of large areas and the higher rate in small or narrow areas where exposure times may be limited. These recommended rates of application of herbicide were based on unpublished information.

The treatment of the three bays in Minnetonka during 2008 resulted in less control than expected. Monitoring of concentrations of herbicides produced by treatment indicated that the levels were lower than expected, which could account for the low levels of control observed. Factors that may have influenced the apparent rapid dispersion of herbicide from the treated areas are under investigation (Skogerboe and Netherland 2008).

Kohlmans Lake was treated with endothall applied at rates to produce concentrations of 1.0 to 1.3 mg/L a.i. and triclopyr at rates to produce concentrations of 0.5 to 0.65 mg/L a.i. Monitoring of concentrations of herbicides produced by treatment indicated that the observed levels were what were expected.

Silver Lake was treated with endothall applied at rates to produce concentrations of _0.75 mg/L active ingredient (a.i.) and triclopyr at rates to produce concentrations of _0.5_ mg/L a.i.

Effectiveness of management of Eurasian watermilfoil in Minnesota lakes

Though the number of Minnesota lakes known to have milfoil increased in 2008, the number of lakes from which applications for DNR funding for control were received remained much lower than the number of lakes eligible to apply (Tables 9 and 10). Also, the number of lakes where cooperators received DNR funding for control of milfoil during 2008 decreased by comparison with the previous year (Table 10). This may be due to limited growth of milfoil on some lakes, perhaps due to the cool spring weather in 2008, though the invasive was abundant in other lakes.

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 in Minnesota. The Invasive Species Program has also received valuable assistance from staff in DNR Fisheries and the Aquatic Plant Management Program in Fisheries and the Division of Ecological Resources.

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 working primarily in Minnesota.

Potential spread of Eurasian watermilfoil
In 2008, Dr. Ray Newman continued working with Ms. Sara Roley, who was a student at the University of Minnesota, on a manuscript entitled "Predicting Eurasian watermilfoil infestations in Minnesota," which they submitted to Lake and Reservoir Management, the journal of the North American Lake Management Society (Roley and Newman *In Press*). In this manuscript, Dr. Newman and Ms. Roley describe the results of research conducted by the University of Minnesota during 2004 with $35,000 provided by the DNR Invasive Species Program.

Genetics of Eurasian, northern, and hybrid watermilfoils
In 2008, Dr. Michael Moody, a researcher at Indiana University, submitted to the DNR a report on continued development of a library of microsatellite markers for Eurasian and other watermilfoils (Moody 2008). While the markers have been useful, more research will be necessary to realize the full potential of this method.

Ecological performance of Eurasian watermilfoil, hybrids between Eurasian and northern watermilfoil, and northern watermilfoil in Minnesota
At the request of the DNR, ERDC researchers initiated a study to determine whether there are differences in the growth or physiological performance of Eurasian, northern, and hybrid watermilfoils under varying environmental conditions at the laboratory, mesocosm, and field level. This research is continuing and preliminary results were described in a presentation by Netherland (2008). No dramatic differences in growth between Eurasian and hybrid watermilfoil have been observed. Researchers have observed the formation of turions, a type of resting structure, by hybrid watermilfoil. This has not been described previously and may affect the potential to manage this plant. It is expected that a complete description of the results will be provided in a written report to the DNR in the future.

Future plans and needs for management of Eurasian watermilfoil

- 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.
- 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 19). 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 19), from pea-sized bulbils that detach from the rhizome, and from bulbils 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.

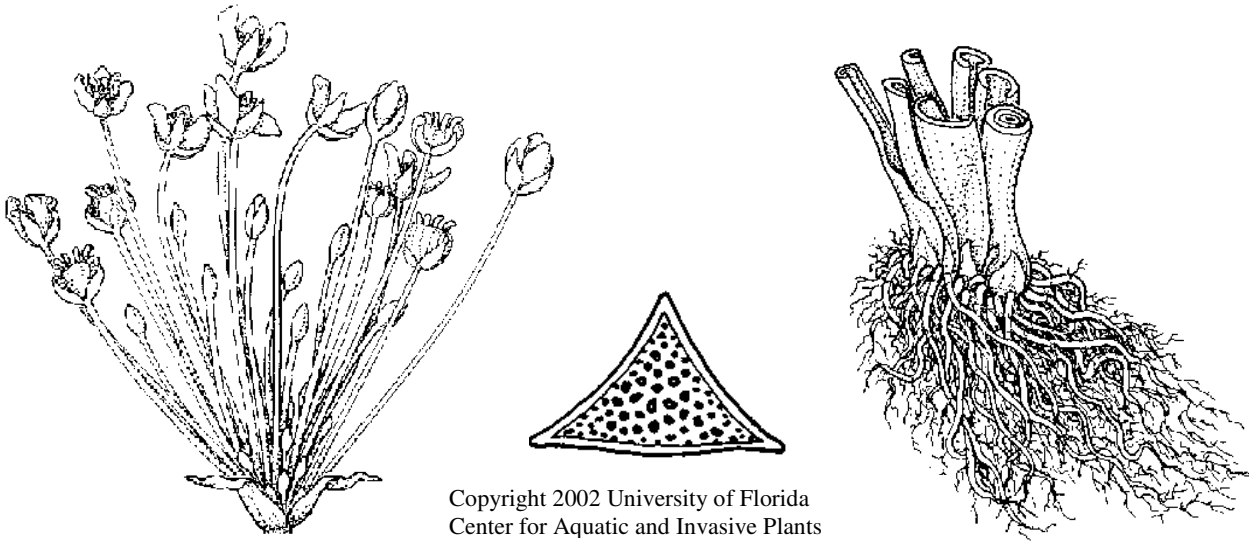

Figure 19. Flowering rush umbel, cross-section of a leaf, and rhizomes.

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 aggressively in North America and displace 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.

Distribution

Flowering rush was first recorded in Anoka County in 1968 (Moyle 1968) and has since been located in 22 bodies of water in eight other counties. Despite its 30-year presence in the state, the distribution of flowering rush is widely scattered and uncommon (Figure 20).

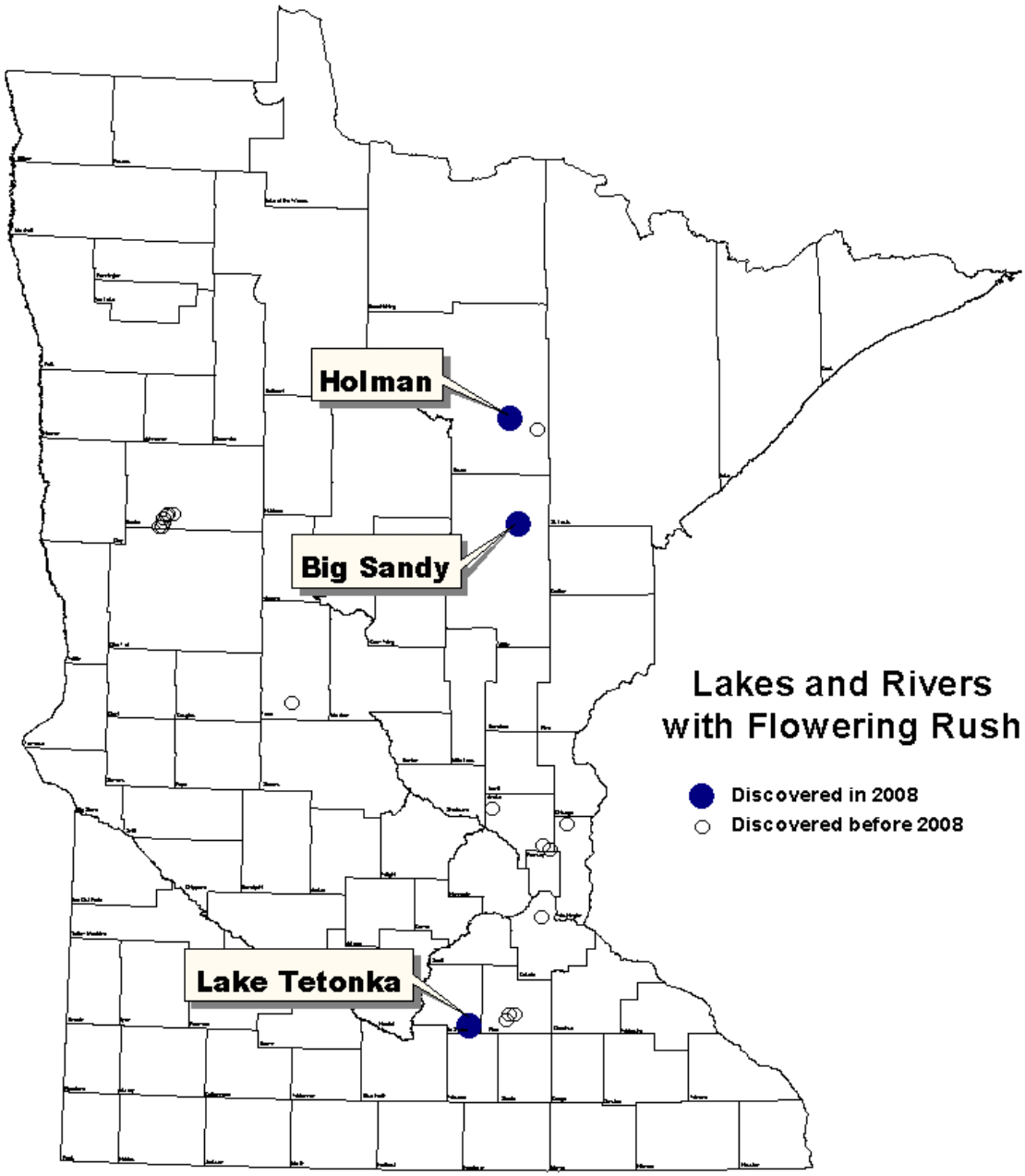

Figure 20. Flowering rush locations as of November 2008.

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).

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 changes.
- 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 - 2008

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 plant 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 by 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
In 2008, staff of the Invasive Species Program surveyed and documented flowering rush on a number of lakes in Minnesota. In northwestern Minnesota, staff of the Invasive Species Program delineated the distribution of flowering rush in lakes of the Pelican River chain. These include Detroit Lake, from which water flows into Muskrat Lake, then into Lake Sallie, then Lake Melissa, then Mill Pond, all of which are in the Pelican River Watershed District (PRWD). From Mill Pond, water flows into Buck Lake, where two small clusters of flowering rush were found and removed during 2008. Searches have not discovered flowering rush farther downstream than Buck Lake, which is in the Pelican Group of Lakes Improvement District (PGOLID), along with other downstream bodies of water. The PGOLID (2008) produced a contingency plan to guide their efforts in 2009. The DNR has been working closely with the PRWD, PGOLID, and other interested parties in the assessment and management of flowering rush in this part of the state.

In northeastern Minnesota, staff of the Invasive Species Program delineated the distribution of flowering rush during 2008 in three lakes: Holman, North Twin, and Big Sandy. Holman Lake is a 146-acre lake located near the town of Marble in Itasca County. After receiving a report of flowering rush in the lake from a DNR area fisheries employee, the Invasive Species Program confirmed the presence of the invasive aquatic plant in the lake.

North Twin Lake is a 250-acre lake located near the town of Marble in Itasca County. Flowering rush was first documented in this lake 13 years ago. In 2008, the Invasive Species Program estimated that the invasive plant occupied 6.7 acres, an increase from the 4.7 acres of flowering rush documented in 2007.

In 2008, staff of University of Minnesota Extension discovered and removed several flowering rush plants from Big Sandy Lake in Aitkin County. This is a 6,526-acre lake located near the town of McGregor. A subsequent inspection of the lake by the Invasive Species Program found no additional flowering rush plants. In the future, the Invasive Species Program will continue to monitor Big Sandy Lake in case the flowering rush reappears.

In southern Minnesota, the Invasive Species Program confirmed the presence of flowering rush in Tetonka and Sakatah lakes, in Le Sueur County near the town of Waterville, after receiving reports of the invasive species from a DNR area fisheries employee. In the future, the Invasive Species Program will continue to monitor the distribution and abundance of flowering rush in these lakes.

Support research to develop and implement better management methods
In 2008, the PRWD continued to apply imazapyr herbicide, for which the trade name is Habitat, to flowering rush. The Invasive Species Program continues to work with the PRWD to evaluate the effectiveness of these treatments.

Recently the chemical manufacturer BASF introduced an aquatic formulation of imazamox, an herbicide with the trade name of Clearcast. An informal test of imazamox, which was applied to a small area of flowering rush on North Twin Lake during 2007, did not indicate that the treatment was particularly effective one year later.

The DNR is exploring with the U.S. Army Engineer Research and Development Center (ERDC) and other researchers the possibility of designing and implementing a study of the efficacy of herbicides on flowering rush growing under controlled conditions.

Provide information to those interested in how to best manage flowering rush
DNR staff including representatives from the Invasive Species Program meets regularly with the PRWD, PGOLID, and others to discuss concerns regarding the expansion of flowering rush in the Detroit Lakes area. Currently, the PRWD is spot-treating flowering rush stands with imazapyr to reduce the nuisances for lake residents and users. 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. Recent herbicide work done by the PRWD and others is demonstrating that flowering rush can be treated with imazapyr without significantly harming submersed aquatic plants. The Invasive Species Program staff will continue to evaluate the utility of these treatments.

Mechanical control by cutting can also be an effective method of reducing dense stands of flowering rush, but only seasonally. 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 it does not eliminate the invasive plant. Digging also may be an effective method of removing small infestations of flowering rush or reducing dense stands of flowering rush, but only seasonally. There is concern that digging may increase the spread of flowering rush within a lake if the entire rhizome is not removed. In lakes where the invasive plant is widespread and well established, it is unclear whether digging may increase the abundance of flowering rush.

Participation of Other Groups in Management Activities

Others involved in flowering rush management in Minnesota in 2008 include: DNR's Division of Fish and Wildlife, PRWD, PGOLID, 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 continuing 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 21). In 2008, 21 new purple loosestrife infestations were identified in Minnesota. There are now 2,379 purple loosestrife infestations recorded statewide (Table 11). 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 - 2008

Chemical control of purple loosestrife

Initial attempts by the DNR to control purple loosestrife relied mainly on the use of herbicides. The most effective herbicide is Rodeo, a formulation of glyphosate, which is a broad-spectrum herbicide that can kill 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

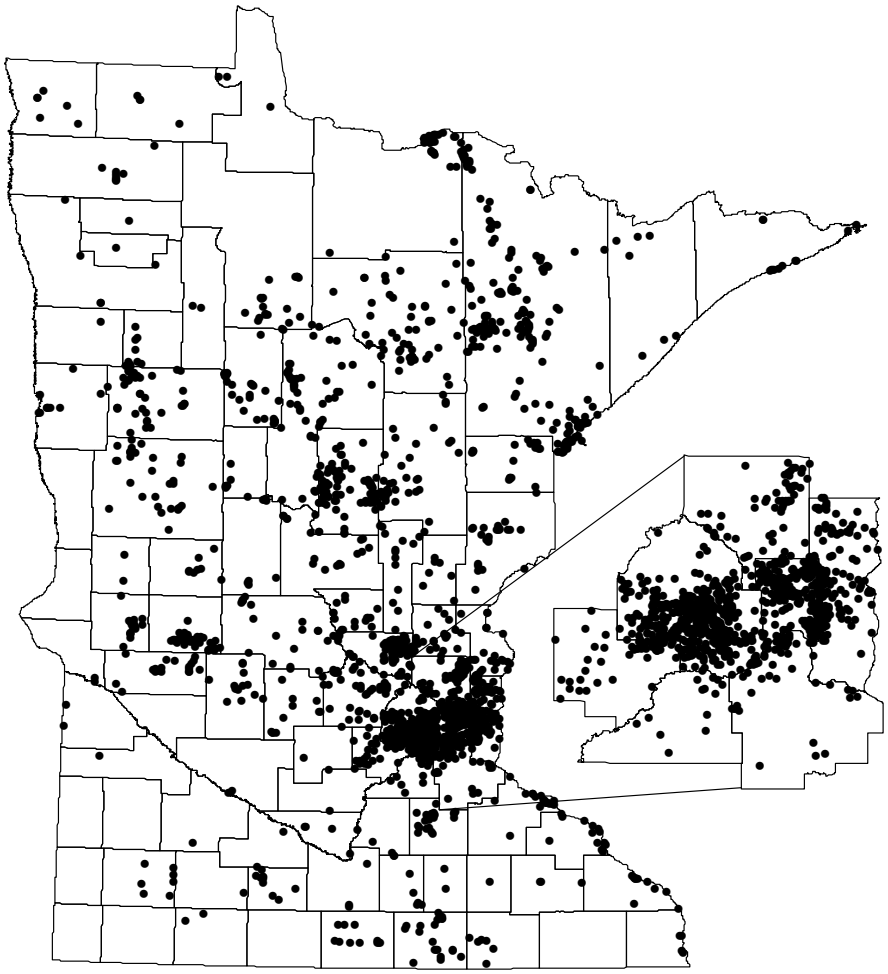


Figure 21. Purple loosestrife infestations in Minnesota as of December 2008.

Table 11. Purple loosestrife infestations in Minnesota recorded by the DNR in 2007 and 2008.

Site Type	Total sites 2007	New sites 2008	Total sites 2008
Lake	711	12	723
River	223	0	223
Wetland	754	7	761
Roadsides and ditches	505	2	507
Other[1]	165	0	165
Total	**2358**	**21**	**2379**

[1]Includes gardens and other miscellaneous sites.

to large populations that have been established for a number of years. This is due in part to the plant's ability to re-establish from an extensive purple loosestrife seed bank.

Research 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. Because purple loosestrife seeds are dispersed by water movement, 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.

Between 1989 and 2008, the number of sites, number of plants, and total cost of treating purple loosestrife with herbicide, have generally decreased (Table 12). 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 2008, only DNR staff was used to treat purple loosestrife stands statewide. DNR staff visited 48 purple loosestrife stands for herbicide control work (Figure 22, Table 12). At one site, workers found no loosestrife plants to treat. A total of 46 sites were treated with herbicides. Most of the sites were very small: 87% had fewer than 100 plants. Ten purple loosestrife plants were hand-pulled from three locations. This work took a total of 330 worker hours, and only 0.2 gallons of Rodeo. The total cost for this effort was $7,600.

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 (one in 2008) are controlled for at least one year beyond the year of treatment 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.

Table 12. Historical herbicide applications performed by DNR and applicators contracted by DNR in Minnesota (1989-2008).

Year	Sites visited	Sites with <100 plants treated	Sites with >100 plants treated	No plants located	Total worker hours	Herbicide quantity used/gal	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	0.9	$8,180
2004	59	30	9	20	370	0.6	$9,400
2005	62	48	9	5	296	0.4	$9,000
2006	95	84	10	1	674	0.4	$12,400
2007	59	53	4	2	510	1.1	$12,400
2008	48	41	6	1	330	0.2	$7,600

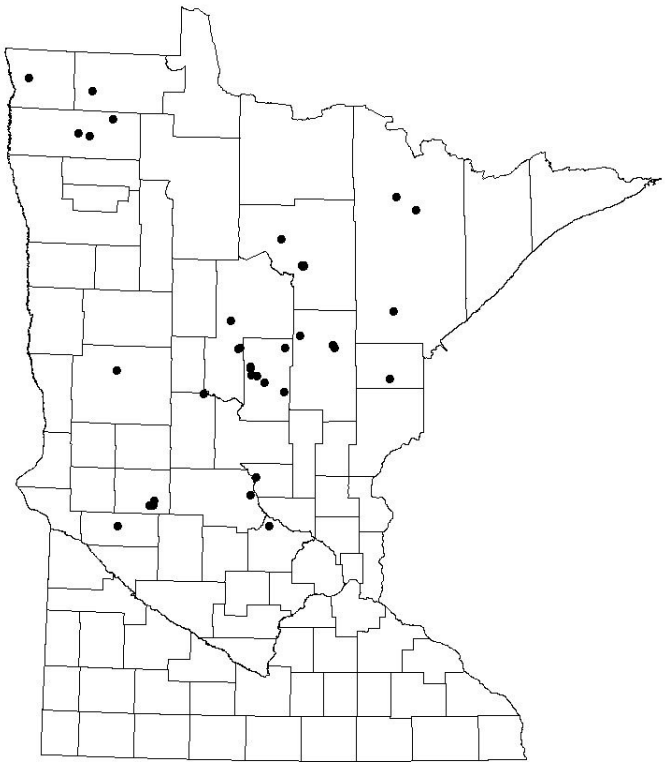


Figure 22. Locations where DNR staff used herbicides to control purple loosestrife in 2008.

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, Minnesota Sea Grant, 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 2008, this cooperative effort has had a significant effect on total number of insects released (Figure 22).

With the success of insect establishment in the field, organized rearing efforts came to an end in 2004. Resource managers are able to collect insects from established

release sites and redistribute them to new infestations. The "collect and move" method has reduced the effort needed to further distribute leaf-eating beetles in Minnesota.

In 2008, an estimated 12,470 leaf-eating beetles were collected and released on 7 sites. To date, the leaf-eating beetles have been released on 831 sites statewide (see Figure 24, Table 13).

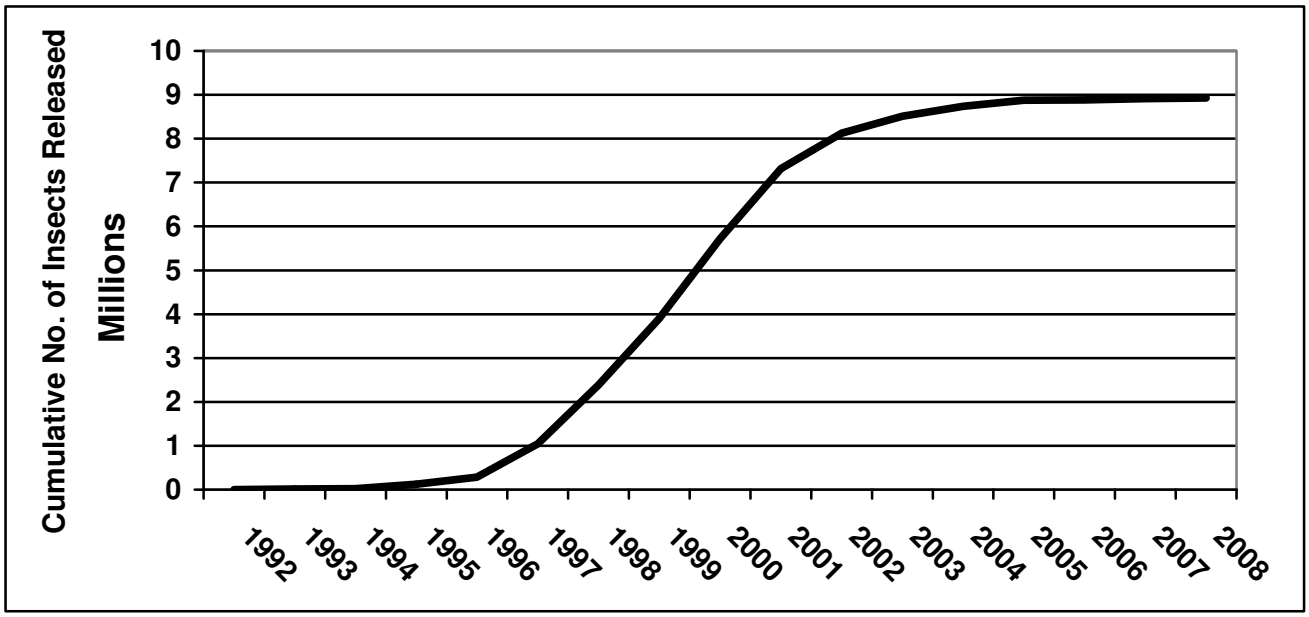


Figure 23. Cumulative number of insects released to control purple loosestrife by year.

Table 13. Summary of number of insects released in each region to control purple loosestrife (1992-2008).

Minnesota DNR Regions	Number of Release Sites	Number of Insects Released
1 – Northwest	135	1,364,560
2 – Northeast	217	1,626,503
3 – Central	414	5,193,302
4 – South	65	705,304
Totals	**831**	**8,889,669**

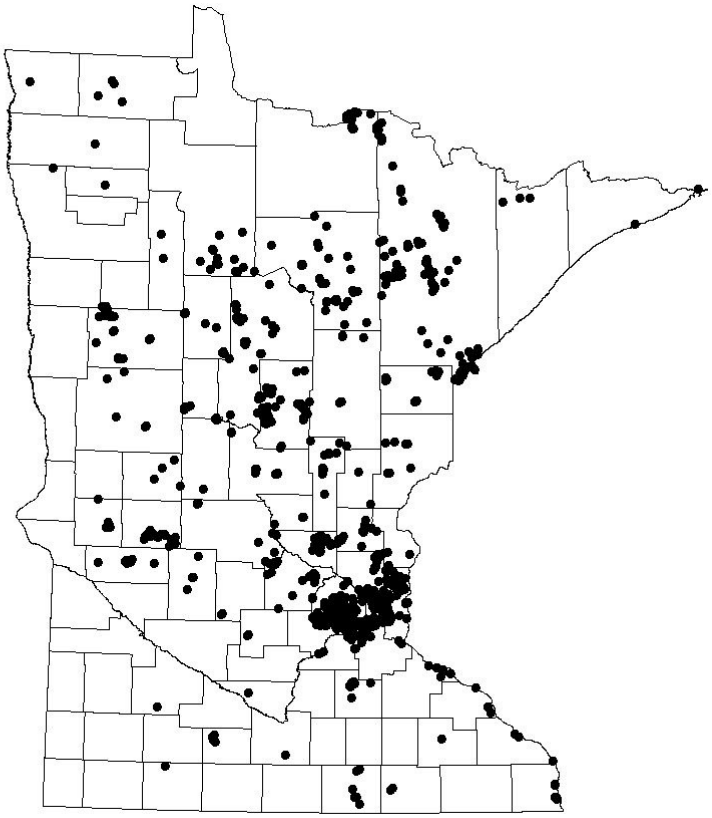
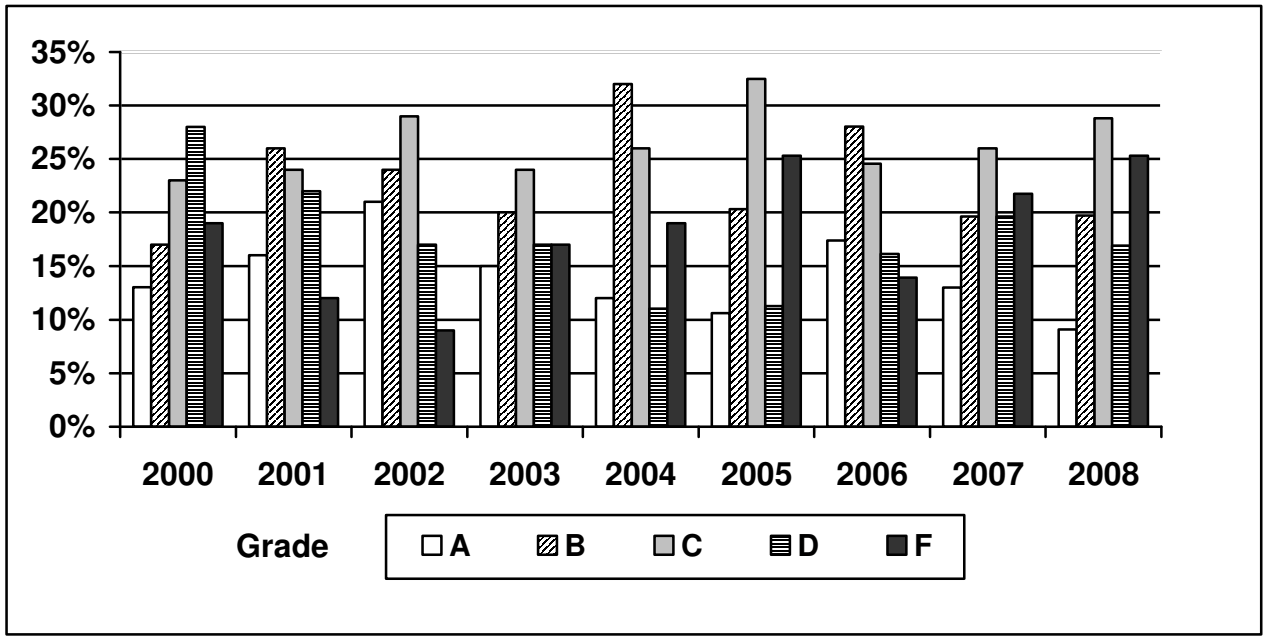


Figure 24. Locations of insects released to control purple loosestrife in Minnesota through 2008.

Biological control insects released between 1992 and 2008 have established reproducing populations at more than 75% of the sites visited. Insect populations increased significantly at many locations with pronounced damage to loosestrife plants. In the summer of 2008, 142 insect release sites were assessed for insect establishment and level of control achieved. At 58% (82 sites) of the sites surveyed, insect populations were increasing and causing damage to the loosestrife infestations. At 9% (13 sites) of all visited sites, the loosestrife was severely defoliated (90-100%) (Figure 19).

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 2008 demonstrated that *Galerucella* introductions have caused moderate to severe defoliation of loosestrife populations on 29% (41 sites) of 142 sites assessed in 2008 (Figure 25)



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.

Figure 25. Sites graded for insect establishment and control.

The DNR continues to assess how loosestrife abundance changes over time and to determine what combinations of biological control agents provided the desired level of control. Over the last 12 years (1995-2007), a field study has been conducted within ten purple loosestrife infestations to quantitatively assess the effects of *G. calmariensis and G. pusilla* on purple loosestrife and non-target native plant communities in Minnesota. The overall results to date suggest that *Galerucella* spp. populations initially peaked between three and five years after establishment. At most sites, purple loosestrife density declined (up to 90%) in response to an increase in *Galerucella* spp abundance. *Galerucella* spp. appear to have a strong numerical response to purple loosestrife density which led to multiple "boom and bust" cycles occurring on many of the sites during the 12-year period. Declines in *Galerucella* spp. typically allowed purple loosestrife populations to rebound. Generally, *Galerucella* spp. populations rebounded as loosestrife abundance increased. The number and amplitude of the boom and bust cycles appears to be related, in part, to the density of the initial purple loosestrife infestation. Sites where purple loosestrife approached 100% cover tended to cycle more frequently than sites with a higher plant diversity and abundance. It appears that in more diverse sites, increased plant competition prevented purple loosestrife from attaining pre-release densities. As purple loosestrife populations declined, plant species richness and/or abundance increased within release sites.

Research on Insects as Biological Control Agents

No new research is currently underway on purple loosestrife biological control. Research completed in 2007 (See Invasive Species of Aquatic Plants and Wild Animals in Minnesota Annual Report 2007) is now being revised and submitted for publication in scientific journals.

Future needs for management of purple loosestrife

- 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 Aquatic Invasive Plant Species in Minnesota

Introduction

Numerous invasive species of aquatic plants exist in the state. The previous chapters described species for which there were continuing efforts. The species listed in Table 14 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, and have been described in previous annual reports.

Brazilian waterweed (*Egeria densa)*

Brazilian waterweed, an invasive, non-native aquatic plant new to Minnesota waters, was discovered in Powderhorn Lake in south Minneapolis at the end of August 2007. Brazilian waterweed is classified as a regulated invasive species in Minnesota. It is important to limit the spread of Brazilian waterweed in Minnesota to prevent the development of potential problems. In an attempt to eliminate the plant from the lake, the DNR and the Minneapolis Park and Recreation Board (MPRB) applied herbicide to the Brazilian waterweed during October. In addition, an aeration system usually operated in the lake by the MPRB during winter was not operated during the winter of 2007-2008.

Inspection of Powderhorn Lake on June 6 and September 17, 2008, did not result in the observation of Brazilian waterweed in the lake. The DNR plans to continue to monitor the lake in future years to determine whether Brazilian waterweed is in the lake.

Water hyacinth (*Eichornia crassipes)*

See Prevention and Containment.

Table 14. Other Aquatic Invasive 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
Hardy hybrid water lily (*Nymphaea* spp. hybrid)	Four known wild populations in Minnesota. One new location found in 2007.	Regulated	2004
Water lettuce *(Pistia stratiotes)*	Plants found in the wild in 2007.	Unlisted	2001
Reed canary-grass *(Phalaris arundinacea)*	Widespread in Minnesota.	Unlisted	2004
Salt cedar (*Tamarix ramosissima)*	One known population that was treated with herbicide and by mechanical methods in 2003-2004. It is believed to have been eradicated from the site.	Unlisted	2004
Introduced subspecies of common reed (*Phragmites australis ssp.australis)*	Only a few known populations in the state; distribution information is lacking.	Unlisted	N/A
Brittle naiad (*Najas minor*)	One known population in the state.	Prohibited	2007

Terrestrial Invasive Plant Management

Overview

Terrestrial invasive plant species are non-native plants that can naturalize, threatening natural resources and their use. Invasive plant species out-compete native plants that provide critical habitat needed to support wildlife species. For example, common buckthorn (*Rhamnus cathartica*) and glossy buckthorn (*R. frangula*) are Eurasian 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 (Heidorn 1991, Randall and Marinelli 1996) and have been linked to increased predation in songbird populations (Schmidt and Whelan 1999).

The DNR manages approximately 5.7 million acres or 95% of all the state-owned lands including Scientific and Natural Areas (184,000 acres), State Forests (4 million acres), Wildlife and Aquatic Management Areas (1.3 million acres), State Parks and Trails (244,000 acres). Prevention and management of invasive species is an important conservation action needed to protect and/or restore habitats for wildlife species, especially those species in greatest conservation need. Within the DNR, there is a critical need to expand the amount of awareness, data, tools and resources to reduce impacts caused by invasive plants on state-managed lands. The goal is to improve or enhance the ability of DNR staff to effectively manage terrestrial invasive plants on DNR-managed lands through management, inventory, education, and research.

This work is being funded by a combination of sources that includes state funding (Legislative-Citizen Commission on Minnesota Resources, Heritage Enhancement and General Fund), and federal funding (U.S. Forest Service and U.S. Fish and Wildlife Service).

Management

Grant Program

The Invasive Species Program initiated a grant program for the management of terrestrial invasive plant species on state-managed lands in 2006. Grants totaling $435,660 were awarded to DNR land managers from October 2007-June 30, 2008. . Approximately $650,000 was awarded to land managers for July 1, 2208-June 30, 2009. The overall goal of this project is to improve and/or protect habitats that have been degraded by terrestrial invasive species on state-managed lands, including State Parks, Forests, Trails, Wildlife Management Areas, and Scientific and Natural Areas.

Management of invasive species is an important conservation action needed to protect and/or restore habitats for wildlife species, especially those species in greatest conservation need. Species in greatest conservation need are defined in Minnesota's Comprehensive Wildlife Conservation Strategy as animals whose populations are rare, declining, or vulnerable to decline, and are below levels desirable to ensure long-term health and stability. Habitats impacted by invasive species include oak savannah,

native prairie, grassland, bluffland, and hardwood forest and wetland habitats. Minnesota's Comprehensive Wildlife Conservation Strategy lists management of invasive species as a Priority Conservation Action for all ecological subsections in the state.

The grants could not be used to substitute for funding current or ongoing activities related to invasive species management within each Division. This funding was meant to allow managers to add or start new invasive species projects or expand on existing projects. Eligible projects activities include: 1) invasive plant surveys; 2) resources that will help staff implement the Invasive Species Operational Order 113; and 3) planning and implementation of invasive plant management efforts.

Outcome Report 2008 Granting Cycle:

Five divisions in FY07/08 completed 32 management grant projects (Table 15). These projects implemented treatment or inventory for more than seven different invasive plant species. The 32 funded grant projects accomplished management at 81 locations and inventoried over 16,000 invasive species plant locations.

The majority of the proposals targeted the control of woody invasive species such as buckthorn, exotic honeysuckles, and Siberian elm. Other projects targeted species that typically grow in open areas such as common tansy, leafy spurge, and spotted knapweed. However, these species also pose a threat to forestry because of their effect on tree regeneration in harvested areas. The section of Wildlife completed two large inventory projects (Table 15). This information is being used to prioritize areas for treatment in the coming years. In September 2007, staff at Glacial Lakes State Park, removed the last buckthorn tree after a multi-year buckthorn control project that was partially funded through the terrestrial invasive species grants program.

Current Grant Proposals ending in June 2009:

In the current 2007-2008 grant cycle, 47 proposals totaling more than $610,807 were submitted for funding in response to a request for proposal for terrestrial invasive plant management (Table 16). The funded proposals included 28 proposals for controlling invasive plants, nine proposals for invasive plant inventories, and ten proposals to do both inventories and control.

Table 15. Overview of the outcomes of funded terrestrial invasive plant inventory/management projects FY07-08.

Division/ Section	Number of Projects	Inventory	Acres	Management and Control	Acres
Ecological Resources	4			• Buckthorn and honeysuckle control (4)	326
Forestry	4	• Invasive species inventory	2,325	• Buckthorn control (2)	582
Parks	16	• Invasive species inventory, equipment, and mapping (part of 10 projects)	1,045	• Primarily woody invasives control (buckthorn, honeysuckle, Siberian elm, cargana); some Canada thistle, spotted knapweed, and garlic mustard control	624
Trails and Waterways	2			• Buckthorn control (1) • Leafy spurge and spotted knapweed control (1)	48
Wildlife	6	• Invasive species inventory (5)	Approx 20,645	• Various herbaceous species control (2) • Woody invasives control (2)	928
TOTAL	**32**		**24,015**		**2,508**

Table 16. Funded terrestrial invasive plant inventory/management projects FY09.

Division/Section	Number of Projects	Project Type	Subtotal
Forestry	14	• Buckthorn, tansy and other invasive plant control (7) • Invasives inventory and purchase of inventory equipment (7)	**$ 205,927**
Parks	20	• Primarily woody invasives control (buckthorn, honeysuckle, Siberian elm, cargana); some Canada thistle, spotted knapweed and garlic mustard control • Invasives mapping and equipment purchase part of 8 projects	**$ 188,550**
Trails and Waterways	1	• Tansy control, leafy spurge, and spotted knapweed control (1)	**$ 2,800**
Wildlife	10	• Mainly invasive species control • Invasives inventory a part of (2)	**$ 191,930**
Ecological Resources	2	• Invasives inventory and equipment a part of (2)	**$ 21,600**
TOTAL	**47**		**$ 610,807**

The majority of the proposals targeted the control of woody invasive species such as buckthorn, exotic honeysuckles, Siberian elm, black locust, and the purchase of survey equipment. Many of the management projects are currently underway but will not be completed until June 30, 2009. Results of the management and inventory efforts from the current grant cycle will be provided in the 2009 Invasive Species Annual Report.

Reducing the Spread and Impact of Invasive Species by DNR Resource Management Activities

Due to the growing threat of invasive species (both terrestrial and aquatic), and the Forest Stewardship Council's Corrective Action Request (CAR) to "implement strategy to identify areas of greatest concern with respect to invasive species and implementation to control," there is a need to address the spread and impact of invasive species by DNR resource management activities from a department-wide perspective. Therefore, the Invasive Species Operational Order 113 identified the need for each DNR Division to develop Invasive Species Divisional Guidelines for their work activities. These were finalized in the spring of 2008 and are currently being implemented at the field level.

Inventory

Using standardized protocols developed by the DNR, 33,000 locations of invasive plant species on state-managed lands have already been mapped using GPS/GIS technologies (Figure 26). This includes surveys conducted in over 25 state parks, 165 wildlife management areas, and along 174 miles of state trails. Data collected in the field is now being sent directly (via the Web) to a central database within DNR where the all-terrestrial invasive plant data is stored and managed. This data is now available to DNR staff through quick themes in ArcView. This terrestrial invasive plant data is updated weekly to ensure managers have the latest available information. Managers are now using this information to target and monitor the results of control efforts on these populations.

Information and Education

A three-day Invasive Species Conference was held this year in Duluth. Over 400 individuals participated in the conference which covered topics related to both terrestrial and aquatic invasive species. Terrestrial invasive participants learned about the ecology of invasion and how to identify, monitor, prevent, and control the most troublesome invaders of Minnesota's woodlands. These non-native invasive species have ecological implications for forest communities, disrupt native species regeneration, and create problems during and after management activities. Other topics included insect and disease issues and biocontrol.

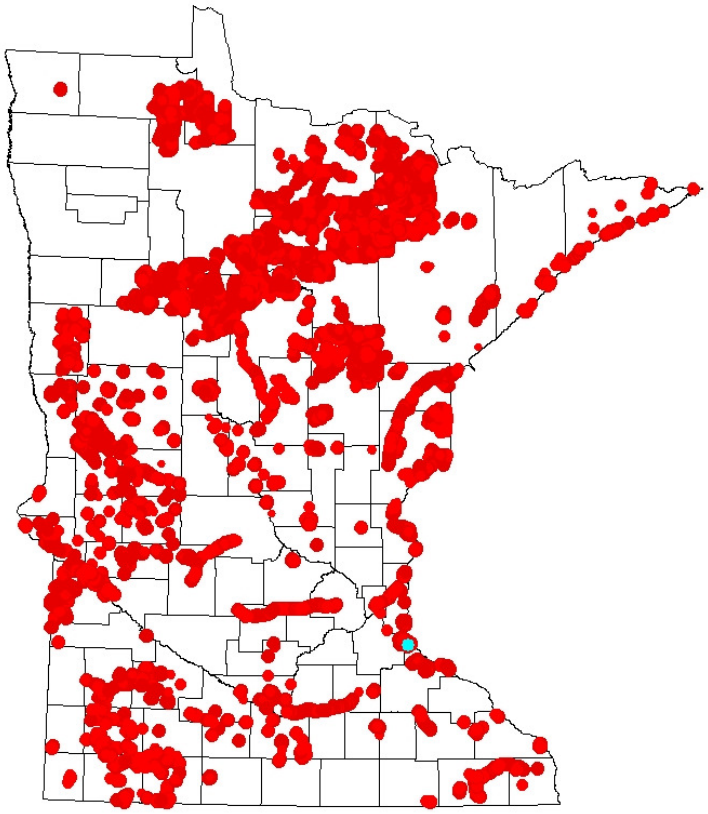

Figure 26. Terrestrial invasive plant inventories (all species), 2008.

Highlights of the conference included:

- Understand the ecological, economic, and recreational/social impacts of invasives.
- Understand the pathways in which invasives spread.
- Understand the requirements of the Invasive Species Operational Order.
- Become familiar with Best Management Practices (BMPs) for forest invasives to help prevent their spread.
- Understand the impacts of forest insects and diseases.
- Develop basic "four season" identification skills and understand the life history of each species, especially as it pertains to eradication and control methods.
- Become familiar with a variety of management and control methods, including mechanical, prescribed fire, grazing, chemical, biocontrols, various tools, and how an integrated approach can work.
- New biocontrol efforts
- Insect and disease movement and control

Research

Research is being carried out to improve management practices of plant species that pose a serious threat to natural resources and their use. Research is underway to improve control of Canada thistle, reduce herbicide use, and reduce impacts to native

plants. Funds are being provided to support research on biological control methods for garlic mustard and buckthorn.

Buckthorn Biological Control Research

Research in Europe. Over the course of this project, researchers with the Center for Applied Bioscience International (CABI) have surveyed, collected and tested a variety of insects for potental biocontrol of *R. cathartica* and *F. alnus.* These species where tested for ability to oviposition on these plants and their choice of oviposition plants. These species where also tested for their host specificity preference. These tests help to determine the effectiveness and efficiency of these species as biocontrol agents and any risk associated with other native related shrubs.

Once these surveys and tests were completed, CABI researchers reassessed the data collected and prioritized the species for further testing. Three species were identified as priority species for further work. These species included *Philereme vetulata* (Lep., Geometridae), *Trichochermes walkeri (*Hom., Triozidae), and *Wachtiella krumbholzi* (Dipt.; Cecidomyiidae). These three species vary in the type of damage they do to *R. cathartica* and *F. alnus* ranging from the production of galls to attacking the fruits of the shrubs.

Further funding secured for the FY09/FY10 biennium will help to complete the work on these three potential biocontrol agents for *R. cathartica* and *F. alnus* control.

Host specificity studies (make sure the insects will not eat plants native to Minnesota and the U.S.) will continue on the high priority insect species. Insects will be prioritized based on their perceived potential to cause damage to buckthorn by impairing growth and/or reproduction, reduce vigor, or cause structural damage. Expected results include a priority list of potential control agents with information of their host specificity to native buckthorn species and other plants as determined. This information will guide future research and eliminate candidate insects that are not good potential agents.

The DNR has initiated a research project on biological control of European buckthorn, conducted by CABI in Switzerland. The Minnesota legislature as recommended by the Legislative-Citizen Commission on Minnesota Resources, from the Environmental Trust Fund and by the DNR has continued to fund this research.

Initial research results suggest that a dozen species of insects show some potential as control agents. Surveys were carried out by CABI researchers in Germany, Italy, Switzerland, Austria, and Yugoslavia (2002-2006). In total, more than 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*. Emphasis was put on field surveys of flower and fruit/seed-feeding insects as key Lepidoptera species. 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.

In support of biological control research, a survey was conducted for insects associated with common buckthorn in a portion of its introduced range in Minnesota. This survey provides baseline information on available feeding niches for potential control agents of

common buckthorn and identifies the natural enemy community that could potentially interfere with agent establishment. In two years of sampling, 356 species representing 111 families and 13 orders were collected from common buckthorn in Minnesota. There was no significant defoliation observed at any of the study sites. We surmise that ample feeding niches are available given that most herbivores collected can be classified as generalists. However, the abundance of parasitoids and predators may hinder establishment of potential biological control agents. Further research is needed to determine if biotic resistance could play a significant role in preventing establishment of herbivores in a classical biological control program for common buckthorn in North America.

Garlic Mustard Biological Control Research

Summary. Since 1998, a consortium of private, state, and federal sponsors have supported the development of biological control for garlic mustard (*Alliaria petiolata*). Four weevil species attacking seeds, stems, and root crowns of garlic mustard have been selected as the most promising biocontrol agents. Individual and combined impacts of these species can increase rosette mortality and decrease seed output, stem height, and overall performance of garlic mustard. The determination of their host specificity, i.e., restriction to garlic mustard as the only plant allowing complete development without possibility to develop in native North American species, has been the highest priority over the past four years. The focus of this work has been on the root feeder *Ceutorhynchus scrobicollis* followed by the two-stem miners *C. alliariae* and *C. roberti*. The results of these tests show high specificity of all species to garlic mustard. Although three European plant species were also attacked in tests, these species are not recorded as field hosts of the weevils. The implementation of safe garlic mustard biocontrol appears within close reach.

Host specificity testing of the final set of native plant species was completed for *C. scrobicollis*. This included additional native species in several genera now considered closely related to garlic mustard. With testing complete, a petition was submitted in April 2008, to USDA-APHIS to allow state agencies to field release *C. scrobicollis* in the United States. We are currently waiting for feedback on the petition.

In anticipation of receiving approval, work has been ongoing to develop mass rearing methods for *C. scrobicollis.* Researchers at the University of Minnesota are testing methods to rear *C. scrobicollis* outdoors as well as within the quarantine facility.

Garlic mustard biological control implementation in Minnesota. A second garlic mustard project was initiated in 2005 to establish permanent plots to monitor garlic mustard populations in anticipation of biological control insect release. To find potential sites, it was necessary to locate garlic mustard populations of the appropriate size in areas where management would not be applied. The established plots then had their species composition and garlic mustard abundance recorded in 2005, 2006, and 2007. Garlic mustard monitoring plots were established in 12 sites in central and southeastern Minnesota. In addition to setting up monitoring sites, a research plan for garlic mustard was developed. Current research on garlic mustard was reviewed and research objectives and experiments related to impacts and control of garlic mustard were developed. Funding for this effort was recommended by the Legislative-Citizen

Commission on Minnesota Resources from the Minnesota Environment and Natural Resources Trust Fund.

While evidence of insect feeding was widespread, the actual amount of leaf damage was low. Across all sites, seasons, and years, the average amount of leaf area damaged due to insects was 1.8 ± 0.03%. Leaf damage did not vary widely from site to site. The lowest mean leaf removal was 0.95% at Pine Bend in 2006, while the highest was 4.4% at Fort Snelling (St. Paul). When biological control weevils are released, it is expected that insect damage, especially windowpane feeding, will increase.

Garlic mustard's biennial life cycle drives some of the changes in garlic mustard cover and population density from year to year. At some sites, one life stage clearly dominates in each year. For example, a site may be dominated by adult flowering plants in spring 2005 and have few seedlings present. In the fall of 2005, there would be few rosettes. In the spring of 2006, the seedling stage would dominate and the site would have many seedling and very few adults. By fall 2006, there would be many rosettes.

Of the 12 sites, six showed a pattern of one life stage dominating each year. Over three years of monitoring, the rosette population density cycled from low to high to low in some sites and from high to low to high at others. It is important to take these population cycles into account when analyzing the impacts of biological control insects. A decrease in adult plants from one year to the next may simply be a result in this natural oscillation in life stage dominance. It will take several years of data to separate out natural population cycles from long-term decreases in population.

Data was collected on garlic mustard plant height and the number of siliques as measures of vigor and reproductive output of the plants. It is anticipated that the introduction of biological control insects will stress the plants and result in smaller plants, which produce fewer siliques. The year-to-year variation in garlic mustard average heights and numbers of siliques again underscores the importance of pre-release monitoring. Monitoring sites with and without biological control release will help us determine the impacts of biological control agents versus natural year-to-year variation. Large natural fluctuations in garlic mustard plant height and numbers of siliques were detected as height and siliques production decreased from 2006 to 2007.

One of the impacts of garlic mustard is that it forms dense populations, which negatively impact native species. Sites with greater garlic mustard cover had lower native species richness and cover than those sites with less cover of garlic mustard. The negative correlations were consistent in both 2006 and 2007. Sites varied in the amounts of native and non-native species present. Native species richness ranged from a low of 1.8 species/0.5m^2 quadrat at Baker Park in 2005 to a high of 6.7 species/0.5m^2 at Willmar in 2007. Native species cover ranged from a low of 9% cover at Baker Park in 2005 to a high of 50% cover at Nerstrand in 2007. Nerstrand also had the lowest non-native species richness and cover (no non-native species were present in the spring 2005-2007). In addition to monitoring whether biological control insects will decrease garlic mustard populations, we can also monitor the response of the native vegetation. Ideally, native species cover and richness will increase as the populations of garlic

mustard decrease. Monitoring data provides baseline information on native species cover and richness.

In addition to the proposed monitoring project, we also looked at the allelopathic potential of garlic mustard. Garlic mustard roots exude allelochemicals, which can negatively affect native species by decreasing germination rates. The active allelopathic compound in garlic mustard is allyl glucosinolate (sinigrin). The seedbank of the study sites were also examined to provide a better understanding of the restoration potential of the sites infested by garlic mustard.

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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. There is considerable concern that these fish could enter the Great Lakes through the Illinois waterways that connect the Mississippi River Basin with the Great Lakes Basin.

Resource managers throughout the UMRB are concerned about Asian carp and their associated impacts on natural resources and human safety. The natural ranges 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 pose unique threats to fish and other aquatic species. Taken together they appear capable of having profound effects on aquatic resources and recreational opportunities.

A commercial fisherman caught a grass carp in the St. Croix River in spring 2006. A bighead carp was caught by a commercial fisherman in fall of 2007 in Lake Pepin (Figure 27). It was the second bighead carp caught in Lake Pepin. There has been no evidence of reproduction of Asian carp in the state. The closest known reproducing populations are in Iowa waters of the Mississippi River and its tributaries.

Management Goals and Options

There are three general options to manage wild populations of Asian carp:

1) no action;
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 UMRB. 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 to limit the northern spread of Asian carp in the UMRB.

Distribution - 2008

The high water in many rivers south of Minnesota in 2008 appears to have enabled northward range expansions of the Asian carp species. Lock and dam structures are

generally barriers to upstream migrations of fish, but when floodwaters overtop the dams fish can swim past them and move upstream. In the Missouri River tributaries, silver carp were reported for the first time in the James River near Mitchell, South Dakota and bigheads were reported up to Huron, South Dakota. There were also reports of bigheads well up the Vermillion and Big Sioux rivers that are just west of the Minnesota-South Dakota border. In October 2008, a South Dakota angler caught a 58.5-pound bighead carp on the Missouri River below the Gavin Point Dam. While this catch did not represent a range expansion, it indicates the ability of this invasive species to prosper in Midwest river systems.

In November of 2008, A Wisconsin licensed commercial fishermen caught five Asian carp in seines in Pool 8 of the Mississippi River that extends from La Crosse, Wisconsin to Reno, Minnesota. Three species of Asian carp were found: one silver carp, at least one and likely two bighead carp, and two grass carp. The catch of a 6- to 7-pound, 24-inch silver carp in the Minnesota-Wisconsin border waters represents a large extension in the range of that species in the Mississippi River. The previous northernmost confirmed report of a silver carp was near Clinton, Iowa—more that 150 miles downstream.

Figure 27. A silver carp caught in Pool 8 of the Mississippi River.

Progress in Management of Asian Carp - 2008

The plan "Preventing the Introduction of Asian Carp into Minnesota" prepared in 2007 focuses on several pathways of introduction 1) spread of wild populations via interstate waters; 2) spread via wild-caught baitfish; 3) importation; 4) incidental inclusion of Asian carp in shipments of farm-raised fish into the state; and 5) unauthorized releases by individuals. Several efforts occurred in 2008 to address the following strategy in the plan – *Pursue development, installation, testing, and evaluation of behavioral fish barriers to prevent migration into the Great Lakes and Minnesota from the Mississippi River*.

- DNR wrote a letter of support for federal funding of the project - "AISR: Ecosystem-Scale Evaluations of the Effectiveness of Sound-Bubble Barriers to Prevent Spread

of Bighead and Silver Carp." That would be conducted in Illinois where the carp are already present.

- University of Minnesota submitted a proposal to LCCMR for a carp barrier study at the U of M Hydro Lab.

- Minnesota Legislature included $500,000 in the state's bonding bill, which was signed by the Governor, for pre-design and design work for an Asian carp barrier.

- DNR continued to work with members of the Minnesota Congressional Delegation in 2008 to pursue $4 million of federal funding to implement recommendations from an earlier feasibility study (FishPro, 2004) to slow Asian carp movement up the Mississippi River. The DNR had desired to have a fish barrier installed in conjunction with one Mississippi River lock and dam such as Lock and Dam 11 (Figure 28). Now that Asian carp have been found in Pool 8 (above Lock and Dam 8), locks above that need to be evaluated for potential barriers.

- U.S. Army Corps of Engineers held a meeting on August 20,2008, to review the Corps' St. Paul District and Detroit District activities in Minnesota. DNR requested discussion on the portion of the Water Resources Development Act (WRDA) of 2007 that calls for the Corps to do the following: "*in consultation with appropriate Federal and State agencies, shall study, design, and carry out a project to delay, deter, impede, or restrict the dispersal of aquatic nuisance species into the northern reaches of the Upper Mississippi River system. The Secretary shall complete the study, design, and construction of the project not later than 6 months after the date of enactment of this Act.*"

  Several topics related to the barrier were discussed with the Corps at the meeting. The questions and their responses are below:

  - Could a credit authorized in WRDA to Minnesota and other the states that contributed $67,000 to the Chicago dispersal barrier be used for planning the barrier? Undetermined as of December 31, 2008.
  - Was federal funding included in any the 2009 appropriation bills? Response - No funds were appropriated or are included in pending bills.
  - Can the Corps begin any work on barrier planning in Minnesota waters with the state bonding appropriation? Response - No work can be initiated until there is a federal appropriation for the barrier.
  - Is there potential to do any work under the Corps' Planning Assistance to States program? Response - There is potential to work on the barrier under this program, but funds for the program are very limited and an appropriation would be needed. Having State bonding funding already available will make the project a higher priority if or when there is a federal appropriation.

Summary of Barrier Situation

A feasibility study conducted in 2004 recommended the use of bioacoustic fish fences at locks on the Mississippi River above known populations of Asian carp to slow their upstream spread. For progress to be made on such a barrier the following must occur: 1) The Corps must be involved and must have some level of federal funds appropriated

before they can work on the project; 2) Wisconsin must support the project since the Mississippi is a border water; and 3) funding for installation is needed.

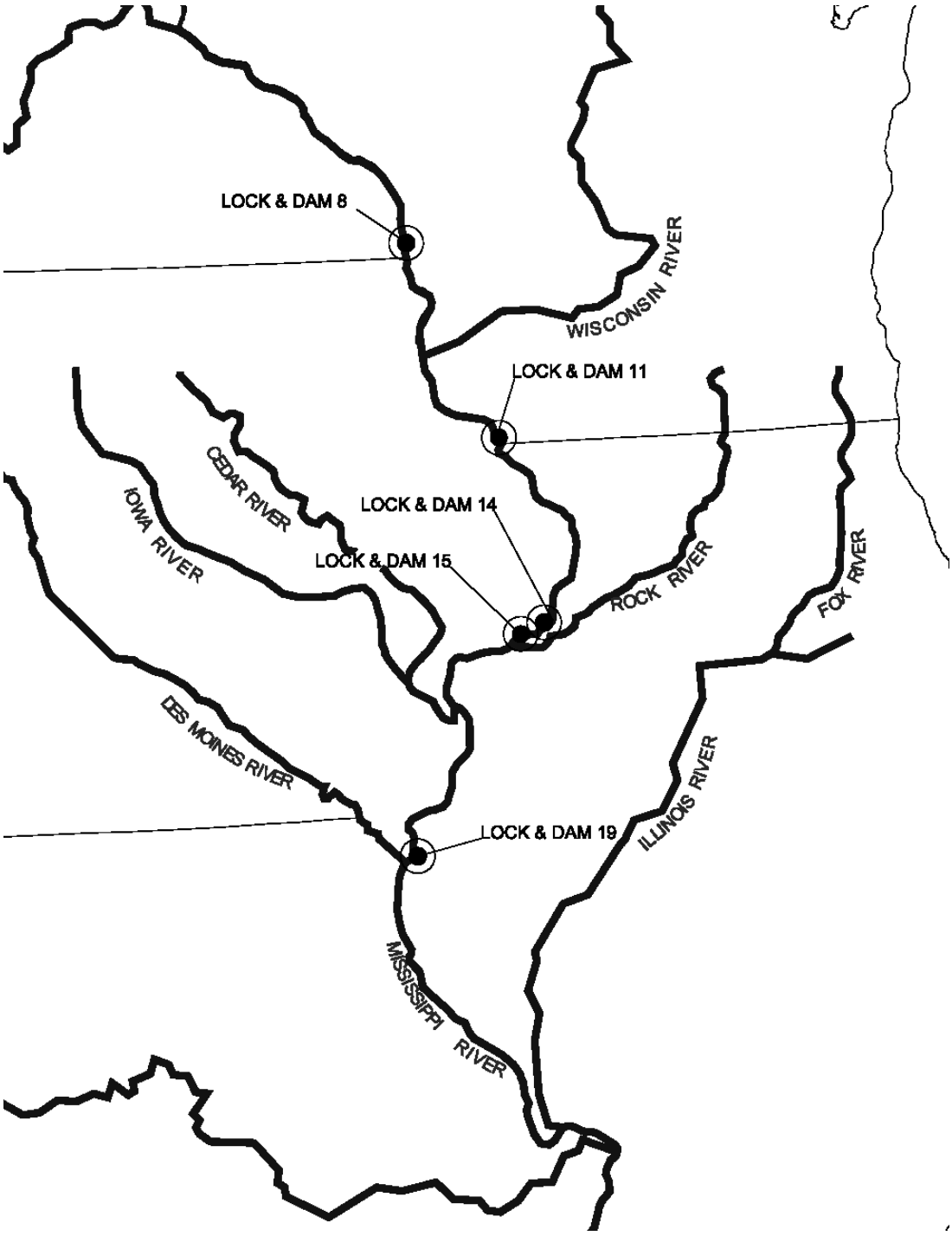

Figure 28. Locations of selected locks and dams on the Mississippi River.

Future needs for management of Asian carp

- Support efforts to maintain two effective barriers to prevent Asian carp passage through the Illinois waterways into the Great Lakes.
- 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.
- Evaluate non-target impacts for proposed dispersal barriers in the Mississippi River or tributaries in Minnesota.

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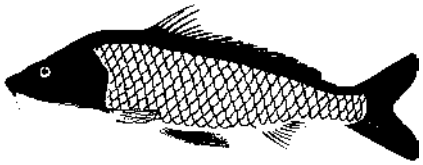
Management of Common Carp

Introduction

Issue



The common carp (*Cyprinus carpio*) was intentionally introduced into Minnesota waters before 1900. It 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, the common carp was recognized as a major factor in the deterioration of aquatic habitat across southern Minnesota. Carp currently occur in the majority of waters across the southern half of Minnesota.

The role of common carp in causing habitat deterioration is in part related to their search for invertebrates in aquatic vegetation and bottom sediments. The feeding activity of this species disrupts shallowly rooted plants and suspends bottom sediments in the water column. In addition, its consumption of invertebrates ”pumps” nutrients from invertebrates into the water column. Carp have high growth rates and their excretion appears to contribute very significantly to internal nutrient loading in many shallow lakes. The additional phosphorus increases the growth of phytoplankton. As water clarity is reduced, the 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 gradually eliminate competition from fish that do.

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

Goals

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

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

Progress in Management of Common Carp - 2008

Several activities occur to inventory common carp infested waters, limit their spread, and remove carp from waters where they exist. Those activities 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 about 400 shallow lakes by DNR Wildlife and Ecological Resources staff in 2008. These surveys evaluate water clarity, chemistry, and depth along with percent occurrence 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 are available in June the following year.

Establish and maintain fish barriers

Fish barriers are used in many locations to limit the movement of common carp between connected waters. Seven electric fish barriers are currently operated under contracts with Smith-Root. Other types of fish barriers including velocity tubes continued to be constructed, repaired, and maintained by DNR Wildlife in 2008. A new fish barrier was constructed in 2008 on Augusta Lake in Cottonwood County. A channel cleanout was completed to Mud Lake on the Fulda WMA in Nobles County in preparation for new fish barrier. New barriers are planned on several lakes and wetlands including Fulda Lake in Murray County and Oscar Lake in Ottertail County.

Remove carp from priority lakes

A major effort was initiated at Swan Lake in Nicollet County during 2005 to eliminate carp. The presence of carp in this premier waterfowl lake was confirmed in late November 2005. In early December 2005, the DNR began to drawdown the water in the lake to eliminate the carp or at least the majority of them, but many carp remained. The drawdown continued in 2006 and a lake-wide Rotenone treatment was done in fall 2006. In 2008, water levels were slightly higher and no carp have been found post-treatment test netting.

In 2008, ongoing carp control occurred on the following lakes: Maria (Murray County), Geneva (Freeborn County), North and South Spellman (Yellow Medicine County). Many of these lakes were drawn down to remove carp and restore vegetation. Most of these lakes remained in draw down to remove carp and restore vegetation. Most of these lakes remained in draw down through the summer. Rotenone was used in refuge areas under the ice in the winter of 2007 at Lake Maria. A rotenone treatment on Lake Geneva was completed in 2008.

In 2008, additional drawdowns to control carp were also conducted on several other lakes and wetlands across the state including North and South Badger Lakes, Hjermstad Lake in Murray County, and Augusta Lake in Cottonwood County.

Research

Dr. Peter Sorensen and others from his lab at the University of Minnesota are conducting research on many aspects of common carp biology and management including: aggregation and sex pheromones, spawning biology, movement

between connected waters of adults and juveniles, recruitment success, population dynamics and population modeling, removal techniques for adults, impacts on water quality, and barrier development. Their work is being supported by several entities as shown in Table 17.

Table 17. Funding sources, durations of research grants that support the common carp research at Sorensen Lab, and goals.

Time Period	Supporting Entity	Focus of Research
2005 – 2009	Legislative-Citizen Commission for Minnesota Resources	1. Pheromonal attractants 2. Spawning biology / spawning sabotage 3. Population dynamics
2005 - 2009	DNR - Ecological Resources DNR - Fisheries (In-kind field support)	1. Population modeling
2008 - 2011	Legislative-Citizen Commission for Minnesota Resources	1. Effects of gamefish on young carp / controlling recruitment 2. Effects of winterkill on recruitment 3. Preliminary work on sensory deterents barriers 4. Food and pheromonal attractants for juveniles
2008 – 2011	Riley Purgatory Bluff Watershed District	1. Developing removal techniques for adult carp 2. Impacts of adult carp on water quality 3. Movement of adult carp between lakes 4. Experimental carp barrier design 5. Carp recruitment success in
2006 - 2009	Invasive Animals Cooperative Research Centre (Australia)	1. Sex pheromonal attractants

Overview

Several lines of research (trapping, fish movement, patterns of recruitment, modeling) sponsored by a variety of agencies are suggesting that integrated control may be possible. Experiments towards implementing these evolving plans are being sponsored by a Twin Cities suburban watershed district.

Pheromones

Three types of pheromones (chemical cues which pass between members of the same species and serve key behavioral functions) have now been characterized in the common carp. All life stages of carp have been found to release a specific-specific body aroma that promotes attraction and aggregation (Sisler and Sorensen, 2007). It is stable and can be isolated. In addition, sexually receptive female carp have been found to release a prostaglandin-derived sex pheromone which attracts males at a moderate distance. Its release can be controlled. Finally, mature male carp have been found to release a pheromonal attractant for sexually receptive female common carp.

Spawning biology of carp
Data collected from radio-tagged carp in 2008 confirms earlier studies by the lab which demonstrates that carp migrate great distances into shallow basins of water to spawn and then release eggs on a range of vegetation types. New data shows that female carp start spawning at daybreak and likely spawn only once a year. This information will be useful in pheromonal control.

Movement between Connected Waters
In 2008, the Sorensen Lab collected a third year of data on carp movement between a system of three interconnected lakes in Chanhassen. The data showed that, similar to 2006 and 2007, up to 30% of adult carp move each spring from deeper lakes into interconnected shallow lakes/marshes where they spawn. Analyses of carp population dynamics suggest that this movement is of key importance in carp reproductive biology.

Population Modeling
The Sorensen Lab finalized data collection and analysis to estimate key parameter values needed to develop a carp population dynamics model which can be used to guide control schemes in Minnesota. Briefly, these data develop that carp populations commonly reach 300 kg/ha, that carp live up to 52 years, and have low mortality rates. Using these estimated values during initial model runs of a computer model created in Australia and fit to Minnesota conditions, indicates that carp control in Minnesota is possible if an integrated approach can be pursued.

Developing removal techniques for carp
In 2008, the Sorensen Lab conducted an experiment in Lake Susan in Chanhassen, which showed that as much as 2/3 of adult carp population can be caused to aggregate in a small (50m x 150m) area by applying bait (corn) over a 10-day period. This result is very promising and next year they will test nets that could be deployed at the baited sites to remove the carp. They have also found that carp forage and aggregate at night, so netting will need to be conducted at that time.

Development of barrier technologies to limit carp movement
Preliminary laboratory studies suggest that air bubble curtains have the potential to limit movement of carp through narrow waterways.

Food and pheromonal attractants for juveniles
Traps have been developed in the laboratory that can be used to attract small carp with food and or pheromones. Further studies are planned.

Effectiveness of Carp Management
Common carp management has been only modestly effective in all types of waters within Minnesota, which is why research to improve management is ongoing. 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.

Future needs for management of common carp

- Continue support for funding of research related to: development of integrated control strategies including the use of pheromones, gamefish to control recruitment; winterkill to remove carp, new fish barrier designs, common carp life history, and 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 Mute Swans

Introduction

Issue

Mute swans (*Cygnus olor*) are native to Europe and Asia and were brought to the United States from the mid-1800s through the early 1900s. Populations of mute swans have established in numerous states. These populations have originated from release or escape of individuals from captive flocks. The current population growth in the Great Lakes states is estimated at 10-20% or higher per year (Scott Petrie, Bird Studies Canada, Port Rowan Ontario, presentation to Mississippi River Basin Panel, 8 September 2005). The birds can consume eight pounds of submersed vegetation and uproot 20 pounds per day causing significant harmful impacts on lake ecosystems.

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 in Minnesota under the game farm and regulated invasive species statutes.

In past years, the DNR has received comments from riparian landowners who are concerned about the presence and increase of mute swans on the lakes where they reside. They are concerned about mute swans interfering with loon nesting that has previously occurred on those lakes. Individuals have also reported seeing the mute swans harassing trumpeter swans. Individuals and lake associations have requested that the DNR remove mute swans from lakes and wetlands where there were birds in the wild.

Goal

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

Distribution

As in previous years, several unconfined mute swans were reported in Minnesota in 2008. Monitoring mute swans in the wild is a strategy necessary to help DNR respond to birds that may establish naturalized populations. During 2007, the DNR recorded reports of wild or escaped mute swans at five locations in the state. A total of six birds were reported in the wild in five counties (Table 18). Sources of the reports include conservation officers, birders, the public, and other DNR staff who observed unconfined birds.

Progress in Management of Mute Swans - 2008

During 2008, DNR conservation officers removed two mute swans from the wild – one in Steele County, and one near Forest Lake in Washington County.

Table 18. Unconfined mute swans reported in Minnesota counties during 2008.

County	Number of Mute Swans Reported	Months Reported
Carver	1 – Goose Lake near Waconia	June (1)
Dakota	1 – Spring Lake Regional Park / Hastings	July (1)
Sherburne	1 – Sherburne Nat'l Wildlife Refuge	June (1)
Steele	1 – Unspecified Location	Unspecified
Washington	2 – Forest Lake / St. Croix River	April (2)
Total for all counties	**6**	

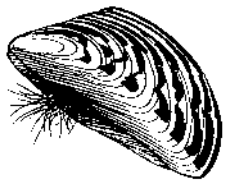
Future needs for management of mute swans

- Encourage reporting and verify occurrences of mute swans in the state.
- 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.

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) and 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.

Management of Zebra Mussels - 2008

Monitoring

New Infestations: No new infestations were reported in Minnesota in 2008 (Figure 29). Downstream expansion continued to occur in the Mississippi River below Rice Lake (Brainerd). Reports from anglers about zebra mussels below the dam in Little Falls were investigated and confirmed by area biologists. Additional survey work in the impoundment above the dam confirmed hundreds of zebra mussels in varying sizes scattered on a variety of substrates. Numbers were higher closer to the dam, but zebra mussels were also found further upstream, including larger adult size mussels. This recent discovery represents a substantial settlement further downstream from the Brainerd area. Settlement and downstream movement will continue in the river until the upstream population merges with existing zebra mussel occurrences in the metropolitan area.

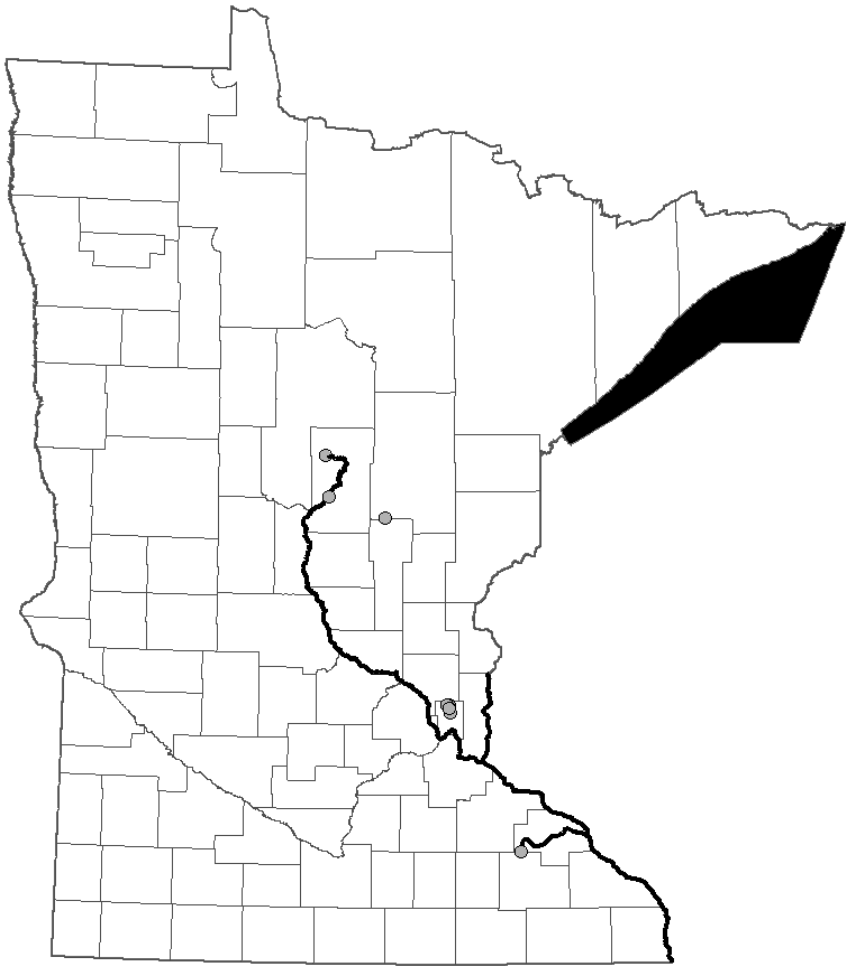


Figure 29. Zebra mussel infestations in Minnesota recorded by the DNR. Gray dots indicate inland lakes; bold black lines indicate infested river areas and Lake Superior.

Existing infestations: Surveys sampling aquatic vegetation in nearshore shallow areas were done on Snail Lake, which receives water pumped from Sucker Lake (infested in 2007) to maintain water levels. However, no zebra mussels were found in the search. No water is currently being pumped between the lakes. Zebra mussel numbers in Pleasant Lake (upstream of Sucker Lake) appear to be increasing from unconfirmed public reports. Reports from St. Paul Regional Water Supply staff showed increased numbers of zebra mussels in Vadnais Lake.

Diving surveys in Lake Ossawinnamakee found many zebra mussels of different size classes attached to rocks and wood on the lake bottom. The population still appears to be increasing in the lake. Invertebrate sampling in Pelican Brook recorded isolated small zebra mussels attached to woody debris below the outlet area.

Dive surveys in Mille Lacs Lake by DNR Fisheries staff found over 24,000 zebra mussels in 23 separate dives in multiple sites around the shore. Additionally, over 700 more zebra mussels were collected during Fisheries trawls. One single commercial launch removed from the lake had over 1,000 small zebra mussels attached to the hull. Surveys suggested that southern sites had lower densities than northern sites, but zebra mussels were found at sites around the lake. Veliger numbers were significantly higher than the previous years. All plankton samples collected in August and September had veligers present, indicating widespread reproduction in the lake. All data suggest that the zebra mussel population in Mille Lacs has expanded enormously and is reproducing and settling at a high rate.

Surveys of aquatic vegetation in Rice Lake showed significant numbers of zebra mussels attached to plants. To attempt to prevent movement by recreational boats, aquatic vegetation in the immediate vicinity of the public access was treated with herbicides. The numbers in this lake are increasing much more rapidly than seen in Lake Ossawinnamakee.

A dive survey was done in Lake Zumbro on a site that has been regularly surveyed since the infestation. Two seasons prior, zebra mussels had experienced a massive die-off. While the numbers were reduced from previous years, zebra mussels remain in the lake. It is not known if they will re-establish levels comparable to those prior to the die-off. It is possible that the severe flooding and resulting high inorganic turbidity may have further reduced zebra mussel numbers in the lake.

The Volunteer Zebra Mussel Monitoring Program continued with mailing of report forms and results from the previous year to all lakeshore residents who had participated last year. Reports to date from volunteers monitoring their lakeshore areas have not found any zebra mussels in any other waters of the state. Information on the program as well as reporting forms have been placed on the DNR Web site to allow users to report electronically.

The National Park Service monitors for zebra mussels using slides on settling plate samplers and veliger samples 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. All samples were negative, with no zebra mussel settlement detected.

Prevention of spread

Public awareness and education efforts continued to be focused in the Brainerd lakes area in response to zebra mussel populations in Lake Ossawinnamakee as well as at Lake Mille Lacs. The recent population explosion in Mille Lacs creates serious concerns over potential spread from this heavily used water body. The number of hours of watercraft inspections increased, as well as inspection time spent in these areas (see Watercraft Inspections and Awareness Events). Public awareness efforts continued (see Watercraft Inspections and Awareness Events) as well as enforcement efforts. Efforts to guide people to private car wash facilities to wash their boats after use in zebra mussel infested waters in central Minnesota continued. Brochures and maps were provided at access sites as well as other cooperating locations. The downstream spread in the Mississippi River seen at the Little Falls area may expose a different set of

boaters to large numbers of mussels and veligers. Work continues on a short DVD produced from underwater video footage from dive surveys in Ossawinnamakee Lake. Efforts on a permit to allow limited water movement from Sucker to Snail Lake continued.

Effectiveness of Management

Minnesota has eight inland lakes that contain this invasive. Zebra mussels in Mille Lacs Lake exponentially increased in density in a lake supporting an extremely high level of boating recreation. Equally of concern is the rapidly increasing population of zebra mussels in Rice Lake. The infestations in a highly used recreational lake and a major river through the middle of the state continue to create difficulties in stopping the spread of this invasive. The infestations last year in the Vadnais chain place populations in the metropolitan area.

Participation of Others

Monitoring efforts for zebra mussels continued by lakeshore residents throughout Minnesota. Approximately 140 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, Ossawinnamakee, Rice) were reported by members of the public indicating the importance and value of this volunteer effort.

Coordination of monitoring efforts on the St. Croix River continues with the National Park Service. Funding for dive survey operations aids in cooperative efforts to document abundance and distribution of zebra mussels in the St. Croix River area.

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 Eurasian collard-dove, New Zealand mudsnail, rusty crayfish, and spiny waterflea in this chapter, Table 19 presents a summary of other invasive animal species in Minnesota.

Eurasian Collared-dove

Species and origin - 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. It arrived from expanding wild populations that are spread across the country.

Distribution - The bird has been observed in 36 Minnesota counties from 1999 to 2007: Big Stone, Blue Earth, Brown, Carver, Chippewa, Clay, Dakota, Freeborn, Goodhue, Hennepin, Houston, Itasca, Jackson, Kandiyohi, Koochiching, Lac qui Parle, Lyon, Martin, Nicollet, Otter Tail, Pennington, Pipestone, Polk, Pope, Redwood, Renville, Rock, Roseau, Sibley, Stearns, Swift, Traverse, Wabasha, Wilkin, Winona, and Yellow Medicine.

In 2008, a Eurasian collared-dove was reported for the first time in Janesville in Waseca County. They were also reported again in Clay and Polk counties. The birds are likely to be in other Minnesota counties and to continue spreading throughout the state.

Management - 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 no regional or national effort to stop their spread.

Mystery Snails (Chinese, banded)

Species and Origin - Two species of mystery snails are confirmed in the state and two others may be present, but as of yet are unrecorded. The Chinese mystery snail (*Bellamya [=Cipangopaludina] chinensis*) is native to Eastern and Southeastern Asia. This snail is large (up to 2 ½ " long), has a globose spiral shell with an operculum (hard plate-like cover closing the opening), and is olive green, green-brown, or brownish colored. The shell has 6-7 whorls and is broadly rounded. The Chinese mystery snail was originally brought to California in 1892 as a food source, and was later found in Massachusetts in 1915 after a suspected aquarium release. It is widely spread across North America, with larger concentrations occurring on the coasts. A closely similar species (Japanese mystery snail, *Bellamya [=Cipangopaludina] japonica*) was also introduced over a century ago to North America. Although it has been recently documented in Wisconsin, no records exist for Minnesota.

The banded mystery snail (*Viviparus georgianus*) is native to south and eastern North America, up along the Mississippi River drainage to Iowa and Illinois. This snail is globose, spiral shaped, and has an operculum, similar in appearance to the Chinese mystery snail but smaller (less than 1 ½ " long). The shell color is light brown to yellow-green and has four parallel reddish bands that wrap parallel to the whorl of the shell. It is possible that aquarium releases have lead to new introductions, with the snail now being found more commonly in Minnesota lakes and rivers, particularly in the central region of the state. Recent information suggests that this taxa may actually be a species complex of three species. Additionally, a European native snail, *Viviparus viviparus*, is nearly indistinguishable from the banded mystery snail and may be present in some waters. However, this has not been confirmed in the state.

Both Chinese and banded mystery snails can produce large populations under good environmental conditions. Negative impacts from high densities of the Chinese mystery snail were reported for one native snail species, but no impacts were seen for a different species. High densities of either of these snails may have impacts on nutrient cycling and could potentially interfere with other benthic grazers and filter feeders, but this has not been shown. Laboratory and pond trials have shown that high numbers of banded mystery snails can prey heavily upon largemouth bass eggs if they invade nests. Mallard ducks were seen feeding heavily upon the banded mystery snails in one report, suggesting that waterfowl were adapting to a new food source. *Viviparus georgianus* is host to a number of parasites in its natural range, and may also serve as an intermediate host in Minnesota waters. While *Bellamya chinensis* has been shown to transmit human parasites in Asia, there are no records or reports documenting this in North America. It is a carrier of unionid parasites that have been reported in mussels in the St. Croix River drainage. Mass die-offs of *Viviparus georgianus* in a number of Minnesota lakes where it has established populations have been seen regularly with large numbers of shells washing ashore and creating nuisances. This "synchronized" die-off of larger banded mystery snails has been previously reported in some studies.

Distribution - There are over 80 reported occurrences for the Chinese mystery snail in Minnesota waters. Most records are from lakes and sections of rivers near the Twin Cities area and in the North Central lakes region. Other areas of concentration are in the Moose Horn River (St. Croix River drainage), Sturgeon River (Little Fork River drainage), and parts of the Lake Superior drainage system. The range of this snail appears to be increasing in Minnesota. DNR Fisheries staff and others continue to report new infestations to the Division of Ecological Resources.

There are almost 50 reports of waters containing the banded mystery snail in Minnesota and others may exist, but have not been reported. The banded mystery snail is most prevalent in the Twin Cities and in the North Central lakes region, mainly in lakes and in slow moving rivers, as well as in the St. Croix River drainage. As with the Chinese mystery snail, the range of the banded mystery snail appears to be increasing.

Management - There are currently no environmentally acceptable control methods specific for mystery snails. Control of native snails in the lakes has been directed at control of swimmers itch situations and is regulated by the Aquatic Plant Management Program. The control method approved is copper sulfate products, which are highly toxic to molluscs. However, this type of control is generally over a smaller area, and

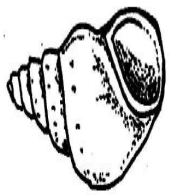
effective only for a limited time, as snails can move into the treated area shortly after treatment. Copper sulfate is also toxic to some algae, various zooplankton taxa, crustaceans, and some aquatic insect taxa. With the broad toxicity of the control material and the slight possibility of eliminating snails from a lake, no lake-wide control is conducted.

Future needs for management of mystery snails

- Increase public awareness of regulations regarding introduction.
- Confirm reports of new collections and add reports to distribution database.

New Zealand Mudsnail

Species and origin - The New Zealand mudsnail (*Potamopyrgus antipodarum*), a tiny snail native to New Zealand, was collected for the first time in Minnesota waters during fall of 2005. Hundreds of the snails were found by a research scientist who was surveying for new invaders in the Duluth Harbor for the U.S. Environmental Protection Agency's Mid-Continent Ecology Division.



New Zealand densities can reach 100,000 to 700,000 per square meter in preferred habitats. They may out-compete species that are important forage for trout and other fishes and provide little nutrition to fish that eat them. Another concern is that they can spread easily in water, as well as on aquatic plants, waders, and other gear used in infested waters. They are able to close their shells, allowing them to survive out of water for days.

Distribution - The mudsnails were first discovered in the U.S. in the late 1980s in the Snake, Idaho, and Madison rivers; they quickly spread to other western rivers. They were discovered in Lake Ontario, and later in Thunder Bay, Lake Superior in 2001. No new infested waters in the state were discovered in 2008.

Management - In 2007, DNR designated the New Zealand mudsnail as a *prohibited invasive species* and designated Lake Superior and the St. Louis River below the Fond du Lac Dam as waters infested with the mudsnails. The designation as *prohibited* means the mudsnails will be illegal to transport, possess, and place into other waters in the state.

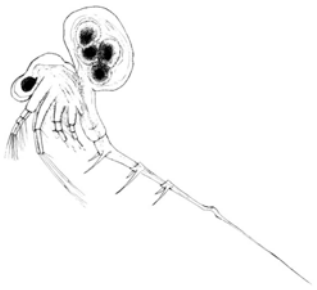
Rusty Crayfish

Species and origin - The rusty crayfish (*Orconectes rusticus*) is an invasive species that is native to the eastern and mid-eastern United States. It has been spread across the Midwest through human activities, likely through release of 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.

Distribution - These crayfish have been reported from more than 40 lakes and eight rivers in the state, scattered from northeast to south-central Minnesota. DNR Fisheries staff encounter rusty crayfish in their lake sampling gear and report findings. Judging from the widespread reported distribution, it is highly likely that rusty crayfish are present, but unrecorded in more waters in the state.

Management - There are currently no selective or effective control methods once the rusty crayfish become established in lakes or rivers. A 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. Populations in larger lakes may be too widespread to initiate any future control methods, and will likely remain in large lakes. With the lack of any selective or even effective control methods, the Invasive Species Program does not conduct any active management of rusty crayfish.

Spiny Waterflea



Species and origin - The spiny waterflea (*Bythotrephes longimanus*) is an invasive cladoceran zooplankter native to Europe. It was brought to the Great Lakes in ballast water in the late 1980s. 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 nutrients) lakes with simpler fish communities. The spiny waterflea produces resting eggs similar to those of native Cladocera, which have some resistance for limited dessication and temperature extremes, providing a long-range dispersal method for overland spread. Adults may become entangled in fishing and boating gear and moved to other water bodies, or transported in infested water moved between water bodies. Ephippia (resting eggs) can remain viable after passage through fish.

Distribution - The initial infestations were confined to Lake Superior and a few nearby waters (Fish and Island lakes). Since that time, monitoring by area DNR Fisheries staff reported that it disappeared from Fish Lake, but remained in Island Lake. However, in the past several years more northern waters have been discovered with populations of *Bythotrephes longimanus*. Infestations in the past few seasons include Caribou, Gunflint, and Devil Track lakes in Cook County, and Crane, Kabetogama, Little Vermillion, Sand Point, and Lake of the Woods as well as the Rainy River. In 2008, Fisheries staff in International Falls collected *Bythotrephes* sp. from Loon Lake (St. Louis County). Additionally, they received reports from DNR staff of this invasive in Lac La Croix--while no collections were available for confirmation, this water body may also be considered infested, particularly with the interconnnectedness of the waters in this area (Figure 30). These discoveries place infestations in major waters on the western edge of the Boundary Waters Canoe Area (BWCA). The level of use, interconnections

between waterways, and inability to contact BWCA users at access areas suggest that other waters in the BWCA may well become infested. Many of the infested waters are large, often deep, and support cool- or cold-water fisheries communities. Spread may be occurring through natural water movement between lakes, via fish or wildlife spreading ephippia, or inadvertently by recreational anglers or boaters. However, users of the BWCA represent a group that has received little focus and may need concerted efforts to try to prevent further spread in this area.

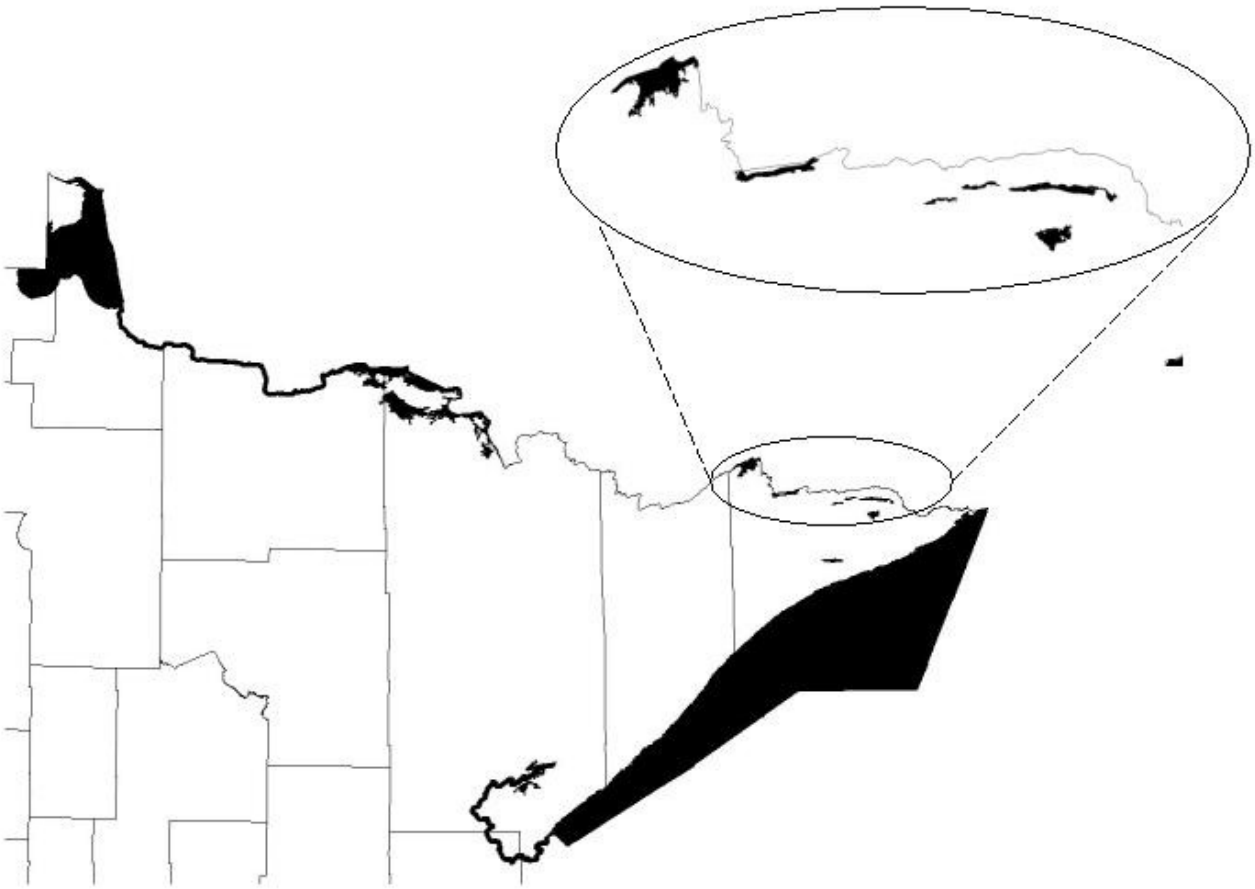


Figure 30. Distribution map of where spiny waterflea (*Bythotrphes longimanus*) has been found as of November 2008. Bold black lines indicate rivers that are infested, black polygons indicate large lakes that are infested, and gray dots indicate other lakes that are infested.

Research - DNR biologists are assisting National Park Service staff from Voyageurs National Park in processing zooplankton samples collected in the Rainy Lake system as part of a large federal study to assess potential impacts of *Bythotrephes*. Zooplankton samples collected over the summer by Baudette area fisheries staff from Lake of the Woods are being analyzed by DNR biologists to provide information on zooplankton

communities as well as spiny waterflea abundance. This data can assist in determining if impacts may be occurring in the lake from the infestation. Area fisheries managers in the northern part of the state have sent zooplankton tows from lakes used for aerial stocking operations to check if these lakes are infested, with negative results to date.

Prevention - In 2008, the DNR and others took many steps to help prevent the spread of spiny waterfleas to additional waters in the state. A variety of public awareness efforts such as signs, newspaper articles, and billboards were some of the tools used to raise awareness on this issue. Access inspection efforts and related public awareness in the Rainy/Lake of the Woods area were intensified (see Watercraft Inspections and Awareness Events), and the new crew formed in the northern area of the state in response to increased spiny waterflea infestations continued their efforts. In Region 1 alone, the number of watercraft inspected increased over 70% from the previous year, mainly due to inspections on *Bythotrephes* infested waters (see Watercraft Inspections and Awareness Events). Increases also were seen in Region 2. Cross-border cooperation on issues such as watercraft inspection and coordination between state, local, federal, and Canadian biologists and managers helped enhance such efforts. Invasive Species Program staff and other DNR biologists attended a water quality meeting involving discussions on invasive species in the Lake of the Woods area. After receiving reports from concerned public in the area, DNR Enforcement officers took action on out-of-state individuals who were illegally collecting baitfish from infested waters resulting in fines and confiscation of harvest gear.

Table 19. Other invasive and non-native wild animal species that have been found in the wild in Minnesota.

Species	Status	Legal Status	Last annual report to include info on this species
Two earthworm species in the genus *Amynthas*	University of Minnesota researchers reported that two species used in composting were discovered in the Twin Cities area of the state.	Unlisted	2007
Annelida (*Pristina acuminate)*	U.S. Environmental Protection Agency in Duluth reported that its monitoring efforts during 2006 in the Duluth–Superior Harbor detected this oligochate that was first noted as a non-native to the Great Lakes in the late 1970s in Lake Erie.	Unlisted	2007
Cnidaria (*Cordylophora caspia*)	U.S. Environmental Protection Agency in Duluth reported that its monitoring efforts during 2006 in the Duluth–Superior Harbor detected this invasive invertebrate (a hydroid) that is known in other Great Lakes.	Unlisted	2007
Daphnia lumholtzi	*D. lumholtzi* were first found in reproductive densities in Lake Pepin in 2003. Samples from 2005 found a single specimen from the main channel in mid-September.	Unlisted	2005
European earthworms (various genera)	Continued public education has focused on preventing the release of earthworms.	Unlisted	2003
Eurasian swine (*Sus scrofa)*	No confirmed reports of wild Eurasian swine in the wild in 2008.	Prohibited	2002
Fallow deer *(Dama dama)*	Several escapes in past years.	Unlisted	2001
Orange-Banded Arion (*Arion fasciatus*)	This non-native slug that is invading forests, is found across the northeastern U.S.; records in Wisconsin since 1948; one of the most common slugs in Ontario. Minnesota infestations include Wood Rill SNA and Chippewa National Forest; otherwise little is known about its distribution in Minnesota. This slug is well established at this site and is a strong herbivore on various understory wildflower species.	Unlisted	2007
Red deer *(Cervus elaphus)*	Reports to DNR of six escaped in 2005. They were dispatched by DNR.	Unlisted	1999
Round goby (*Neogobius melanostomus)*	No new water bodies in 2008.	Prohibited	2005
Ruffe (*Gymnocephalus cernua)*	No new water bodies since 1988.	Prohibited	2002

Table 19. (Continued)

Species	Status	Legal Status	Last annual report to include info on this species
Sika deer (*Cervus nippon)*	Several escapes in past years. Reports to DNR of 10 escaped from one location in 2007. Eight were recovered and one was shot by a hunter.	Unlisted	2001
Three spine and four spine stickleback (*Gasterosteus aculeatus* and *Apeltes quadracus)*	In Lake Superior.	Unlisted	2000
Tubenose goby (*Proterorhinus marmoratus)*	The tubenose goby was first discovered in the St. Louis River estuary in 2001. It has also been documented in several other lakes and rivers within the Great Lakes Basin.	Prohibited	2005

Appendix A - 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 = technical assistance for control by others
E = control to reduce populations, escapes, and nuisance conditions
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							
Curly-leaf pondweed (*Potamogeton crispus*)	X	X	X	X	X	X	X
Eurasian watermilfoil (*Myriophyllum spicatum*)	X	X	X	X	X	X	X
Flowering rush (*Butomus umbellatus*)	X	X	X	X	X	X	X
Other non-native aquatic plants	X		X	X	X	X	X
Purple loosestrife (*Lythrum salicaria*)	X		X	X	X	X	X
Animals							
Common carp (*Cyprinus carpio*)			F		F/W	F/W	X
Mystery snails (*Bellamya [=Cipangopaludina] chinensis; B. japonica; and Viviparus georgianus*)	X	X	E				X
Mute swan (*Cygnus olor*)	X		X		X		X
New Zealand mudsnails (*Potamopyrgus antipodarum*)	X	X	X				X
Round goby (*Neogrobius melanstromus*)	X	X	F/O		NIF		X
Ruffe (*Gymnocephalus cernuus*)	X	X	F/O		NIF		X
Rusty crayfish (*Orconetes rusticus*)	X						X
Spiny waterflea (*Bythotrephes longimanus*)	X	X	F				X
Zebra mussel (*Dreissena polymorpha*)	X	X	X			X	X

E - DNR Ecological Resources staff in addition to those in the Invasive Species Program monitor these species
F - DNR Fisheries monitors these species
F/O - DNR Fisheries and other agencies monitor these 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

Appendix B - Invasive Species Program Staff

Title / Area of Responsibility	Name	Phone	E-mail
Invasive Species Program Staff (Central Office)			
Invasive Species Program Supervisor - supervision of overall program, policy and direction, legislative issues	Luke Skinner	651-259-5140	luke.skinner@dnr.state.mn.us
Invasive Species Prevention Coordinator - education and public awareness, permits, regulations and prevention grants	Jay Rendall	651-259-5131	jay.rendall@dnr.state.mn.us
Aquatic Invasive Species Management Coordinator- technical and financial assistance for aquatic invasive plant management	Chip Welling	651-259-5149	chip.welling@dnr.state.mn.us
Terrestrial Invasive Species Management Coordinator - technical assistance and biological control programs	Vacant		
Grants Coordinator - administers invasive species management and prevention grants	Wendy Crowell	651-259-5085	wendy.crowell@dnr.state.mn.us
Watercraft Inspection Program Coordinator - supervise program staff; awareness events at water accesses; and cooperative inspector hires	Heidi Wolf	651-259-5152	heidi.wolf@dnr.state.mn.us
Research Scientist - zebra mussels, spiny waterflea, rusty crayfish, and other invasive aquatic invertebrates	Gary Montz	651-259-5121	gary.montz@dnr.state.mn.us
Enforcement - statewide coordination of enforcement of invasive species regulations for aquatic plants and wild animals	John Hunt	651-259-5040	john.hunt@dnr.state.mn.us
Invasive Species Specialists (Field Staff) - Primary contact for aquatic invasive species issues at the local level. Provide technical assistance for invasive species management and prevention activities for their respective work areas.			
Northwest MN (Park Rapids)	Darrin Hoverson	218-266-2106	darrin.hoverson@dnr.state.mn.us
West-Central MN (Fergus Falls)	Howard Fullhart	218-739-7576 ext. 259	howard.fullhart@dnr.state.mn.us
Northeast MN (Grand Rapids)	Rich Rezanka	218-999-7805	richard.rezanka@dnr.state.mn.us
Central MN (Brainerd)	Dan Swanson	218-833-8645	dan.swanson@dnr.state.mn.us
Central and Southeast MN (St. Paul)	Brittany Hummel	651-259-5828	brittany.hummel@dnr.state.mn.us
Southern MN (New Ulm)	Joe Eisterhold	507-359-6079	joe.eisterhold@dnr.state.mn.us
Watercraft Inspection Program Assistants (Field Staff) - Supervise local watercraft inspectors and provide outreach for awareness events at water accesses			
Northern MN (Park Rapids - seasonal)	Bruce Anspach		bruce.anspach@dnr.state.mn.us
West-Central MN (Fergus Falls - seasonal)	Anna Ness	218-739-7576 ext. 247	anna.ness@dnr.state.mn.us
Central MN (Brainerd - seasonal)	Vacant	218-833-8737	
Central and Southeast MN (St. Paul)	Maureen Ziskovsky	651-259-5146	maureen.ziskovsky@dnr.state.mn.us
General Information		651-259-5100	

Appendix C - 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/Southern Forest Health Specialist	Ed Hayes	507-206-2834
Northeast Forest Health Specialist	Mike Albers	218-327-4115
Northwest Forest Health Specialist	Jana Albers	218-327-4234
Forest Health Program Coordinator	Val Cervenka	651-259-5296
Silviculture Lands and Roads Supervisor	Al Jones	651-259-5271
Invasive Species Coordinator	Susan Burks	651-259-5251

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 Exclusion Unit addresses species such as Asian long-horned beetle, Grecian foxglove, and emerald ash borer. The Gypsy Moth Unit coordinates all aspects of survey, treatment, and regulatory work pertaining to gypsy moth. MDA prepares an annual report for these programs.

Plant Protection Division Contacts

Invasive Species Exclusion Unit	Teresa McDill	651-201-6448
Gypsy Moth Unit	Lucia Hunt	651-201-6329

Agricultural Development and Financial Assistance Division Contacts

Weed IPM Program Coordinator	Anthony Cortilet	651-201-6608
Weed Biological Control Project	Monika Chandler	651-201-6468

Interagency Invasive Species Groups
There are several invasive species committees or work groups that facilitate coordination between the involved agencies.

Weed Integrated Pest Management Committee - Jeanne Ciborowski, MDA - Integrated Pest Management Coordinator, Agricultural Development and Financial Assistance Division, 651-201-6217.

Gypsy Moth Program Advisory Committee - Lucia Hunt, MDA - Gypsy Moth Unit, Plant Protection Division, 651-201-6329.

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 Exclusion Unit, Plant Protection Division, 651-201-6448 and Jay Rendall, DNR Invasive Species Program, Ecological Resources Division, 651-259-5131.

Appendix D - State Statute Changes in 2008

(Note: Underlined parts are new.)

Minnesota Statutes 2006, section 84D.10, subdivision 2, is amended to read:

Subd. 2. Exceptions. Unless otherwise prohibited by law, a person may place into the waters of the state a watercraft or trailer with aquatic macrophytes:

(1) that are duckweeds in the family Lemnaceae;

(2) for purposes of shooting or observation blinds attached in or on watercraft in amounts sufficient for that purpose, if the aquatic macrophytes are emergent and cut above the waterline;

(3) that are wild rice harvested under section 84.091; or

(4) in the form of fragments of emergent aquatic macrophytes incidentally transported in or on watercraft or decoys used for waterfowl hunting during the waterfowl season.

Minnesota Statutes 2006, section 84D.13, subdivision 4, is amended to read:

Subd. 4. Warnings; civil citations. After appropriate training, conservation officers, other licensed peace officers, and other department personnel designated by the commissioner may issue warnings or citations to a person who:

(1) unlawfully transports prohibited invasive species or aquatic macrophytes;

(2) unlawfully places or attempts to place into waters of the state a trailer, a watercraft, or plant harvesting equipment that has aquatic macrophytes or prohibited invasive species attached;

(3) intentionally damages, moves, removes, or sinks a buoy marking, as prescribed by rule, Eurasian water milfoil;

4) fails to drain water, as required by rule, from watercraft and equipment before leaving designated zebra mussel, spiny water flea, or other invasive plankton infested waters; or

(5) transports infested water, in violation of rule, off riparian property.

M.S. 115.0301 DEFINITIONS.

Subdivision 1. Application. For purposes of sections 115.0301 to 115.0309, the following terms have the meanings given them.

Subd. 2. Agency. "Agency" means the Pollution Control Agency.

Subd. 3. Ballast water. "Ballast water" means water taken on board a vessel to control trim, list, draft, stability, or stresses of the vessel, including matter suspended in the water, or any water placed into a ballast tank during cleaning, maintenance, or other operations.

Subd. 4. Ballast water management. "Ballast water management" means mechanical, physical, chemical, and biological processes used, either singularly or in combination, to remove, render harmless, or avoid the uptake or discharge of harmful aquatic organisms and pathogens within ballast water and sediment.

Subd. 5. Commissioner. "Commissioner" means the commissioner of the Pollution Control Agency.

Subd. 6. Constructed. "Constructed" means a state of construction of a vessel at which the keel is laid, construction identifiable with the specific vessel begins, assembly of the vessel has begun comprising at least 50 tons or one percent of the estimated mass of all structural material of the vessel, whichever is less, or the vessel undergoes a major conversion.

Subd. 7. Foreign vessel. "Foreign vessel" means a vessel of foreign registry or operated under the authority of a foreign country.

Subd. 8. Sediment. "Sediment" means matter that has settled out of ballast water within a vessel.

Subd. 9. State waters of Lake Superior. "State waters of Lake Superior" means the surface waters of Lake Superior and waters that discharge, flow, or otherwise are transferred into Lake Superior that are under the jurisdiction of the state.

M.S. 115.0306 BALLAST WATER MANAGEMENT PLAN.

Subdivision 1. Ballast water management plan required. (a) The operator of a vessel that is designed, constructed, or adapted to carry ballast water in state waters of Lake Superior shall conduct all ballast water management operations of the vessel according to a ballast water management plan that is designed to minimize the discharge of invasive species, meets the requirements prescribed by the commissioner under subdivision 2, and is approved by the commissioner.

(b) The owner or operator of a vessel required to have a ballast water management plan under paragraph (a) shall maintain a copy of the vessel's ballast water management plan on board at all times and keep the plan readily available for examination by the commissioner.

Subd. 2. Ballast water management plan approval. (a) The commissioner may not approve a ballast water management plan unless the commissioner determines that the plan:

(1) describes in detail the actions to be taken to implement ballast water management;

(2) describes in detail the procedures to be used for disposal of sediment at sea and on shore;

(3) describes in detail the safety procedures for the vessel and crew associated with ballast water management;

(4) designates the officer on board of the vessel in charge of ensuring that the plan is properly implemented;

(5) contains the reporting requirements for vessels as prescribed by the commissioner; and

(6) meets all other requirements prescribed by the commissioner.

(b) The commissioner may approve a ballast water management plan for a foreign vessel on the basis of a certificate of compliance with the criteria described in paragraph (a) issued by the vessel's country of registration according to standards established by the commissioner.

M.S.115.0307 BALLAST WATER RECORD BOOK.

Subdivision 1. Ballast water record book required. The owner or operator of a vessel required to have a ballast water management plan under section 115.0306 shall maintain, in English, on board the vessel, a ballast water record book in which each operation of the vessel involving ballast water or sediment discharge is recorded as required by the commissioner. The ballast water record book shall be kept readily available for examination by the commissioner. In cases where a vessel is without a crew and being towed, the ballast water record book may be kept on the towing vessel.

Subd. 2. Retention period. (a) Except as provided in paragraph (b), a ballast water record book required in subdivision 1 shall be retained on board the vessel for three years after the date on which the last entry in the book is made and shall be retained under the control of the vessel's owner for an additional three years.

(b) The commissioner may prescribe alternative time periods for record retention by foreign vessels that are consistent with international practices.

Subd. 3. Regulations. (a) The commissioner shall require, at a minimum, that:

(1) each entry in the ballast water record book be signed and dated by the officer in charge of the ballast water operation recorded;

(2) each completed page in the ballast water record book be signed and dated by the owner or operator of the vessel; and

(3) the owner or operator of the vessel transmit any information to the commissioner regarding the ballast operations of the vessel as the commissioner may require.

(b) The commissioner may provide for alternative methods of record keeping, including electronic record keeping, to comply with the requirements of this section. Any electronic record keeping method authorized by the commissioner shall comply with applicable standards of the state and the National Institute of Standards and Technology governing reliability, integrity, identity authentication, and nonrepudiation of stored electronic data.

M.S.115.0309 CONSULTATION AND COOPERATION.

Subdivision 1. Great Lakes Panel on Aquatic Nuisance Species. The commissioner of natural resources shall cooperate to the fullest extent practicable with the Great Lakes Panel on Aquatic Nuisance Species to ensure development of standards for the control of invasive species that are broadly protective of the state waters of Lake Superior and other natural resources. The commissioner of the Pollution Control Agency shall serve as the alternate to the commissioner of natural resources if necessary.

Subd. 2. Cooperation with other state agencies. In developing the permit process and any standards established under sections 115.0301 to 115.0309, the commissioner is encouraged to consult with the commissioners of commerce, agriculture, natural resources, and any other agency that the commissioner determines to be necessary to develop and implement an effective program for preventing the introduction and spread of invasive species through ballast water.

Subd. 3. Canada and other foreign governments. In developing the permit process and any standards established under sections 115.0301 to 115.0309, the commissioner is encouraged to consult with the government of Canada and any other government of a foreign country that the commissioner determines to be necessary to develop and implement an effective program for preventing the introduction and spread of invasive species through ballast water.