

Invasive Species of Aquatic Plants and Wild Animals in Minnesota

**Annual
Report
2007**

*for the year
ending December 31*



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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 2007

Zebra mussels infest water supply lake chain in Ramsey County

In September, zebra mussels were discovered in a chain of four lakes, which serve as a system of drinking water reservoirs for St. Paul and surrounding communities. Water is pumped from the Mississippi River through the chain of lakes that includes Charley, Pleasant, Sucker, and Vadnais before being pumped to the treatment plant.

On the basis of these discoveries, all the lakes in this chain were designated as infested waters. Shoreline surveys were also done on Snail Lake, which had received water pumped from Sucker Lake to maintain water levels. However, no zebra mussels were found in Snail Lake.

The findings represent a setback in the cooperative efforts of the St. Paul Regional Water Services (SPRWS) and Department of Natural Resources (DNR) to prevent movement of zebra mussels. Over the past two years, the two agencies have worked together to address the potential zebra mussel threat. SPRWS has treated the water pumped from the river during this time in an attempt to prevent movement of free-floating zebra mussel larvae. It is impossible to know how the zebra mussels entered this lake chain. Treatments may have been ineffective, zebra mussels may have been in the system prior to treatments, or they may have been moved inadvertently on recreational boating or other equipment. SPRWS officials are confident that this early discovery will allow them to maintain operations without disruption, as other Great Lakes area water utilities have been dealing with this problem for a number of years and have developed proven techniques for dealing with it. However, these zebra mussel populations in the heart of the metropolitan area are a source of spread to other metro area waters.

Law enforcement coordination halts transport of zebra mussel infested pump

In October, officials at the St. Croix Weigh Station and DNR conservation officers observed and responded to the illegal movement of zebra mussels through the state. A North Dakota company hauling a piece of pumping equipment from a reservoir in Vermont had its trailer impounded in Minnesota when it was found the pump contained an estimated 5,000-10,000 zebra mussels (see Figure 1). During a routine inspection of the trailer at the weigh station, alert staff noticed the zebra mussels, and a conservation officer was called for assistance. The officer ordered the pump to be cleaned before it was moved through the state, as it is illegal under Minnesota laws to transport zebra mussels.

The pump unit was scraped and high-pressure washed at a truck cleaning facility in St. Paul before being permitted to travel on to the company in North Dakota. Proper collection and disposal of the zebra mussels was carried out by the cleaning personnel. The company has stated it will review its transport procedures in light of this incidence.



Figure 1. Thousands of zebra mussels were found on a pump unit that was en route to North Dakota from Vermont.

Responding to the continued spread of spiny waterflea in northern waters

DNR and other agencies made it a priority to strengthen efforts to slow the continued spread of spiny waterflea, *Bythotrephes longimanus*, in the northern border area of the state through watercraft inspections and a public awareness campaign (see Figure 2).

More populations of spiny waterflea were discovered in northern waters including 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. Spread between connected waters may be occurring through natural water movement between lakes, via fish or wildlife spreading ehippia (resting eggs), or inadvertently by recreational anglers or boaters.

Significant efforts were made to raise awareness in the Rainy Lake-Lake of the Woods region. A new DNR watercraft inspection team was created, and Voyageurs National Park also had inspectors, that spent the season working at public access sites in this area. Public awareness efforts also were conducted to educate the boating and angling public on procedures to prevent spread. Signs, newspaper articles, and billboards were some of the tools used to raise awareness on this issue. Cross-border cooperation on

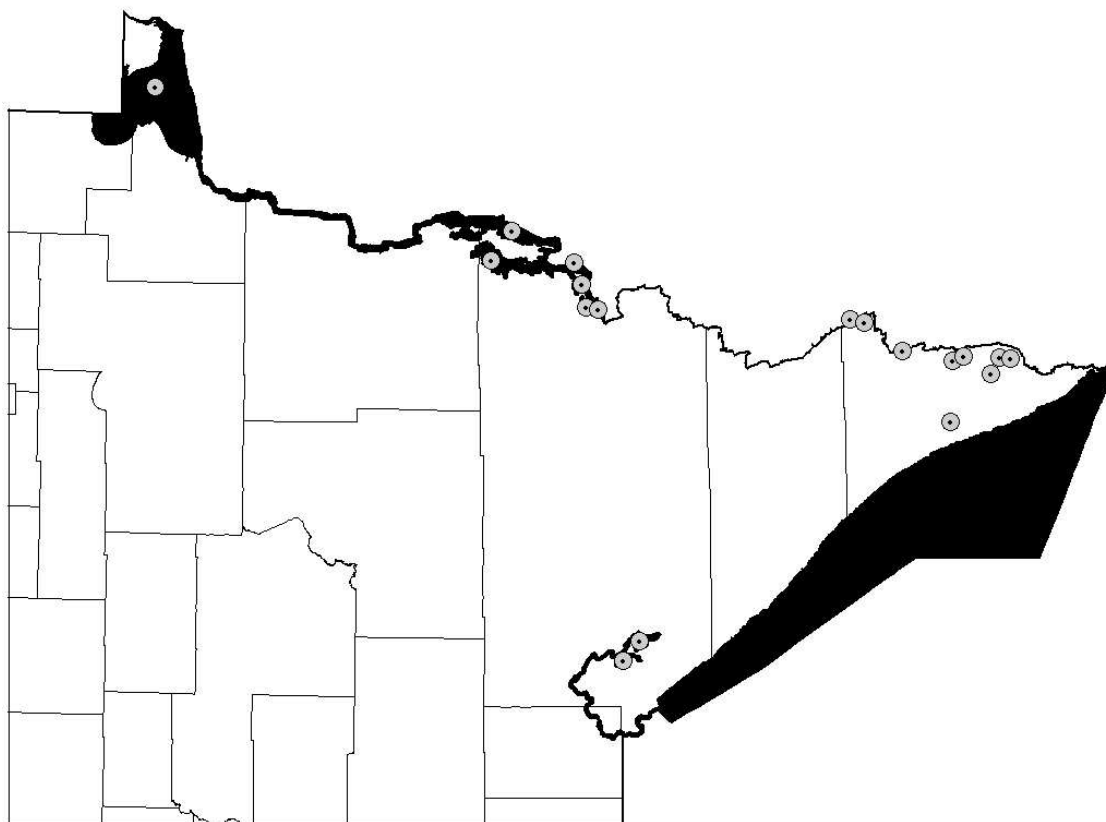


Figure 2. Spiny waterflea locations as of November 2007. Bold black lines indicate rivers that are infested, black polygons indicate large lakes that are infested, and gray dots indicate other lakes that are infested.

issues such as watercraft inspection and coordination between state, local, federal, and Canadian biologists and managers helped enhance such efforts. Other prevention activities related to the infested waters include prohibitions on taking bait for personal use, training commercial bait harvesters and restricting their activity, and placing restrictions on nets used for sport gill-netting in some large infested lakes.

Brazilian elodea found in Powderhorn Lake

The commercial sale of aquatic plants and animals is a significant pathway by which invasive species can reach Minnesota waters. One invasive aquatic plant sold for use in aquariums is Brazilian elodea (see Figure 3). Unfortunately, this plant was found in Powderhorn Lake in south Minneapolis at the end of August. It is suspected that someone may have dumped the contents of an aquarium, including the Brazilian elodea, into the lake. Goldfish, which also are sold in the aquarium trade and are not native to Minnesota, have been seen in Powderhorn Lake. This observation suggests that past aquarium releases have occurred there.

The DNR found the Brazilian elodea to be widely distributed in Powderhorn Lake and abundant in a few small areas. This suggests that the plant likely was introduced before the summer of 2007 and survived at least one winter. In an attempt to control and

prevent the spread of Brazilian elodea, the DNR and the Minneapolis Park and Recreation Board applied herbicide to the invasive plant in Powderhorn Lake during October. Inspection of the lake next spring will indicate whether this effort was successful.



Figure 3 - The DNR found that Brazilian elodea is widely distributed in Powderhorn Lake. Photo: Virginia Tech Weed Identification Guide Archive, Virginia Polytechnic Institute and State University.

Status of Invasive Species in Minnesota: 2007

Aquatic Plants

Eurasian watermilfoil was discovered in 10 additional water bodies during 2007 including Union Lake in northwestern Minnesota where the plant had not been seen previously. The total number of milfoil infested water bodies is 201 (see Figure 4).

Purple loosestrife was found in 30 new sites in 2007, bringing the total number of known infestations to 2,358.

Curly-leaf pondweed is known to occur in 752 lakes in 70 Minnesota counties.

Brazilian elodea was found in Powderhorn Lake in Minneapolis (see Hot Topics).

Wild Animals

Zebra mussels were discovered in drinking water reservoirs serving St. Paul and surrounding communities (see Hot Topics). Currently zebra mussels are 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.

No new **New Zealand mudsnail** infested waters were discovered in the state in 2007.

Spiny waterflea continues to spread along Minnesota-Canadian border waters (see Hot Topics).

Chinese and banded mystery snails are being reported in Minnesota waters—82 occurrences of the Chinese mystery snail and 45 occurrences of the banded mystery snail have been reported.

Mute swans were found at eight locations in 2007. A total of 10 birds were reported in the wild.

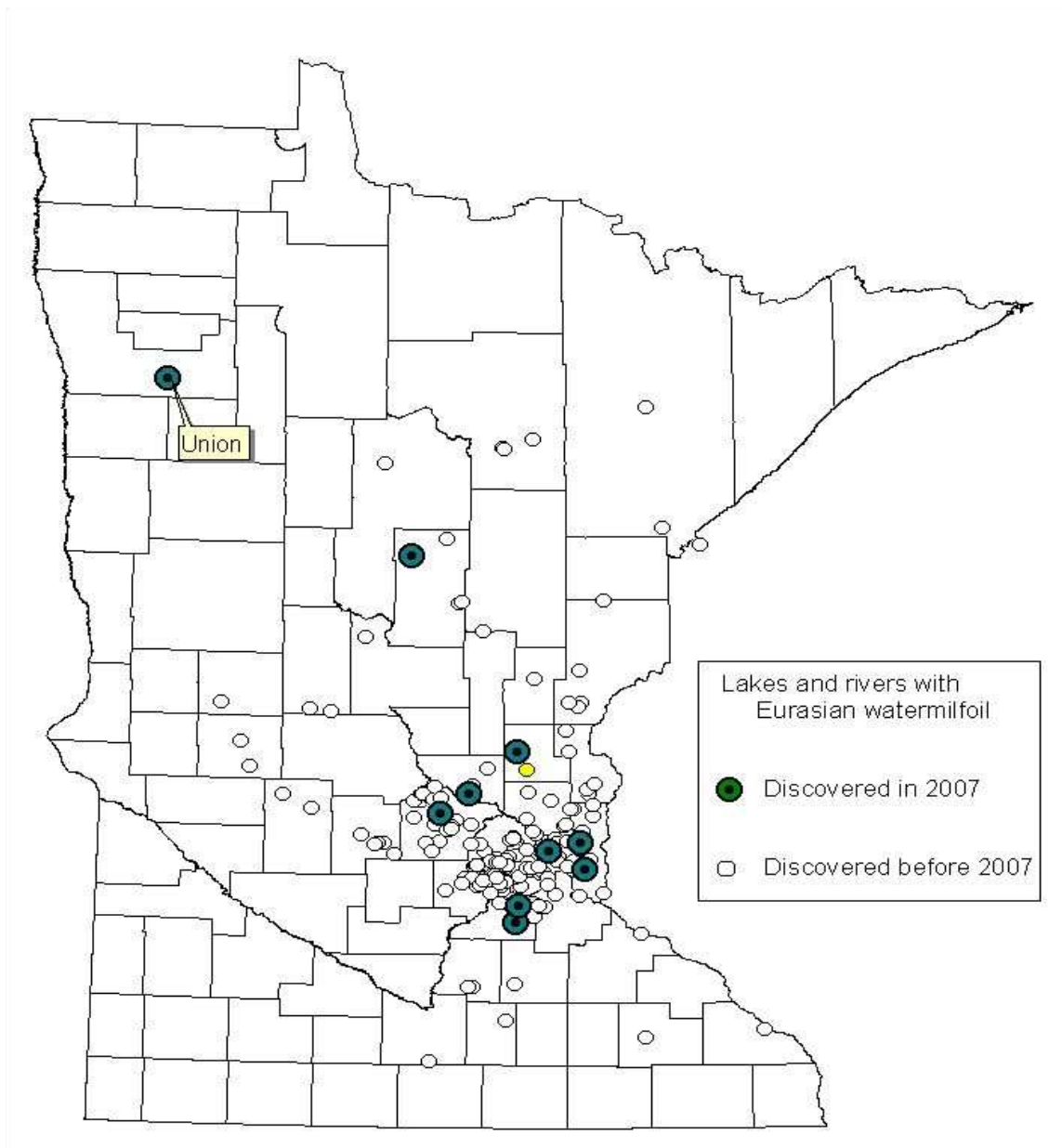


Figure 4. Eurasian watermilfoil locations in Minnesota as of November 2007.

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 2007, DNR adopted emergency rules to designate waters found to have Eurasian watermilfoil, New Zealand mudsnail, spiny waterflea, or zebra mussels as infested waters. In addition, permanent rules that designated northern snakehead and New Zealand mudsnail as prohibited invasive species became effective.

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 in northern Minnesota to help raise awareness about the continued spread of spiny waterflea in this region.

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 is the unintentional transport on boats, trailers, and other recreational equipment.

Watercraft inspections

In 2007, approximately 50 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 24,000 inspection hours, inspected 42,000 watercraft, and distributed more than 5,452 Invasive Alert Tags. In addition, inspections were conducted at 66 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 sixth year. Inspectors spent an additional 1,490 hours on four Lake Minnetonka accesses because of the funding provided by the LMCD.

Enforcement

Conservation officers spent 3,222 hours enforcing the invasive species laws and rules. Statewide, there were 39 civil citations, five summons, and 27 written warnings issued to individuals for violation of invasive species laws. Officers increased efforts in the Mille Lacs area, Lake of the Woods, Rainy River watershed, and other locations because of the presence of zebra mussels and spiny waterfleas in those areas. Additional minnow dealer checks and training for bait dealers in the Baudette, International Falls, and Mille Lacs areas took place this year.

Education

Providing information to the public about the actions they can take to help stop the spread of aquatic invasive species is a key component of this effort. Expanded enforcement efforts were conducted as part of "Stop Aquatic Hitchhikers! Week" the last week of June. Conservation officers worked extra hours and watercraft inspectors distributed informational materials at public water accesses to help keep this important issue in the forefront as people made their outdoor recreation plans before the busy Fourth of July holiday. Paid advertising and public service announcements were placed during the week to help support this effort

3. Reduce the impacts caused by invasive species

DNR Operational order

A DNR Operational Order to reduce the spread and impact of invasive species by DNR resource management activities was completed in 2007. The purpose of the operational 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; and 3) ensure that DNR resource management activities comply with the forest certification Corrective Action Plan concerning 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 \$200,000 were given to 15 lakes under this program for control efforts or for the collection of pre-treatment data. In addition, \$119,000 in grants was given to 28 lakes to control nuisance populations of Eurasian water milfoil. 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.

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 milfoil, 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 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. Several state, federal, and private entities continue to work on the development of a statewide invasive species plan for aquatic and terrestrial invasive species. This collaborative effort will provide a common structure for coordinating and guiding invasive species detection and response efforts, and encourage input from its partners.

Revenue and Expenditures

The primary funding source for the Invasive Species Program is a \$5 surcharge on watercraft registered in Minnesota. The surcharge, coupled with additional 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 generated \$2,498,000 for invasive species prevention and management activities for the 2007 fiscal year.

Figure 5 illustrates how the funding was spent from the Water Recreation Account. The Management/Control and Inspections/Enforcement categories accounted for 61% of aquatic invasive species spending in FY07. These two spending categories along with expenditures for Education/Public Awareness activities, an additional 12%, 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.

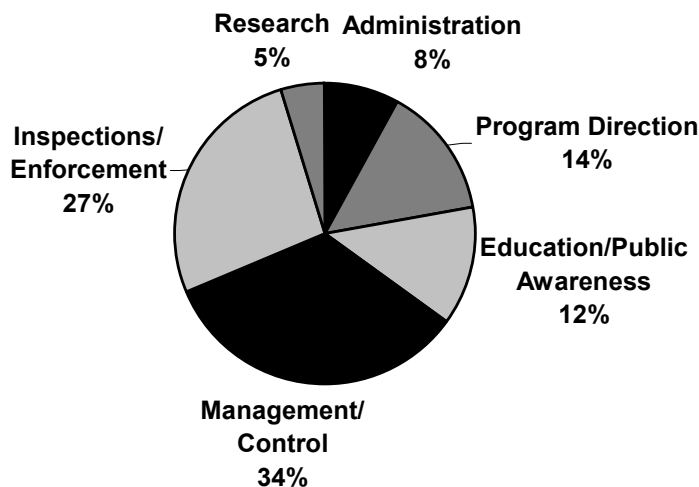


Figure 5. Aquatic Invasive Species Program spending from the Water Recreation Account and General Fund in FY07 by major categories.

Future Plans

An expansion of funding from the 2007 Legislature will allow substantial increases in a number of invasive species activities. Specific target areas include expansion of:

- 1) grants to help groups manage invasive aquatic plants;
- 2) enforcement efforts by DNR conservation officers;
- 3) watercraft inspection program;
- 4) efforts to prevent the introduction of invasive aquatic invertebrates;
- 5) 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) 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) public awareness efforts.

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 Table 1). 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 with other states, agencies, and partners with similar concerns.

Most activities of the Invasive Species Program are conducted or directed by staff from DNR's Division of Ecological Resources. The Division hires about 50 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.

In recent years, 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

Table 1. 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 (<i>Potamogeton crispus</i>)	X	X	X	X	X	X	X
Eurasian watermilfoil (<i>Myriophyllum spicatum</i>)	X	X	X	X	X	X	X
Flowering rush (<i>Butomus umbellatus</i>)	X	X	X	X	X	X	X
Other non-native aquatic plants	X		X	X	X	X	X
Purple loosestrife (<i>Lythrum salicaria</i>)	X		X	X	X	X	X
Animals							
Common carp (<i>Cyprinus carpio</i>)			F		F/W	F/W	X
Mystery snails (<i>Bellamya [=Cipangopaludina] chinensis; B. japonica; and Viviparus georgianus</i>)	X	X	E				X
Mute swan (<i>Cygnus olor</i>)	X		X		X		X
New Zealand mudsnails (<i>Potamopyrgus antipodarum</i>)	X	X	X				X
Round goby (<i>Neogobius melanostomus</i>)	X	X	F/O		NIF		X
Ruffe (<i>Gymnocephalus cernuus</i>)	X	X	F/O		NIF		X
Rusty crayfish (<i>Orconetes rusticus</i>)	X						X
Spiny waterflea (<i>Bythotrephes longimanus</i>)	X	X	F				X
Zebra mussel (<i>Dreissena polymorpha</i>)	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

state managed lands; and 4) develop or improve management practices through research (i.e., biological control).

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.

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.

Divisions of Ecological Resources and Fish and Wildlife

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, 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.

Division of Enforcement

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

Bureau of Information and Education

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

Participation in Statewide, Regional, and National Groups

The DNR Invasive Species Program and other agencies in the state participate in statewide groups such as the Minnesota Invasive Species Advisory Council, the 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 2007 due to other invasive species demands. Completing the draft for public review and finalizing the plan will be resumed in early 2008.

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 over the next 18 months.

State Funds

FY07- The primary funding source is a \$5 surcharge on the registration of watercraft in Minnesota. “Surcharge” receipts are deposited in the Water Recreation Account and appropriated by the Legislature. The surcharge on Minnesota watercraft generates sufficient funds to allow an annual appropriation of approximately \$1,200,000. Beginning in 2004, the Legislature appropriated additional funds from “regular” watercraft license receipts; this category equaled \$594,000 in FY07. The “Surcharge” column in Table 2 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.

FY08 - 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.

Table 2. State and local funding (in thousands of dollars) received by the Invasive Species Program, fiscal years 2003, 2004, 2005, 2006, and 2007.

Fiscal Year	Surcharge ²	Invasive Species Acct	General Fund	Legislative Citizen Commission on Minnesota Resources ¹	Local Contributions	Total
2003	1,191					
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		1,349	1,520	100	45	3,014

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 2).

Recommendations by the LCCMR are based on results of a competitive process. During the FY04/05 biennium, funding was provided for a project focused on European buckthorn and spotted knapweed, two high-priority terrestrial invasive plants. This project is a joint effort by DNR and the MDA. 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 3. For example, funds from the U.S. Fish and Wildlife Service (USFWS) support the implementation of the St. Croix Interstate Management Plan for aquatic invasive species. A portion of DNR’s public awareness efforts and zebra mussel monitoring dives on the St. Croix River are paid from these funds. Two grants have been approved by the U.S. Environmental Protection Agency (USEPA) to support research on the biological control of European buckthorn. Funding from the U.S. Forest Service (USFS) was also obtained to initiate a garlic mustard biological control project. These federally funded projects often operate on timelines that are different from the state’s fiscal year.

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

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
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
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 2007, which includes the last half of the Minnesota fiscal year 2007 (FY07), January 1-June 30, 2007, and the first half of fiscal year 2008 (FY08), July 1-December 31, 2007. To provide a comprehensive review of expenditures and to meet the report's January 15, 2007 due date, we report on expenditures that were incurred in FY07 (July 1, 2006-June 30, 2007).

Cost Accounting

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

Minnesota Statute (M.S. 84D.02 Subd. 6) identifies five expenditure categories that must be reported. Those categories are Administration, Education/Public Awareness, Management/Control, Inspections/Enforcement, and Research. A sixth category, Program Direction, has been added to cover a variety of program-wide or "big-picture" activities that do not fit easily into the reporting categories required by statute. Expenditures within each category are subdivided to reflect the program activities described in the following chapters.

Administration

Administration includes *Support Costs* assessed by the Division of Ecological 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. In previous years, department operational support costs were taken off before program funds were distributed to the Divisions. As a result, these costs were not accurately reflected in previous annual reports. The increase in FY07 Administration spending versus FY06, largely reflects this change in practice.

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.

Program Direction

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 2007 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 2007 (FY07) Expenditures

Expenditures on aquatic invasive species activities during FY07 (July 1, 2006-June 30, 2007) totaled \$2,245,000. Expenditures from the "Water Recreation Account," the largest single source of funding, are listed along with spending from other accounts (Table 4). 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 4, \$417,000 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 \$1,833,000 of Water Recreation Account expenditures by the Invasive Species Program during FY07 (Table 4) were more than the \$1,795,000 appropriated by the Legislature (Table 2). This difference reflects unspent FY06 funds that "rolled forward" and were available in FY07.

Figure 4 provides a broad outline of how the funding was spent from the "Water Recreation Account" and the general fund for aquatic invasive species. Within Figure 4, the Management/Control category (\$755,000) and Inspections/ Enforcement category (\$595,000) represent two largest segments of the budget; these two categories accounted for 60% of aquatic invasive species expenditures in FY07. The focus on those two categories, plus Education/Public Awareness which represents an additional 10% of FY07 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. FY07 spending targeted specifically at Eurasian watermilfoil was \$282,000; \$305,000 was spent on curly-leaf pondweed. This is a substantial increase from 2006. 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.

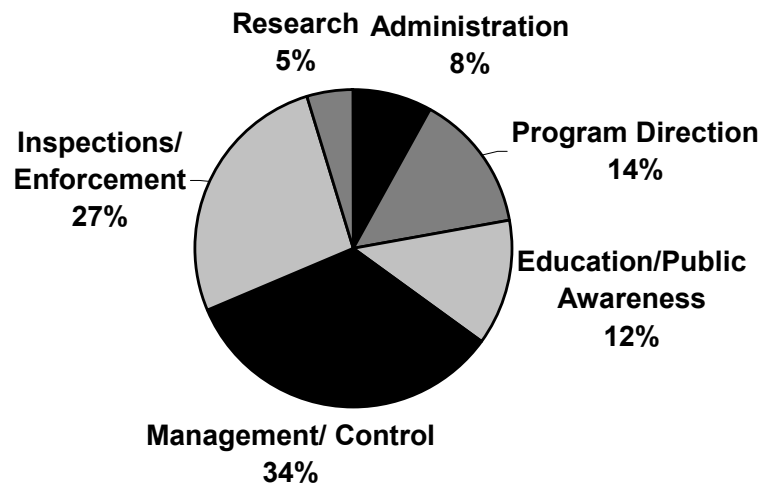


Figure 6. Aquatic Invasive Species Program spending (Water Recreation Account and General Fund only) in FY07 by major categories.

Fiscal Year 2008 (FY08) Future Expenditures

Since this report is due in the middle of FY08, projected expenditures for that fiscal year are not reported. A comprehensive review of FY08 expenditures will be provided in the 2008 Annual Report.

The expansion of funding from the 2007 Legislature will allow substantial increases in a number of invasive species activities. 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 2007 with FY07 and FY08 funds.

Table 4. Invasive species related expenditures in fiscal year 2007 (FY07) (in thousands of dollars).

Categories of Expenditures	Water Recreation Account	General Fund	Other Funding Sources
	FY07	FY07	FY06
Administration Division Support Costs Regional Representation Clerical Administrative Support Subtotal	158	23	
Program Direction State coordination Support regional/federal activities Training, supervision, related work Equipment and services Other Subtotal	314		
Education/Public Awareness Radio spots, TV, Web site development Other Subtotal	139	146	1⁵
Management/Control General Eurasian watermilfoil Purple loosestrife Zebra mussel Curly-leaf pondweed Flowering rush Other aquatic invasive species Terrestrial invasive species Subtotal	126 219 60 23 175 1 6 1 611	12 1 1 <1 130 -- -- 128 273	1 ³ -- -- -- -- -- -- 1,3 ⁶⁸ 71
Inspections/Enforcement Watercraft inspections Enforcement - access checks Prevention - laws/risk assessments Subtotal	442 53 10 505	26 47 17 90	1 ¹ -- -- 1
Research General Eurasian watermilfoil Purple loosestrife Other aquatic species Terrestrial Invasive Plants Subtotal	<1 62 21 23 -- 106	18 18	-- -- -- -- 1,2,3 ²⁰² 202
Total	1833	550	279

¹Other DNR funding, ²LCCMR funding, ³Federal funding

*Subtotals are rounded to the nearest thousand

Education and Public Awareness

2007 Highlights

- New education efforts including training sessions, presentations, and informational materials were offered in northern Minnesota to help raise awareness about the continued spread of spiny waterfleas along the U.S.-Canadian border waters
- Several communication media were used to complete the second year of the three-state “Stop Aquatic Hitchhikers!” campaign. They included billboards at key travel corridors, lawn banners at boat accesses and special events, and information and displays at travel information centers
- Expanded enforcement activities were conducted statewide as part of “Stop Aquatic Hitchhikers Week!” June 23-30
- A new 18 x 24-inch “Help Stop Aquatic Hitchhikers!” sign was developed in 2007 for use at prep and tie-down areas of public water accesses.

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 - 2007

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 in 2007 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, June, 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.

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

Television

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 aired on metro area cable stations to coincide with outdoor programs and Twins baseball coverage.

Newspapers and informational materials

A newspaper advertising campaign was completed in 2007. 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. Also, a new 4 x 6-inch card

was developed for distribution near spiny waterflea infested waters by DNR creel census clerks, conservation officers, watercraft inspectors, bait dealers, and the National Park Service.

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 ten 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 2007 *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 2007 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 to distribute information cards that provide references to state laws at zebra mussel infested waters. Two versions of the cards were developed—one for distribution specifically in the Mille Lacs Lake area and the second for distribution to all other areas of the state.

Billboards

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

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. New distribution maps were added this year as well as new images and text, offering more detail to individuals seeking invasive species information online.

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 in 2006 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 Northwest Sportshow, Fly Fishing Expo, Minnesota Muskie Expo, and Minneapolis Boat Show. 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.

Stop Aquatic Hitchhikers Week

Gov. Tim Pawlenty proclaimed June 23-30 *Stop Aquatic Hitchhikers Week* in Minnesota as a way to help keep this important issue in the forefront as people made their outdoor recreation plans for the busy Fourth of July holiday. DNR conservation officers worked extra hours to educate boaters and anglers about steps they should take to minimize the spread of invasives as well as to enforce invasive species laws. Paid advertising and public service announcements were placed during the week to help support this statewide effort.

Exhibits**Underwater Adventures**

DNR and Underwater Adventures partnered on a new informational exhibit featuring invasive species topics at the Underwater Adventures exhibit located at the Mall of America in Bloomington. Work on the exhibit was started in 2006 with the installation of a large silver carp model and a "Habitattitude" message about not releasing unwanted pets into the wild. A continuous loop video on Asian carp was added this year. A meeting with Underwater Adventures and DNR representatives along with other conservation partners is scheduled for April 2008 to discuss a potential expansion of the invasive species exhibit.

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. New video programming for the large screen TV was completed in 2006. Final content for the computer kiosk about aquatic invasive species, how people can help, and the partners who developed or supported the exhibit was also completed in 2006.

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 third 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 24,000 hours of inspection (see Watercraft Inspections and Awareness Events) providing boaters with information and tips on ways to reduce the spread of invasive species. The DNR developed a new 18 x 24-inch "Help Stop Aquatic Hitchhikers!" sign in 2007 for use at prep and tie-down areas of public water accesses. It will replace the previous "Help Prevent the Spread" and

“Stop and Remove” signs. Additionally, “Invasive Species Alert” signs are placed near the water at accesses to infested waters.

Presentations

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

Effectiveness of Public Awareness Efforts

Background

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

Participation of Others in Public Awareness Activities

“Stop Aquatic Hitchhikers!” Campaign

A three-state project and other projects are building upon efforts to extend and evaluate the national “Stop Aquatic Hitchhikers!” campaign 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 have 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. 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 will evaluate whether 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 will be involved in campaign efforts in Minnesota. Others, such as Minnesota Sea Grant and Region 3 of the USFWS, will be implementing the campaign in the state.

In Minnesota, Sea Grant has worked to broaden the campaign partnership. Joining 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.

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.

The Minnesota Invasive Species Advisory Council (MISAC) produced a 2008 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 fourth

year MISAC has produced the calendar, which was distributed to natural resource, agricultural, highway, and other professionals in 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 about invasive species. The DNR is a member and co-chair of MISAC.

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

2007 Highlights of Minnesota Sea Grant's educational and research activities related to aquatic invasive species in Minnesota:

The University of Minnesota Sea Grant Program is active in invasive species related public education campaigns, outreach, and research. Sea Grant often partners with the DNR to co-develop programs and materials to avoid duplication of effort, save money, resources, and time, and to integrate our expertise to effectively address AIS issues in Minnesota and beyond.

- Minnesota Sea Grant continues to co-lead "Habitattitude," a national public education campaign for aquarists and water gardeners. At the 2007 Minnesota Green Expo, Sea Grant, Extension, Water Resources, Minnesota DNR, U.S. Fish and Wildlife Service-Region 3, Irrigation Association, and the Minnesota Nursery and Landscape Association promoted a *Wise Water Ways!* Educational booth. Professionals from over 1,200 garden centers, nursery, turf, and landscape design businesses attended the event. In 2007, Sea Grant promoted the campaign via 23 presentations, displays, events, and printed materials. Results of a 2005 consumer survey show that public education can prevent release of unwanted aquarium fish and plants, resulting in environmental protection. A follow-up campaign survey is planned for 2008.
- Sea Grant is leading a three-state effort to extend and evaluate the national "Stop Aquatic Hitchhikers!" campaign along key invasive corridors in Minnesota, Wisconsin, and Iowa. Beginning in 2006, a multimedia campaign has strategically used billboards, highway signs, and display panels at rest areas, television, radio, and newspaper ads, kiosks at retail outlets, gas pump topper ads, lawn banners, windshield fliers, and stickers. Preliminary results of a 2006-2007 survey of boaters and anglers show that exposure to the campaign's logo and messages not only raised awareness, but changed boater behavior. Ninety-nine percent of Minnesota boaters and anglers surveyed were influenced to take action in the future to prevent the spread of AIS. The best sources for information to reach them were: signs at water accesses, watercraft inspectors, regulation booklets, billboards, and television and radio ads.

- Sea Grant continues to promote the successful Aquatic Invasive Species-Hazard Analysis and Critical Control Point (AIS-HACCP) training for aquaculturists, wild baitfish harvesters, hatchery operators, fisheries managers, and conservation officers, aimed at preventing the spread of AIS or to provide AIS-free certification. Sea Grant led production of a new manual and DVD, and sponsored three workshops. To accompany the workshops and training materials, a new pocket guide, *A Field Guide to Fish Invaders of the Great Lakes Region*, was produced for private and public fisheries personnel.
- Sea Grant continued to lead a water garden and shoreline restoration initiative designed to prevent the introduction and spread of AIS. Posters, tip cards, plant sticks, and tags were distributed to nurseries and garden centers. A water gardening display was exhibited at 15 county fairs and other events reaching about 28,000 people. A training session for Master Gardeners was offered during its annual conference.
- Sea Grant continues to collaborate with the Water Resources Center and the University of Minnesota Extension's Shoreland Education Team to sponsor workshops on aquatic invasive species control and management, rain gardens, aqua/landscaping, and revegetation.
- Sea Grant educates youths about AIS by promoting and distributing lesson plans, traveling resource kits, and curricula to teachers and educators.
- Sea Grant responded to new threats of AIS in the Lake Superior region. Staff attended several meetings that focused on viral hemorrhagic septicemia (VHS). At the request of the Minnesota bait industry, staff attended a VHS meeting in Washington, D.C. concerning an emergency order by the U.S. Department of Agriculture, Agricultural Health and Plant Inspection Service. They were also invited to participate in a meeting on VHS Prevention in Lake Superior hosted by the National Park Service. Dozens of presentations were given on VHS and a fact sheet on *VHS Virus* produced by NOAA was revised and distributed.
- Sea Grant is collaborating with the Great Lakes Maritime Research Institute (GLMRI). GLMRI is a University of Minnesota, Duluth and University of Wisconsin consortium providing the research based for expanded ports, harbor efforts, and issues related to ballast water mediated introductions of potential AIS. Sea Grant was invited by the Minnesota Pollution Control Agency to participate in a forum concerning ballast water in Duluth.
- Sea Grant partnered on the Great Ships Initiative (GSI) led by the Northeast-Midwest Institute and their collaborators. In 2007, the GSI launched the first freshwater ballast water testing facility in North America, in Superior. Sea Grant is assisting in gathering information and strategic planning and supporting outreach and communications efforts.

- Sea Grant staff participate on state, regional, and national task forces including MISAC, the Great Lakes Panel on ANS (alternate Minnesota representative), St. Croix River AIS Task Force, the Lake Superior AIS Prevention Project Team, and the ANS Task Force's Communication, Outreach and Education Committee.

Future needs for public awareness in Minnesota

- Maintain spending on paid public awareness radio/TV spots 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

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

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

In 1999, the Division of Enforcement took steps to better focus enforcement efforts. An Invasive Species Enforcement Plan that allocated hours and prioritized invasive species enforcement needs in each district was initiated.

Activities in the statewide Invasive Species Enforcement Plan were included as a specific component of the annual work plans for all Enforcement Division activities since FY05. These annual work plans describe in detail each enforcement district's responsibilities in meeting various responsibilities, including invasive species, and ensure that appropriate work activities and levels are accomplished. Funding levels were increased in November of 2006 to address the Division exceeding hourly goals for the last several years. Additional funding was added to the Division budget to be spent on enforcement efforts to prevent spread of invasive species. District work plans will be updated for FY08-09.

Goals

One of the Department's goals related to enforcement is to prevent the spread of invasive species within Minnesota. Part of this goal is to lower the percentage of trailered boats transporting prohibited invasive species, aquatic vegetation, and infested water within the state. The second part is to respond quickly when reports are received that invasive non-native wild animals have escaped from captivity. The Division also responds to complaints of illegal water appropriation and movement of equipment involving invested waters.

Progress in Enforcement Efforts - 2007

Several types of enforcement activities have occurred to limit the introduction and spread of invasive species including: educational contacts and group presentations, checks of trailered boats at water accesses, monitoring commercial bait harvest equipment and investigating the illegal importation of bait, investigating complaints concerning appropriation or equipment transfer from infested waters, and follow up on

illegally-released non-native invasive animals. In 2007, conservation officers spent 3,222 hours enforcing the invasive species laws and rules. Statewide, there were 39 civil citations, five summons, and 27 written warnings issued to individuals for violation of invasive species laws and rules. Others may have been issued by local peace officers. Officers spent many hours educating the public on the regulations and handing out informational pamphlets. Officers also made presentations at resort and lake association meetings and sportshows.

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

- Invasive Species Training was provided for all conservation officers at the annual in-service training at Camp Ripley in February.
- The Division launched a “Stop Aquatic Hitchhikers” project June 12-26, 2007 that included additional overtime for enforcement and a media campaign to highlight invasive species issues.
- Division Guidelines were developed to prevent the spread of invasive species in compliance with Operational Order 113.
- Additional training and direction were provided at district meetings with reference to specific infested waters.
- On Oct 27, 2007, Minnesota inspectors at a weigh station on Interstate 94 at the Wisconsin border found a trailer 300 pounds overweight for its tires and wouldn't let it continue. After the drivers agreed to unhitch the open-topped trailer and return two days later with a larger truck, inspectors spotted what they believed were several thousand zebra mussels on the pumps and called in DNR officers, who confirmed the finding.
- In the Central Region, officers investigated an incident of two wild boars in Anoka County near Carlos Avery Wildlife Management Area.

Roadchecks of trailered boats have not been conducted since 2002 (Table 5). The reasons for suspending roadchecks are described below.

In 1994, the Minnesota Supreme Court decided the case of *Ascher v. Commissioner of Public Safety*. *Ascher* held that the police could not conduct sobriety checkpoints. The Court's reasoning was that these checkpoints constituted an unlawful invasion of privacy. The Court held that law enforcement officials must have reasonable suspicion of a violation before stopping a motorist. In the years between 1994 and 2002, the Division of Enforcement maintained that the needs for resource protection outweighed individual privacy interests in the roadcheck scenario. Accordingly, we supported the use of game and fish roadchecks and invasive species roadchecks.

Developments in our state's appellate courts signaled that natural resource enforcement measures must comply with the same constitutional rules that govern general police “searches and seizures.” The DNR continued game and fish checks after the *Ascher* case based upon an opinion from the Attorney General's staff. However, the Division of Enforcement discontinued the use of game and fish roadchecks and invasive species roadchecks in 2002 as a result of the *Colosimo* decision. Upon the State's successful appeal of *Colosimo*, the Enforcement

Division has been attempting to reinstate the use of roadchecks in an effort to regain this important tool for the benefit of our natural resources.

Enforcement at water accesses

Enforcement near infested waters

Conservation officers increased efforts in the Mille Lacs area, Lake of the Woods, Rainy River watershed, and other locations based on the presence of zebra mussels and spiny waterfleas. The Division continued to conduct invasive species enforcement activities along the Mississippi River, focusing on the transportation of zebra mussels and infested water. Boaters using infested waters must empty bilges, live wells, and bait buckets so that they do not transport invasive species. There was also an increase in minnow dealer checks, and training/meetings were held to address bait dealers and special permits in the Baudette, International Falls, and Mille Lacs areas.

Efforts also focused on educating the public on the laws relating to transporting water from infested waters in live wells and bait buckets. Zebra mussel and spiny waterflea awareness cards were handed out to the public again this year. Time was spent educating the public at accesses at infested waters.

Enforcement during the waterfowl hunting season

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

Responding to escaped non-native (exotic) animals

In 2007, conservation officers responded to at least two situations where mute swans were in the wild (see Management of Mute Swans). There were reports to conservation officers of escapes of non-native deer and elk and other non-native wild animals.

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

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

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

Goals for 2008

The DNR believes that enforcement plays a critical role in reducing the spread of invasive species, however, it is only part of the larger prevention effort. Increased funding will be used to increase enforcement efforts to historical levels, and increase efforts in areas of infestations. The Division is working on the development of positions that combine the duties of the wetlands enforcement officers with increased invasive species enforcement. In order for the regulations on invasive species to be effective in reducing their spread, there must be: a balanced mix of public education and awareness efforts, voluntary compliance from the general public, and enforcement of the regulations. One measure of the effectiveness of enforcement efforts targeting trailered boats would be a long-term decrease in the percentage of boats carrying vegetation. Efforts will be increased near infested waters (specifically zebra mussels and milfoil). The Division also has a representative on the Terrestrial Invasives Species work group.

Participation of Others

Conservation officers continued to work with lake associations and other user groups to assist in spreading the word about controlling the spread of invasive species. An official from Deephaven reported that local peace officers have issued citations to vehicles towing boats with aquatic vegetation attached.

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, New Zealand mudsnail, ruffe, round goby, spiny waterfleas, white perch, or zebra mussels. The current *infested waters* lists are found the *State Register*. The most current list of infested waters was published on October 15, 2007.

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

Goals

- Continue to support efforts to integrate and improve the comprehensiveness, enforceability, and responsiveness of federal laws regarding noxious weeds, injurious wildlife, and other designations related to invasive species. Specifically seek reauthorization of the National Invasive Species Act (NISA) and designations of injurious wildlife such as the black carp.
- Continue to adopt rules, or use other means, which may be allowed in the future, that designate additional prohibited invasive species, regulated invasive species, and unregulated non-native species.

Progress in Regulations - 2007

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 2007 on these areas is described below:

- The National Invasive Species Act of 1996 was not reauthorized in 2007.
- The U.S. Fish and Wildlife Service (USFWS) added all forms of live black carp (*Mylopharyngodon piceus*), silver carp (*Hypophthalmichthys molitrix*), largescale silver carp (*Hypophthalmichthys harmandi*) including gametes, viable eggs, and hybrids to the list of injurious fish under the Lacey Act. The silver and largescale silver carp designation became effective on August 9, 2007. The black carp designation became effective on November 19, 2007. By these actions, the USFWS prohibits the importation into or transportation between the continental United States, the District of Columbia, Hawaii, the Commonwealth of Puerto Rico, or any territory or possession of the United States of live black carp, gametes, viable eggs, and hybrids. Live black carp, gametes, viable eggs, and hybrids can only be imported under permit for scientific, medical, educational, or zoological purposes, or without a permit by federal agencies solely for their own use. Interstate transportation of live black carp, gametes, viable eggs, and hybrids currently held within the United States will be allowed only by permit. USFWS may issue interstate transportation permits for scientific, medical, educational, or zoological purposes.
- The USFWS had not designated the bighead carp as injurious wildlife as of December 31, 2007.

State statute changes

The Legislature passed legislation in 2007 that included the following modifications:

- 1) DNR must give priority to preventing the spread of aquatic invertebrates, including zebra mussel and spiny waterflea, and to preventing the spread of round goby;
- 2) DNR may not issue grants for management of invasive plants if chemicals proposed for use are likely endocrine disruptors;
- 3) Applicants for DNR grants for management of invasive plants in public waters must have a workable plan for improving water quality and reducing the need for additional treatments;
- 4) A plan to prevent the introduction of Asian carp into Minnesota waters must be made available by DNR to the public by November 1, 2007. This plan can be found at www.dnr.state.mn.us/invasives/aquaticanimals/asiancarp/index.html;
- 5) Designations of infested waters are now exempt from rulemaking; infested waters may be designated by publishing a written order (e.g., Commissioner's Order) in the *State Register*;
- 6) Waters may be designated as infested waters if they are highly likely to become infested because they are connected to waters with invasive species;
- 7) Emergency rules to designate prohibited, regulated, and unregulated invasive species may be adopted permanently, rather than for only 18 months;
- 8) Anglers who take Asian carp species must report it to the DNR within 7 days of taking (S.F. 1131); and
- 9) The Mississippi Whitewater Park must be designed to prevent the spread of aquatic invasive species.

Emergency rulemaking

In 2007, DNR adopted emergency rules to designate waters found to have Eurasian watermilfoil, New Zealand mudsnail, spiny waterfleas, or zebra mussels as infested waters. On March 12, 2007, new Eurasian watermilfoil, spiny waterflea, and zebra mussel infested waters were published in the *State Register*. Several additional designated infested waters with spiny waterfleas near the Minnesota-Canadian border were published in the *State Register* on July 30, 2007.

Permanent rulemaking

Proposed permanent rulemaking that began in 2005 became effective in October 2007. The rules designated infested waters that have previously been designated in emergency rule, but have not yet been designated in permanent rules, although these were superseded by a Commissioner's Order due to a change in the designation process. The proposed rules also designated northern snakehead fish (*Channa argus*), New Zealand mudsnail (*Potamopyrgus antipodarum*), tubenose goby (*Proterorhinus marmoratus*) and brittle naiad (*Najas minor*) as additional prohibited invasive species. Chinese water spinach (*Ipomoea aquatica*) was redesignated as a *regulated invasive species*. Brazilian waterweed (*Egeria densa*) was designated as a *regulated invasive species*.

Commissioner's Order

Statute changes now allow the designation of infested waters via DNR Commissioner's Order instead of rulemaking. The first such order, with all infested waters known as of October 4, 2007, was published in the *State Register* on October 15, 2007.

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 Minnesota Pollution Control Agency who regulate wastewater to inform licensees about laws regarding transport of water from infested waters and also contact marinas statewide regarding invasive species laws.

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 - 2007

Complete required hours of watercraft inspection

In 2007, approximately 50 watercraft inspectors worked through the summer providing information to the public on watercraft inspections and invasive species. Inspections began in late April and continued through mid-October. Within this 25-week period, watercraft inspectors logged more than 24,000 inspection hours. A total of 42,000 watercraft/ trailers were inspected.

During the inspection season, inspections were conducted at 66 fishing tournaments and continued through October in order to reach waterfowl hunters. Inspectors distributed more than 5,400 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 6 and Figure 5). The actual distribution of time reflects both the number of PWAs and the intensity of public use at those accesses. The percent of time that the program is spending in each region has stayed relatively stable from 2001 to 2006 with an increase in time in Region 2 between 2004 and 2007, (Figure 6). This change could be attributed to the new infestations in greater Minnesota in the past years. There has also been a increase in Region 4 between 2006 and 2007 due to an increase in inspection hours in the area.

Table 6. Number of watercraft inspections conducted by watercraft inspectors in 2002, 2003, 2004, 2005, 2006 and 2007. (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

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 2007, inspections on uninfested waters represented about 20% of the total inspections (8,300 inspections) and approximately 29% of the inspection hours (6,800 hours). Due to an increased number of cooperative contracts for additional inspections at several uninfested water bodies, both the number of hours and inspections at uninfested waters have increased since 2006.

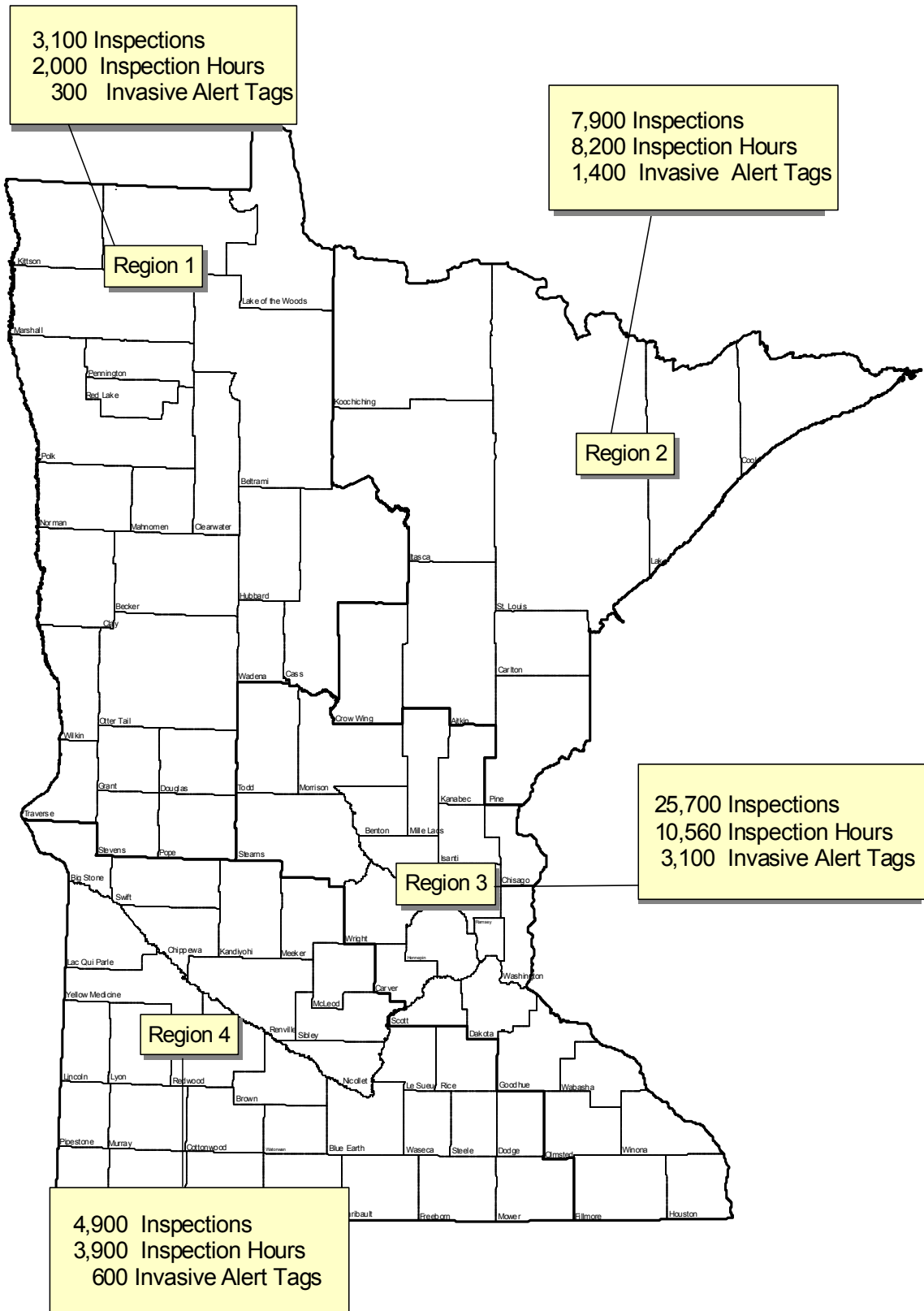


Figure 7. DNR watercraft inspections at public water accesses in 2007.

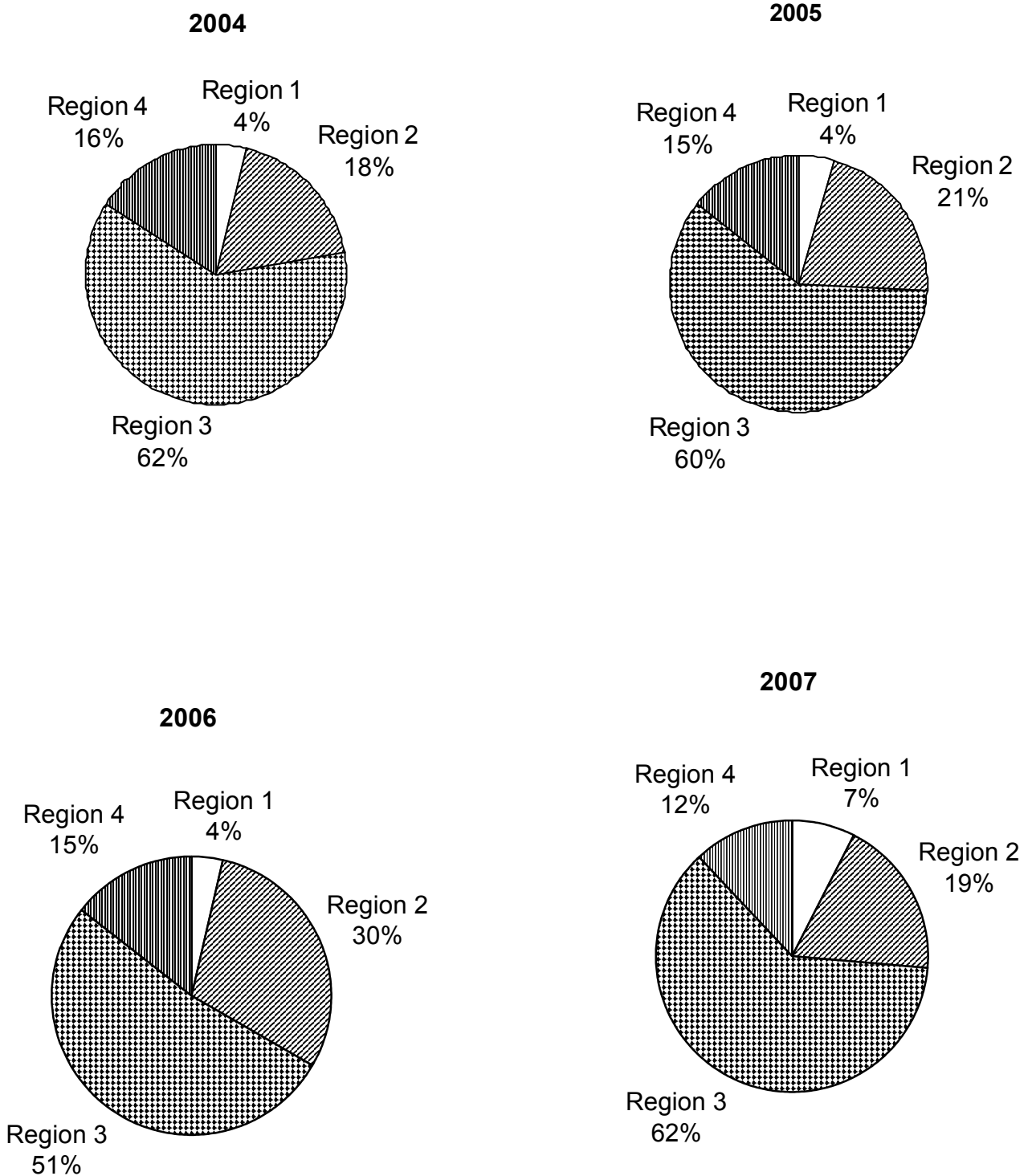


Figure 8. Percent of the state's total watercraft inspection hours spent in each region in 2004, 2005, 2006 and 2007.

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” or who have cooperatively hired with us.

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), 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, who spanned multiple counties, was formed in order to educate watercraft users about the spiny waterfleas and the actions they could take to prevent the spread of this invasive specie.

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 95%. Boaters from other states using Minnesota water bodies had a lower response at 89%. The range of percentages for each Minnesota county where at least 100 inspections had been done varied from 85% (in Stearns County) to 100% (in Pope County). Of those who said they were not familiar with the laws, slightly more than 2% (27 out of 1,148) had invasive species or vegetation on their watercraft when they entered the access. In contrast, slightly less than 1% (217 out of 23,079) 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, 8.8% said they were not familiar with the invasive species laws. In contrast, of those with a year 2007 decal, 44 out of 10,072 boaters or slightly more than four tenths of one percent 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 prevent the Department from conducting them (see Enforcement).

Increase educational efforts with citizen groups

In 2007, 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. Eleven volunteer trainings were conducted during the season; trainees included Bay Lake Association, Wadena Soil and Water Conservation District, Hubbard County Coalition of Lake Associations, Lake Belltaine Association, the Whitefish Property Owner's Association, Lake Zumbro Watershed District, North Long Lake Association, Gull Lake Association, and Upper Hay Lake Association. The Watercraft Inspection Program also gave talks at four lake association meetings, the school for environmental studies, and at the Congress of Minnesota Resort's fall conference.

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 Watercraft Inspection Program provided training, equipment, and supervision. The Lake Minnetonka Conservation District (LMCD) worked with the Watercraft Inspection Program for the sixth year. Inspectors spent an additional 1,490 hours on four Lake Minnetonka accesses because of the funding provided by the LMCD. Both Bay and Pike lake associations worked cooperatively with the DNR for the fourth year. Pike Lake Association's cooperative efforts with the Watercraft Inspection Program increased inspection hours on its lake by 360 hours and Bay Lake Association's cooperative efforts increased inspection hours by 407 hours. The Big Sandy Lake Association worked cooperatively with the DNR for the third year and increased the hours spent at Big Sandy by 384 hours. Five lake associations participated in the cooperative inspection program in 2007 for the second time. Three of those lake associations are from the west central part of the state: the Otter Tail Lake Association increased its hours by 137, the Pelican Lake Association cooperatively hired for 363 hours, and the Big Watab Lake Association increased its hours by 206. The Lower Hay Lake Association is part of the Whitefish Area Property Owners Association in the Brainerd area and also participated in the program for the second year; they increased their hours by 146. The Watercraft Inspection Program was very pleased with the strong citizen group involvement we experienced this year.

Estimate of Risk from Trailered Boats

The percentage of boats/trailers carrying vegetation as they were trailered out of a lake or river varied widely by county (Figure 7). These variations may be caused by several variables including the amount and type of vegetation in the water body, its proximity to the public water access, and the amount of recreational boating traffic. An average of 14% of the watercraft checked by watercraft inspectors were found with vegetation.

Transportation of Other Invasive Species

There was one watercraft inspected that had zebra mussels on it as the operator prepared to launch into the Mississippi River at Bay Point access. Two watercraft were found to have attached zebra mussels while exiting Minnesota waters, both of them

were leaving the St. Louis River. 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. One watercraft also exited Maple Lake in Wright County with a round goby. In each of these cases, the watercraft owner would have been asked to dispose of the invasive species before leaving the access.

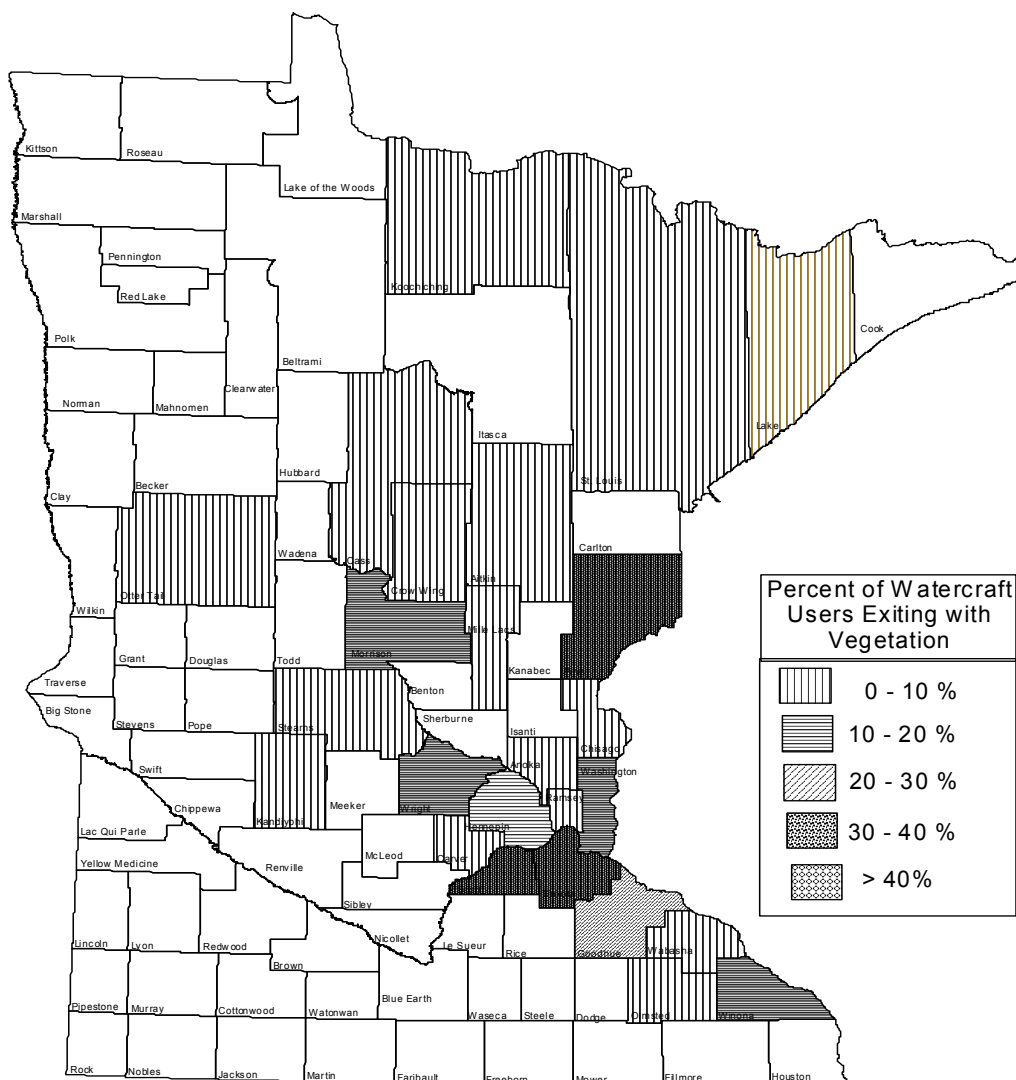


Figure 9. Percentage of exiting watercraft with attached vegetation prior to inspection and cleaning (in counties where more than 100 boats were inspected upon leaving an access).

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 8). Boaters are instructed to voluntarily affix the decal to the winch post of their trailer. This allows inspectors to identify the boaters who have already spoken with inspectors during the summer. Boaters with a decal are given a brief reminder to drain water and remove vegetation from their boats. The decals have been used for 12 years now and have been well received by the public. The approximately 30,000 decals distributed during the 2007 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.
- Expand the number of community events in which we participate in order to educate new audiences about invasive species.



Figure 10. Decal provided to boaters by DNR watercraft inspectors in 2007.

Risk Assessment and Risk Management

2007 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 an Operational Order to reduce the movement of invasives through DNR activities.

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

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.

Classification of invasive species as regulated or prohibited.

During 2006, DNR staff reviewed the risk assessments prepared in previous years and proposed several permanent changes to Minnesota Rules chapter 6216 (<http://www.revisor.leg.state.mn.us/arule/6216/>) (Invasive Species Program, 2006, 2007).

In 2007, permanent rules were adopted that classified the following species as *regulated invasive species*:

- Brazilian waterweed (*Egeria densa*)
- Chinese water spinach (*Ipomoea aquatica*) which was reclassified from a *prohibited invasive species*.

The following species were classified as *prohibited invasive species*:

- northern snakehead fish (*Channa argus*)
- tubenose goby (*Proterorhinus marmoratus*)
- New Zealand mudsnail (*Potamopyrgus antipodarum*)
- Brittle naiad (*Najas minor*)

The notice of adoption of the permanent rules was published in the October 15, 2007 issue of the *State Register*, and the rules became effective October 22, 2007.

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

Designation of infested waters

In order to help prevent to 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. Risk assessment on several species in 2006 and 2007 led to the designation of waters known to contain flowering rush, brittle naiad, and Brazilian waterweed as infested waters.

Development of a DNR Operational Order to reduce the spread of invasives

In 2006, an intra-departmental team began efforts to develop an Operational Order (Op Order) to reduce the spread and impact of invasive species by DNR resource management activities. This team has representatives from the DNR divisions of Ecological Resources, Enforcement, Fish and Wildlife, Forestry, Lands and Minerals,

Parks and Recreation, Trails and Waterways, and Waters as well as the Bureau of Management Resources. 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.

The operations order was signed by Commissioner Holsten and enacted on June 1, 2007. All Divisions and Bureaus are responsible for ensuring the discipline guidelines are developed and implemented within one year of this signing. A team of aquatic and terrestrial experts has been organized to help develop the divisional guidelines for the Division of Ecological Resources. The initial intra-departmental Invasive Species Operational Order team will review all final Division and Bureau guidelines to ensure implementation of the Operations Order and its consistency.

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.

In 2007, there were several incidents that demonstrated the risk of movement of invasive aquatic plants through the horticultural industry. The discovery of two non-native, invasive species of aquatic plants in private ponds in northeastern Wisconsin is evidence that the risk of invasion resulting from horticultural activities is significant. The ponds are owned by an individual who grows non-native aquatic plants and orders

plants from suppliers outside Wisconsin. One of the plants, hydrilla, *Hydrilla verticillata*, is classified as a *prohibited invasive species* in Minnesota and was detected as an un-ordered or incidental receipt in a shipment of plants purchased by Maki and Galatowitsch (2004) for a study of aquatic invasive plants moving into Minnesota through the horticultural trade. The other non-native invasive species found in northeastern Wisconsin was yellow floating-heart, *Nymphoides peltata*, which is widely sold through the horticultural trade.

Brazilian waterweed (*Egeria densa*) was found growing in a small pond in Minneapolis. Brazilian waterweed is a commonly sold aquarium plant, which may have been accidentally released by an aquarium owner. This was the first time this plant was found growing in the wild in Minnesota. The DNR arranged for chemical treatment of the Brazilian waterweed (see Other Invasive Aquatic Plant Species in Minnesota).

A member of the public alerted the DNR of the sale of *Potamogeton crispus* (curly-leaf pondweed) in a Minnesota aquarium store. After being contacted by DNR staff, the owner agreed to destroy the plants and to contact his plant buyer so that they could avoid purchasing non-native invasive species in the future.

These incidents demonstrate the continued need for public education both to aquatic plant sellers and consumers. Because of this ongoing need, in 2007 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.

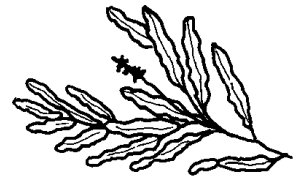
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Management of Curly-leaf Pondweed

2007 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 \$200,000 were given to 15 lakes under this program for lake-wide control of curly-leaf pondweed, or for the collection of pre-treatment data.
- 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 additional treatment. In addition, this law states that grants may not be made for chemicals that are likely endocrine disruptors. These criteria will be incorporated into the 2008 grant offer.
- The DNR continued to support research on the effects of lake-wide curly-leaf pondweed treatments.



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 752 Minnesota lakes in 70 of the 87 counties (Figure 9). 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.

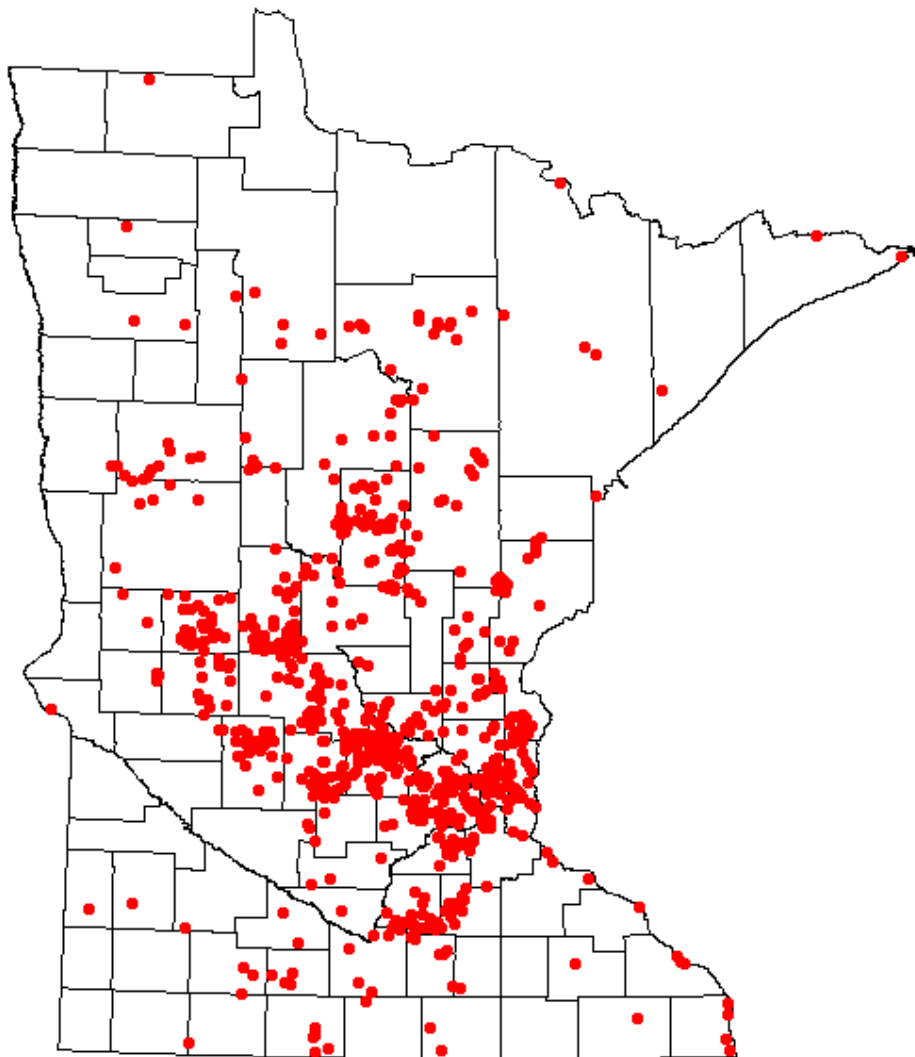


Figure 11. Curly-leaf pondweed locations in Minnesota as of October 2007 (compiled from reports from DNR Fisheries, Wildlife, and Ecological Resources staff).

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 - 2007

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 2007, 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). In addition, the 2006 Legislature directed the DNR to provide some funding to Lake Osakis in Todd County for curly-leaf pondweed management. The DNR provided \$30,000 for management of curly-leaf pondweed in Lake Osakis in 2007.

Technical Assistance

Surveys of lake vegetation

In 2007, DNR staff 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. DNR staff from the divisions of Ecological Resources and Fish and Wildlife conducted point-intercept surveys on lakes with curly-leaf pondweed. 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 2007, staff organized a meeting on submersed aquatic plants, which included several talks on curly-leaf pondweed control. In addition, staff also attended many lake association 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. In Press) 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 2007. 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 and Research**

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. In Press).

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 amount of curly-leaf pondweed in a lake (Invasive Species Program 2006).

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 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 were used to control curly-leaf pondweed lake-wide. Twelve of these projects were partially funded under a new DNR grant program "Pilot projects to control curly-leaf pondweed or Eurasian watermilfoil on a lake-wide basis for ecological benefits" which was introduced in 2006 (<http://www.dnr.state.mn.us/grants/habitat/lakewide.html>). Funding under this grant program will be available in 2008.

The DNR established this grant program to provide funding for pilot lake-wide curly-leaf pondweed and Eurasian watermilfoil control projects. 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 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 2007, this grant program made \$190,000 available for lake-wide control of curly-leaf pondweed or Eurasian watermilfoil (Table 7). In addition \$10,000 was made available for the collection of pre-treatment plant occurrence data (Table 8). The maximum amount available to any one project was \$30,000.

Thirty-eight project proposals were submitted for grants under this program for 2007. An additional five preliminary applications were submitted. Fifteen projects (Tables 7 and 8) 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 1.0 ppm endothall herbicide and 1.0 ppm 2,4-D herbicide was used to treat the Eurasian watermilfoil and curly-leaf pondweed in Silver Lake. All treatments were done in late April or early May, when water temperatures were between 50 and 60 degrees F.

In order to be accepted into the grant program, there had to be adequate pre-treatment data available on the lake proposed for treatment. Ten thousand of the \$200,000 available was set aside for grants for the collection of pre-treatment aquatic plant survey data. Three projects were granted funding for that purpose (Table 8).

Monitoring of pilot lakes

All of the lakes included in the grant program for pilot lake-wide treatments had previous aquatic vegetation surveys. Several of the lakes included had been studied in previous years by various cooperators. As part of the grant program, all of the included lakes had aquatic vegetation surveys done, as well as water quality monitoring.

Surveys of Aquatic Vegetation

The DNR is providing \$119,000 to Dr. Newman at the University of Minnesota (U of MN) to monitor changes in the aquatic plant community of Lower Mission, Weaver, Crookneck, Fish, Julia, and Rush lakes, as well as three untreated reference lakes in 2006 through 2008. In 2007, lakes were surveyed 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 in 2007 (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.

Table 7. Pilot program - Projects granted funding for lake-wide control of curly-leaf pondweed (CLP) or Eurasian watermilfoil (EWM) or both in 2006 and 2007.

County	Lake	Acres Treated in 2007	Amount Granted in 2006 (\$1,000s)	Amount Granted in 2007 (\$1,000s)	Type of Treatment	Years of treatment in 2007	Target plant(s)
Crow Wing	Lower Mission	250	25	25	endothall	2	CLP
Hennepin	Medicine	0*	20	20*	endothall	3	CLP
Hennepin	Weaver	150	10	10	fluridone	3	CLP
Isanti	Long	300	0	20	endothall	1	CLP
Lincoln	Benton	2600	30	30	fluridone	3	CLP
Meeker	Clear	140	0	20	endothall	1	CLP
Morrison	Crookneck	20	10	10	endothall	2	CLP
Ramsey	Silver	50	0	10	endothall/2,4-D	1	EWM and CLP
Scott	Fish	20	10	10	endothall	3	CLP
Sherburne	Julia and Rush**	100	10	10	endothall	2	CLP
Wadena	Blueberry	230	0	25	endothall	1	CLP

* Medicine 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.

**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.

Table 8. Projects granted funding for the collection of aquatic plant survey data in 2007.

County	Lake	Size of Lake (acres/ littoral acres)	Amount Granted (\$1000s)
Isanti	Florence	141/127	2
LeSueur	Tetonka	1336/ 548	6
Morrison	Long	120/63	2

Aquatic plants in the other six lakes in the grant program were surveyed by staff of the Invasive Species Program, ERDC researcher John Skogerboe, Steve McComas of Blue Water Science, Carolyn Dindorf from Fortin Consulting, and private consultant Matt Swanson. Dr. Newman and his staff, along with Invasive Species Program staff are analyzing data from these surveys.

Water Quality Monitoring

Various water quality parameters were measured on the pilot project lakes (Table 9). In addition, Secchi depth readings were taken twice monthly throughout the spring and summer by the cooperators on each lake granted control dollars. Dr. Newman and his staff collected a light, temperature, and oxygen profile in each of the lakes he worked on, as well as collecting water samples for phosphorus and chlorophyll a concentrations on each plant sampling date.

Results of repeated lake-wide treatments

The following are some recent results of lake-wide treatments that have been going on for several years. A report of results from 2006 and 2007 treatments should be available in the spring of 2008.

Effects on target plants:

Comments from lake residents, aquatic plant surveys, and DNR staff observations indicate that the treatments were successful in controlling curly-leaf pondweed and Eurasian watermilfoil.

Effects on native plants:

Most treated lakes have experienced both an increase in the overall distribution of native aquatic plants and declines in the distribution of particular species. In addition, Medicine Lake, which contained Eurasian watermilfoil at the time of treatment, experienced a large increase in the distribution of that invasive species.

Lower Mission Lake, Crow Wing County

The 2006, treatment of Lower Mission Lake was associated with an increase in the maximum depth of vegetation, an increase in the distribution of some native species, and a decline in the distribution of other species (Table 6). The maximum depth of vegetation increased from 4.8 meters in June 2005 to 7.0 meters in 2006 (Perleberg 2005, James Johnson, U of MN unpublished data).

Medicine Lake, Hennepin County

There were no substantial declines in native species following treatment. Most native species had a small increase in frequency comparing 2004 to 2006. The only substantial increase in a native species was an increase in *Elodea canadensis*. In addition, the frequency of Eurasian watermilfoil in the lake increased substantially from September 2004 to September 2006 (Table 11).

Table 9. Water quality parameters measured on pilot lake-wide treatment lakes in 2007 in addition to Secchi depth.

County Lake	Parameters measured	Sampling Schedule	Samples collected by
<u>Hennepin</u> Medicine	Total phosphorus Cholorophyll a Total nitrogen Soluble reactive phosphorus temperature, dissolved oxygen, pH, and conductivity profiles	Bi-weekly	Three Rivers Park District
<u>Hennepin</u> Weaver	Total phosphorus Cholorophyll a Total nitrogen Temperature, dissolved oxygen, pH, and conductivity	Bi-weekly	Three Rivers Park District
<u>Isanti</u> Long	Total phosphorus Cholorophyll a	Twice monthly	Citizen Lake Monitoring Program
<u>Lincoln</u> Benton	pH, alkalinity Cholorophyll a Total suspended solids	Monthly	Lincoln County Environmental Office
<u>Morrison</u> Crookneck	Total phosphorus Cholorophyll a Dissolved oxygen/ temperature/ pH, alkalinity	Monthly	Professional Lake Management
<u>Ramsey</u> Silver	Total phosphorus Cholorophyll a Total nitrogen Temperature, dissolved oxygen, pH, and conductivity SRP phosphorus Turbidity	Twice monthly	Ramsey County
<u>Scott</u> Fish	Total phosphorus Chlorophyll a Total nitrogen Temperature, dissolved oxygen, pH, and conductivity profiles	Bi-weekly	Three Rivers Park District
<u>Sherburne</u> Rush and Julia	Total phosphorus Chlorophyll a	Twice/month	Citizens working with DNR staff
<u>Wadena</u> Blueberry	Total phosphorus Cholorophyll a	Monthly	Citizen Lake Monitoring Program

Table 10. Percent occurrence of native submersed aquatic plant species with a frequency of 10% or greater on at least one sampling date in Lower Mission Lake. Lower Mission Lake was subjected to lake-wide endothall treatment in 2006 and 2007.

Species	June 2005 (Peleberg 2005)	June 2006 (Johnson, U of MN)
(Coontail) <i>Ceratophyllum demersum</i>	30	66
(Canadian waterweed) <i>Elodea Canadensis</i>	31	32
(Flatstem pondweed) <i>Potamogeton zosteriformis</i>	10	0.4
(Musk grass) <i>Chara</i> sp.	9	23
(Northern watermilfoil) <i>Myriophyllum sibiricum</i>	15	6

Table 11. Percent occurrence of submersed aquatic plant species with a frequency of 10% or greater on at least one sampling date in Medicine Lake. Medicine Lake was subjected to lake-wide endothall treatment in 2004, 2005, and 2006. Data collected and analyzed by John Skogerboe ERDC, as reported in Vlach and Barten (2006).

Species	September 2004	September 2005	September 2006
(Coontail) <i>Ceratophyllum demersum</i>	39	39	40
(Canadian waterweed) <i>Elodea Canadensis</i>	4	14	18
(Bushy pondweed) <i>Najas flexilis</i>	5	8	10
(Sago pondweed) <i>Stuckenia pectinata</i>	16	15	15
(Wild celery) <i>Vallisneria Americana</i>	27	33	32
(Musk grass) <i>Chara</i> sp.	13	17	19
(Eurasian watermilfoil) <i>Myriophyllum spicatum</i>	8	18	70

Weaver Lake, Hennepin County

The 2005 and 2006 fluridone treatments of Weaver Lake were associated with an increase in the maximum depth of vegetation, an increase in the distribution of some native species, and a decline in the distribution of other species (Table 12). The maximum depth of vegetation increased from 3.4 meters in August 2004 to 5.6 meters in August 2006 (Johnson U of MN, unpublished data). Most common submersed aquatic plants increased following treatment with the exception of *Ceratophyllum demersum*, which experienced a substantial decline in distribution (Table 12).

Table 12. Percent occurrence of submersed aquatic plant species with a frequency of 10% or greater on at least one sampling date in Weaver Lake. Weaver Lake was subjected to whole-lake fluridone treatment in 2005, 2006, and 2007 (Johnson U of MN, unpublished data).

Species	August 2004	August 2005	August 2006
(Coontail) <i>Ceratophyllum demersum</i>	82	38	33
(Flat-stem pondweed) <i>Potamogeton zosteriformis</i>	3	5	13
(Sago pondweed) <i>Stuckenia pectinata</i>	3	6	18
(Wild celery) <i>Vallisneria Americana</i>	12	17	23
(Water star-grass) <i>Zosterella dubia</i>	2	7	19

Lake Benton, Lincoln County

The effects of fluridone treatment on native plants in Lake Benton are mixed. In June 2006, the overall frequency of native plants was 4%, which was higher than the overall frequency of native plants in June 2005 or 2004. During 2006, Invasive Species Program staff collected native plants for the first time in a biomass sample.

Nevertheless, *Potamogeton richardsonii*, which was observed in Lake Benton in July 2004, has not been observed since then. In September 2007, DNR staff worked with Lincoln County staff to plant native submersed aquatic plants in one area of the lake. Plant propagules were placed in enclosures to help protect new plants from damage by fish.

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.

Available Secchi disk observations show trends of increasing transparency in Lower Mission, Weaver, Benton, and perhaps Fish lakes (Table 13). In Crookneck, transparency may have decreased. In the other lakes there did not appear to be clear trend over years in Secchi disk transparency.

One lake in the program for which detailed water quality analysis is available is Medicine Lake in Hennepin County. This is an 890-acre lake with 400 littoral acres that was subjected to lake-wide early-season treatment with endothall herbicide in 2004, 2005, and 2006. Water quality parameters were monitored by Three Rivers Park District. Their data showed that "[2005 and 2006 phosphorus] concentrations were an improvement [*i.e. lower*] in comparison to pre-treatment years when excessive growth of curly-leaf pondweed contributed to phosphorus loading." Nevertheless, Three Rivers Park District believes that "The decrease in total phosphorus concentration from the reduction of curly-leaf pondweed may be offset by increases in watershed loading...Despite a decrease in phosphorus concentrations for 2005 and 2006, there were no significant differences in chlorophyll-a concentrations or Secchi depth transparency." (Vlach and Barten 2006).

Table 13. Mean annual Secchi disk transparency (meters) in lakes subjected to lake-wide treatment of curly-leaf pondweed. All data, with the exception of data for Lake Benton, comes from the Minnesota Pollution Control Agency online database.

Year	Lake							
	Lower Mission	Medicine	Weaver	Benton	Crookneck	Fish	Julia	Rush
Pre-treatment	0.8	1.6	1.7	0.5	3.0	1.2	0.7	0.5
1	1.7	1.7	4.3	0.5	2.6	1.1	0.6	0.5
2		1.5	3.2	1.3		1.5		
3		1.4						

Research to improve management of curly-leaf pondweed

Status of on going evaluation conducted in Dakota County of early-spring application of low rates of endothall for selective control of curlyleaf pondweed

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 (Invasive Species Program 2005).

Early spring, whole-lake applications of endothall applied as Aquathol K for control of curlyleaf pondweed (*Potamogeton crispus*) were discontinued on Schwanz Lake (13 acres) and Blackhawk Lake (37 acres) after 2003. Curly-leaf pondweed was reduced to low levels in spring 2004, and residual turions in the sediment were nearly eliminated. In spring of 2004, a second study was initiated to demonstrate the use of small scale applications of endothall applied as either Aquathol K or Aquathol Super K to prevent curly-leaf pondweed from returning to nuisance levels. No treatments were conducted on Schwanz Lake in 2004, and 12 acres were treated on Blackhawk Lake using Aquathol K.

Aquathol Super K was applied to 2 acres on Schwanz Lake and 6 acres on Blackhawk Lake in April 2005, and 1.5 acres and 5 acres again in April 2006. In April 2007, 1.5 acres on Schwanz Lake and 14 acres on Blackhawk Lake were again treated with Aquathol Super K. Low levels of curly-leaf pondweed continue to persist in both Schwanz and Blackhawk lakes, however, the plants remained below nuisance levels with small-scale maintenance treatments (Skogerboe ERDC 2007, unpublished data).

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

ERDC researchers working in cooperation with Mississippi State University, the DNR, and CerexAgri continued to test the efficacy of early spring applications of endothall in combination with 2,4-D against curly-leaf pondweed and Eurasian watermilfoil in two Minnesota lakes (Invasive Species Program 2006). Field trials were initiated in 2003 to demonstrate improved, selective, long-term control of curly-leaf pondweed and Eurasian watermilfoil using early-spring applications of endothall combined with 2,4-D. Four lakes infested with curly-leaf pondweed and Eurasian watermilfoil were selected in the Minneapolis/St. Paul, MN area. Pre-treatment plant surveys were conducted in June and August of 2003, and two lakes were treated with the combination of endothall (1 mg/L ai) and 2,4-D (0.5 mg/L ai) in April 2004, 2005, and 2006. Endothall (1 mg/L ai) combined with triclopyr (0.5 mg/L ai) were applied in May 2007. The two untreated lakes served as reference lakes. Post-treatment plant evaluations were conducted in June and August 2004 through 2007. Herbicide treatments were successful at reducing curly-leaf pondweed and Eurasian watermilfoil densities by more than 95% throughout the lakes. Herbicide treatments resulted in no significant changes in native plant abundance or diversity during the first year post-treatment, but native plant diversity and abundance did increase in treated lakes during the second and third year post-treatment. Water clarity was not reduced following removal of Eurasian watermilfoil and curly-leaf pondweed. (Skogerboe and Getsinger 2006, 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 ERDC 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. In 2007, ERDC provided results from an evaluation of the ability of fluridone-treated curly-leaf pondweed to withstand varying levels of turbidity. They found that without turbidity, fluridone concentrations of

3 to 5 ppb suppressed the growth of curly-leaf pondweed. The addition of turbidity to the water column further suppressed the growth of curly-leaf pondweed in all treatments, including the untreated references, by as much as 80%. Nevertheless, they also found that numbers of turion produced by the plants increased with increased turbidity (Poovey et al. In preparation).

Future needs for management of Curly-leaf pondweed

- Review available information on the ecology and management of curly-leaf pondweed to identify possible research projects that might be carried out to improve management of 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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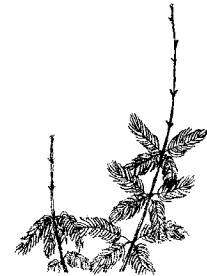
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Management of Eurasian Watermilfoil

2007 Highlights

- Eurasian watermilfoil was discovered in ten additional Minnesota water bodies during 2007. There are now 202 Minnesota lakes, ponds, rivers, and streams known to contain the submersed aquatic invasive plant.
- One lake discovered in 2007 to have Eurasian watermilfoil was Union Lake (Polk County) in northwest Minnesota where the plant has not been seen previously.
- Cooperators on 28 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.
- 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 2007.

Spread of Eurasian Watermilfoil in Minnesota during 2007

Milfoil was newly discovered in ten lakes during 2007 (Table 14 and Figure 10). The discovery of milfoil in Union Lake means that the invasive plant is now in another part of the state that has not had to deal with this invasive plant in the past. Inspection by the DNR revealed that the plant was widespread in the lake and abundant in some locations. This observation suggests that the plant had been present in the lake for a period of years before it was reported to the DNR. Another concern about the presence of milfoil here is that the lake has an artificial outlet through which water is pumped when levels in the lake are high. The outlet is located in a wetland from which water can run to the southwest and eventually into the Sandhill River, which in turn empties into the Red River. Concern about the potential for milfoil to be pumped through the outlet from Union Lake and ultimately carried into the Red River led the DNR to search the waters downstream of the lake. To date, no milfoil has been found downstream of the outlet from Union Lake.

Five of the new lakes are located in the seven-county metropolitan area. Another three of the lakes are located in “collar” counties, those adjacent to the seven-county metropolitan area. Milfoil is now known to occur in 202 water bodies in Minnesota.

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 14. Classification of water bodies in Minnesota with Eurasian watermilfoil during 2007.

Classification	Spring	New in Summer	Fall
Lakes eligible for management with state funds	135	6	141
Lakes ineligible for management with state funds			
Public water but no public access	40	4	44
Not public water	9	0	9
Rivers or streams	8	0	8
Total	192	10	202

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 users of Minnesota lakes. These individuals suspect that the abundant vegetation is milfoil and report the occurrence to the Invasive Species Program. During 2007, 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

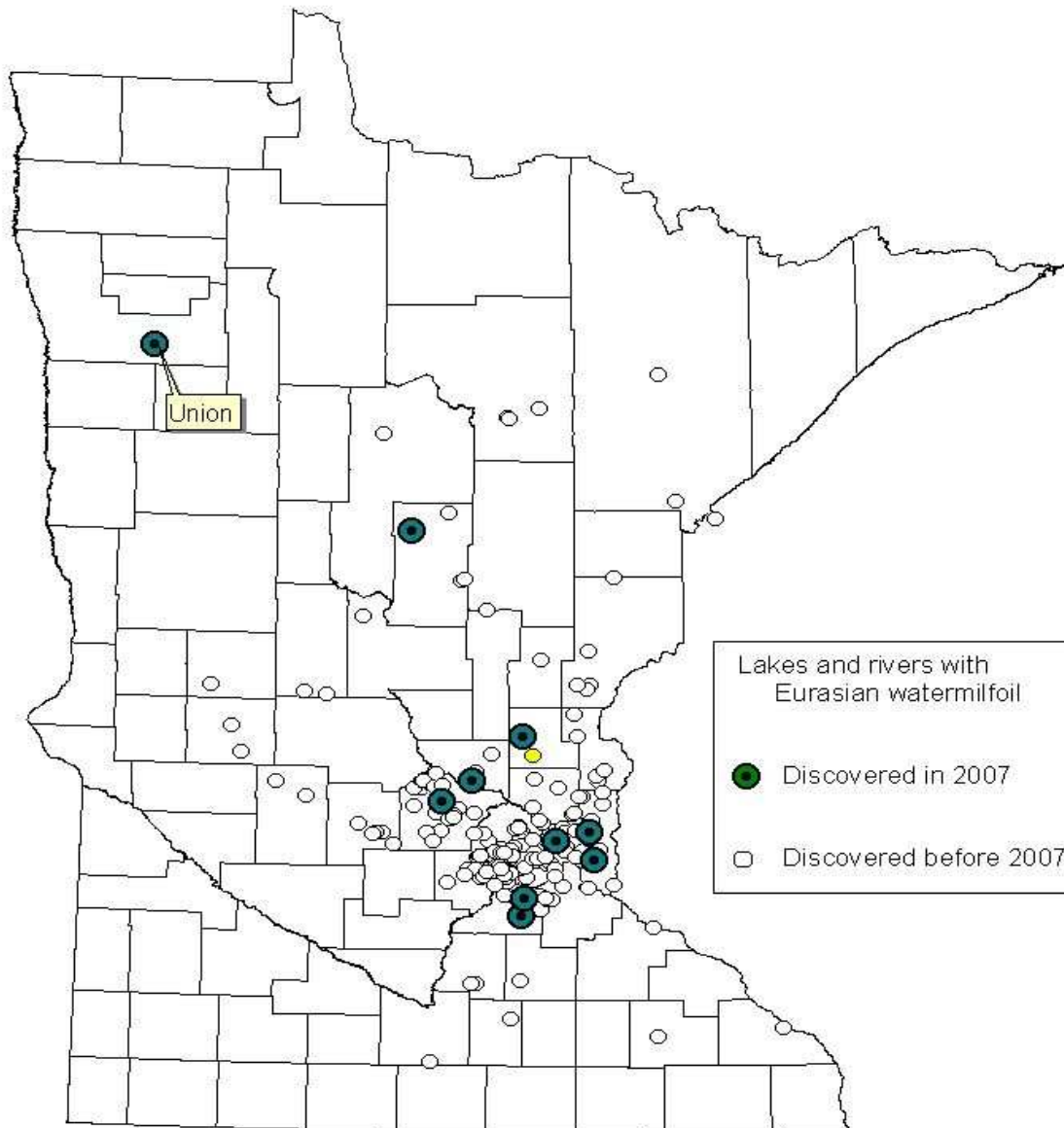


Figure 12. Distribution of water bodies with Eurasian watermilfoil in Minnesota as of November 2007. Union Lake in Polk County in northwest Minnesota, which was discovered to have Eurasian watermilfoil in 2007, is labeled.

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 2007

Classification of water bodies for management of Eurasian watermilfoil

In the spring of 2007, the Invasive Species Program classified the 192 bodies of water known to have milfoil (Table 14). One hundred thirty-five lakes were determined to be eligible for management with state funds because they have public water accesses and are protected waters that are regulated by the state (Minnesota Statute 103G.005, Subd. 15).

Some lakes were determined to be ineligible for management with state funds because they either do not have public water accesses or are not protected waters. Lastly, flowing waters such as rivers and streams are not usually considered for management of milfoil with state funds because 1) users of these waters in Minnesota rarely encounter problems caused by milfoil like those found in lakes; and 2) use of herbicides is less reliable and effective in rivers and streams than in lakes.

Six of the ten water bodies that were discovered to have milfoil during 2007 were eligible for management with state funds because they have public water accesses (Table 14). Four lakes found to have milfoil in 2007 have no public water access and, consequently, are ineligible for management with state funds.

Management of Eurasian watermilfoil

During 2007, 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 2007) 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 30 lakes (Table 15). Applications were reviewed by the Invasive Species Program in relation to the standards described in the announcement that is available to potential cooperators (DNR 2007). Twenty-eight of the applications were approved for funding. Questions about some applications led to inspections of the milfoil in these lakes by staff of the Invasive Species Program. These inspections revealed that some 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. 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. Applications for reimbursement were not approved for two lakes.

Table 15. Number of Minnesota lakes where management of Eurasian watermilfoil was supported with state funds in 2002-2007.

	Applications received	Applications approved	Applications denied or not pursued
2002	32	21	11
2003	32	23	9
2004	26	18	8
2005	37	27	10
2006	27	23	4
2007	30	28	2

As a result, the DNR expects to reimburse cooperators on 28 lakes for costs of milfoil management during 2007.

Assessment of Eurasian watermilfoil

In addition to control, the DNR also offers funding to support assessments of the potential for Eurasian watermilfoil to produce dense and matted growth that might interfere with watercraft use, swimming, or other traditional recreational uses of a lake. The offer of state funding is described in an announcement that is available to potential local cooperators (DNR 2006) who are expected to take the lead in assessment of the milfoil. This requires a survey of milfoil in the lake to be done by a contractor, who will then provide a report to the cooperator. During 2007, the DNR received two applications for reimbursement for assessments of milfoil in two lakes. One of the two assessments was completed in 2007; the other likely will be completed in 2008.

Control of Eurasian watermilfoil by the DNR at DNR public water accesses

The Invasive Species Program initiated treatment of milfoil on three lakes either in the immediate vicinity of public water accesses operated by the DNR or in harbors on Mille Lacs and Leech (Table 16). 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.

High-intensity management of Eurasian watermilfoil

The goals of high-intensity management are to 1) limit the spread of the plant within a lake; 2) reduce the abundance of milfoil within a lake; and 3) slow the spread of the invasive to other lakes. High-intensity management usually involves efforts to find all milfoil in a lake and treat it with herbicide. High-intensity management may be undertaken by the Invasive Species Program on lakes that either have small, recently discovered populations of milfoil or are located in areas of Minnesota where there are few, if any, other lakes with milfoil. During 2007, the Invasive Species Program conducted high-intensity management on one lake in the Brainerd area (Table 16).

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.

Demonstration project for selective control of Eurasian watermilfoil and curly-leaf pondweed in three bays on Lake Minnetonka

In 2006 a project was initiated on Lake Minnetonka to demonstrate the potential of aquatic herbicides to provide selective control of Eurasian watermilfoil (*Myriophyllum spicatum*), hereafter called milfoil. The project was led by the Lake Minnetonka Conservation District (LMCD). Monitoring of aquatic plants was done by ERDC researchers. The DNR provided technical assistance and the LMCD provided support to the effort. Three plots were established on Carman, Gray's, and Phelp's bays (Skogerboe and Welling 2007). Three different herbicide treatments were used including triclopyr, 2,4-D, and a combination of endothall and 2,4-D. The distribution and abundance of aquatic plants in the plots were monitored during May or June on the day of treatment, early July, and mid-August during 2006 and during June 2007.

All three herbicide applications maintained low density of milfoil for the entire summer. Based on percent occurrence data, the combination of endothall and 2,4-D was not as successful as in previous demonstrations in other lakes (Skogerboe and Getsinger 2006). Previous demonstrations utilized 2,4-D applied as liquid DMATM 4, but label restrictions did not allow use of DMATM 4 in the relatively small plot on Carman Bay. Consequently, 2,4-D was applied using the granular formulation Aqua-Kleen®, which had not been previously tested in combination with endothall. The slow release of herbicide from the granules probably resulted in insufficient 2,4-D in contact with the plants. Native plants were abundant in all treated plots following the herbicide applications.

Development of a Lake Vegetation Management Plan for selective control of Eurasian watermilfoil and curly-leaf pondweed in three bays on Lake Minnetonka

In 2007, an effort was begun to develop a Lake Vegetation Management Plan for three bays on Lake Minnetonka. The rationale for the effort is to determine whether a plan can be developed to allow bay-wide selective control of milfoil. The effort was initiated

by the Lake Minnetonka Association and the LMCD. To date, three meetings with stakeholders have been held and a fourth such meeting is expected to be held early in 2008. Monitoring of aquatic plants in support of this effort during 2007 was done by ERDC researchers. The DNR provided technical assistance.

Effectiveness of management of Eurasian watermilfoil in Minnesota lakes

Though the number of Minnesota lakes known to have milfoil increased in 2007, 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 14 and 15). The number of lakes where cooperators received DNR funding for control of milfoil during 2007 increased slightly by comparison with the previous year (Table 15).

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 2007, Dr. Ray Newman continued working with Ms. Sara Roley, his student, 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 Revision). 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.

Table 16. Number of lakes, budgets, and expenditures in different classes of management of Eurasian watermilfoil in Minnesota during 2007.

	Number of lakes in class in spring	Funds budgeted in spring	Number of lakes in class where control or assessment was done	Funds spent
Maintenance Management				
Control by Cooperators and Reimbursed by DNR				
	126	122,000	28	119,000
Assessment by Cooperators and Reimbursed by DNR				
	--	11,000	2 ¹	3,000
Control by DNR at DNR Public Water Access				
	--	12,000	3	14,000
High-Intensity Management				
	0	Contingency	1	3,000
Totals				
	--	145,000	34	139,000

¹ One of these lakes applied for funding in 2007, but does not plan to do the work until 2008.

Chemical profiles of Eurasian and northern watermilfoils

In 2007, Drs. Michelle Marko, Ray Newman and colleagues published a paper online on the chemical profiles of Eurasian and northern watermilfoils (Marko et al. 2007).

Results of this study by the University of Minnesota indicated differences between the two species, which may account, at least in part, for the ability of Eurasian watermilfoil to displace certain native plants in North America.

Genetics of Eurasian, northern, and hybrid watermilfoils

In 2007, Dr. Michael Moody, a researcher at Indiana University continued to study the genetics of Eurasian, northern, and hybrid watermilfoils. Previously, he worked with a private company to develop a library of microsatellite markers for Eurasian watermilfoil and other watermilfoils (Moody 2005). Subsequently, the potential utility of the markers was evaluated by analysis of samples of milfoils from two Minnesota lakes (Moody 2006). In 2007, Dr. Moody conducted additional and more extensive sampling of milfoils in Minnesota lakes to further examine genetic variability using microsatellite markers. A report on this effort will be forthcoming.

Also during 2007, a study on the geographic distribution and genetic variation in hybrid watermilfoil by Dr. Moody, which previously had been released electronically, was published (Moody and Les 2007).

Ecological performance of Eurasian watermilfoil, hybrids between Eurasian and northern watermilfoil, and northern watermilfoil in Minnesota

Recently, it has been observed in some Minnesota lakes with moderate to high water clarity and much native vegetation that Eurasian watermilfoil or perhaps hybrids between this species and native northern watermilfoil, *M. sibiricum* (Moody and Les 2002, Moody and Les 2007), may have limited distributions and occur at low levels of abundance. Understanding variation in the distribution and abundance of an invasive species like Eurasian watermilfoil is important to development of realistic expectations of invasions and approaches to management. A reasonable approach to addressing this question would be to grow plants from different populations under uniform experimental conditions (e.g., Santamaría et al. 2003). Further, the experiments should include both parental genotypes, as well as the hybrid, to provide a comprehensive analysis of ecological performance.

At the request of the DNR, the ERDC researchers agreed to undertake 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 in progress and results will be reported to the DNR in the future.

Research on approaches to control of Eurasian watermilfoil

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

In Minnesota during 2007, ERDC researchers agreed to undertake a study begun in 2003 to determine whether early spring treatment with low rates of endothall and 2,4-D herbicides will control both milfoil and curly-leaf pondweed (Skogeboe and Getsinger 2006). The researchers also want to determine whether reductions in milfoil and curly-leaf will produce a more diverse and abundant native plant community. Lastly, the project is intended to determine whether the expected shift in vegetation will affect the fish community. One paper on the composition of the fish communities in the four study lakes was published by Slade et al. (2005). The study is being conducted by the ERDC in cooperation with Mississippi State University and the DNR. United Phosphorous Inc. (formerly CerexAgri), an herbicide manufacturer, provided financial and technical support in past years. The lakes were treated in spring, 2007 for the fourth year: endothall (1 mg/L ai) combined with triclopyr (0.5 mg/L ai) were applied in May. Monitoring of the vegetation was done during the open water season of 2007. Additional written results are expected to be reported to the DNR in the future.

Susceptibility of selected species and hybrids of milfoil to aquatic herbicides

Recent documentation of hybridization of Eurasian (*Myriophyllum spicatum*) and northern watermilfoil (*Myriophyllum sibiricum*) by Moody and Les (2002, 2007) may have implications for management strategies including the use of herbicides and biological control. In conjunction with the discovery of hybrid milfoils, there have also been anecdotal reports of reduced activity of the herbicides 2,4-D and fluridone in the upper Midwest. Reduced efficacy of herbicides has been noted at sites that have been managed over time. While this could simply be a matter of yearly variations in initial plant vigor and environmental conditions on the date of treatment, the number of reports from different locations suggests the potential for the development of increased herbicide tolerance by a milfoil biotype.

In 2005, the DNR provided funding to the ERDC to support a study of potential variation among different species and genotypes of milfoils in susceptibility to herbicides. Results showed no significant differences between the hybrid and Eurasian watermilfoil populations in their responses to herbicide. Complete results of this study and recommendations were conveyed in a final report from the ERDC to the DNR (Netherland et al. 2006). Some results of the study were published by Poovey et al. (2007) and Slade et al. (2007).

Research on an approach to limit spread of Eurasian watermilfoil

A study of the potential to use hot water to kill milfoil on trailered watercraft was completed by Blumer (2007) at the University of Minnesota. The research focused on fragments of milfoil that were exposed to six different water temperatures ranging from 45 to 80 °C for periods of two, five, and ten minutes. Exposure to water with temperatures of ≥ 60 °C was necessary to kill milfoil fragments. Duration of exposure had little effect at the temperatures tested. These results suggest that using hot water alone to kill milfoil fragments attached to watercraft may not be feasible due to the high temperatures required.

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

The plant spreads primarily vegetatively from thick rhizomes (Figure 11), from small tubers that break off the rhizome, and from small bulblets that form in the inflorescence. Water currents, ice movement, (Haber 1997), and muskrats (Gaiser 1949) can easily move these reproductive structures to new locations within a water body.

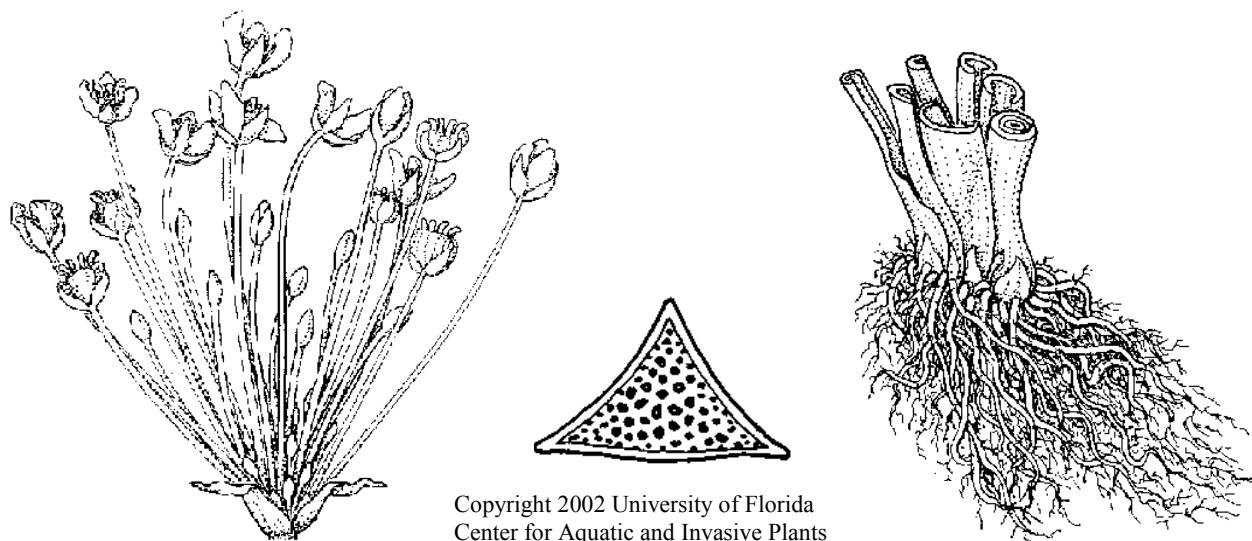


Figure 13. Flowering rush umbel, cross-section of a leaf, and rhizomes.

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 more aggressively in North America than in its native Europe and may become an aggressive competitor with native wetland vegetation (Anderson et al. 1974; Staniforth and Frego 1980). Given the invasive characteristics of flowering rush, it is classified as a *prohibited invasive species* in Minnesota.

Distribution

Flowering rush was first recorded in Anoka County in 1968 (Moyle 1968) and has since been located in six other counties. Despite its 30-year presence in the state, the distribution of flowering rush is widely scattered and uncommon (Figure 12).

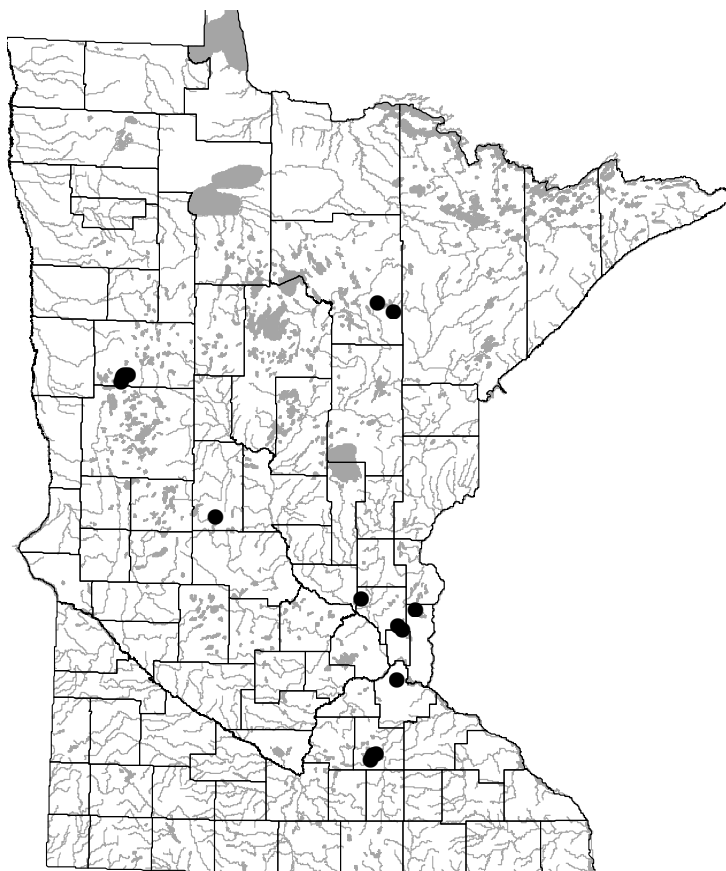


Figure 14. Flowering rush locations as of November 2007.

New introductions are likely the result of intentional planting from horticultural sales. More information about the distribution of flowering rush in the state can be found in the 2000 Exotic Species Annual Report (Exotic Species Program 2001). There were no new discoveries of flowering rush locations in 2007.

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 - 2007

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 2007, Invasive Species Program staff surveyed and documented flowering rush on North Twin Lake and Hart Lake in Itasca County. Surveys were also conducted on Detroit Lakes: Big Detroit, Little Detroit, and Deadshot Bay (Curfman Lake), all in Becker County. The surveys of the Detroit Lakes took place on July 19, 23, and 24, 2007. A point intercept survey was conducted that encompassed 349 sample points reaching from the shoreline to a water depth of around 16 feet. This survey followed protocols established during previous years' surveys to ensure consistency in data.

Support research to develop and implement better management methods

In 2003 through 2007, the Pelican River Watershed District (PRWD) contracted with a private herbicide applicator to test different herbicides registered for aquatic use on small plots of flowering rush. Several herbicides and application rates were tried including glyphosate, imazapyr, 2, 4-D (granular and liquid), diquat, and various adjuvants. From this work, imazapyr, trade name Habitat, performed the best. The flowering rush within the imazapyr plots was reduced significantly for at least two years after treatment. As a result, the PRWD has halted its mechanical harvesting program in exchange for spot treating flowering rush stands with imazapyr. In 2007, the PRWD treated three lakes using Habitat. Seventy-four acres on Detroit Lake including Deadshot Bay (Curfman Lake) were treated and 12 acres were treated on Lakes Sallie and Melissa, both downstream from Detroit Lake.

Recently the chemical manufacturer BASF introduced a herbicide named Clearcast. In 2007, the U.S. Environmental Protection Agency and the MDA approved Clearcast for an experimental use program. Clearcast, also known as imazamox, shows promise for controlling certain aquatic plants like flowering rush. Clearcast was applied to three acres of flowering rush on North Twin Lake (Itasca County) along the entire shoreline in spot applications in 2007. This is much of the same area where manual cutting has been used in the past with limited long-term success. Treatment was performed by a private herbicide applicator in September 2007 near the end of the growing season for flowering rush. Weekly observations after the herbicide application indicated reduction in flowering rush throughout the treatment area. However, because the treatment occurred late in the growing season, the true effectiveness of the treatment may not be apparent until the 2008 season. In addition, detailed pre-treatment aquatic vegetation sampling was completed to document any non-target impacts of this herbicide.

Provide information to those interested in how to best manage flowering rush

The PRWD annually meets with DNR staff including representatives from the Invasive Species Program to discuss concerns regarding the expansion of flowering rush within and into lakes in the Detroit Lakes area. Currently, the PRWD 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.

On North Twin Lake in Itasca County, flowering rush is actively managed by Greenway Township. In 2005 and 2006, the herbicide imazapyr was used to treat the area near the public water access and a township swimming beach. Previous to the use of herbicides, hand cutting has seasonally reduced the dense stands of flowering rush on North Twin Lake, but has not provided long-term control of the plant, in fact, flowering rush has spread throughout the lake in recent years. If treatments with imazapyr or imazamox prove to be successful, Greenway Township will save money and staff time on flowering rush management.

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 controlled for at least two years with imazapyr without significantly harming submersed aquatic plants. Given the short time this herbicide has been used on flowering rush, 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 flowering rush may increase its spread if the entire rhizome is not removed, but can be effective at removing small infestations of flowering rush.

Participation of Other Groups in Management Activities

Others involved in flowering rush management in Minnesota in 2007 include: DNR's Division of Fish and Wildlife, PRWD, and Greenway Township in Itasca County.

Future needs for management of flowering rush

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

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Management of Purple Loosestrife

Background

Purple loosestrife (*Lythrum salicaria*, *L. virgatum* and their hybrids) is a wetland plant from Europe and Asia that invades marshes and lakeshores, replacing cattails and other wetland plants. The DNR and other agencies manage purple loosestrife because it harms ecosystems and reduces biodiversity by displacing native plants and habitat for wildlife (Blossey et al. 2001). The Purple Loosestrife Program was established in the DNR in 1987. State statutes direct the DNR to coordinate a control program to curb the growth of purple loosestrife (M.S. 84D.02, Subd. 2) and a significant amount of progress has been made toward the development of a sound approach to manage this invasive.

This management program integrates chemical and biological control approaches and cooperates closely with federal and state agencies, local units of government, and other stakeholder groups involved in purple loosestrife management. The goal of the program is to reduce the impact purple loosestrife is having on our environment. Management efforts include both biological and chemical control methods, monitoring management efforts, and supporting further research.

Statewide Inventory of Purple Loosestrife

In 1987, the DNR began to inventory sites in Minnesota where purple loosestrife was established. DNR area wildlife managers, county agricultural inspectors, local weed inspectors, personnel of the Minnesota Department of Transportation, and the general public report purple loosestrife sites to the DNR. The DNR maintains a computerized list or database of sites that includes the location, type of site, and number of loosestrife plants present (see Figure 17). In 2007, 30 new purple loosestrife infestations were identified in Minnesota. There are now over 2,300 purple loosestrife infestations recorded statewide (Table 13). Of those sites, the majority (70%) are lakes, rivers, or wetlands. Inventory totals indicate that Minnesota presently has over 63,000 acres infested with purple loosestrife.

Progress in Management of Purple Loosestrife - 2007

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

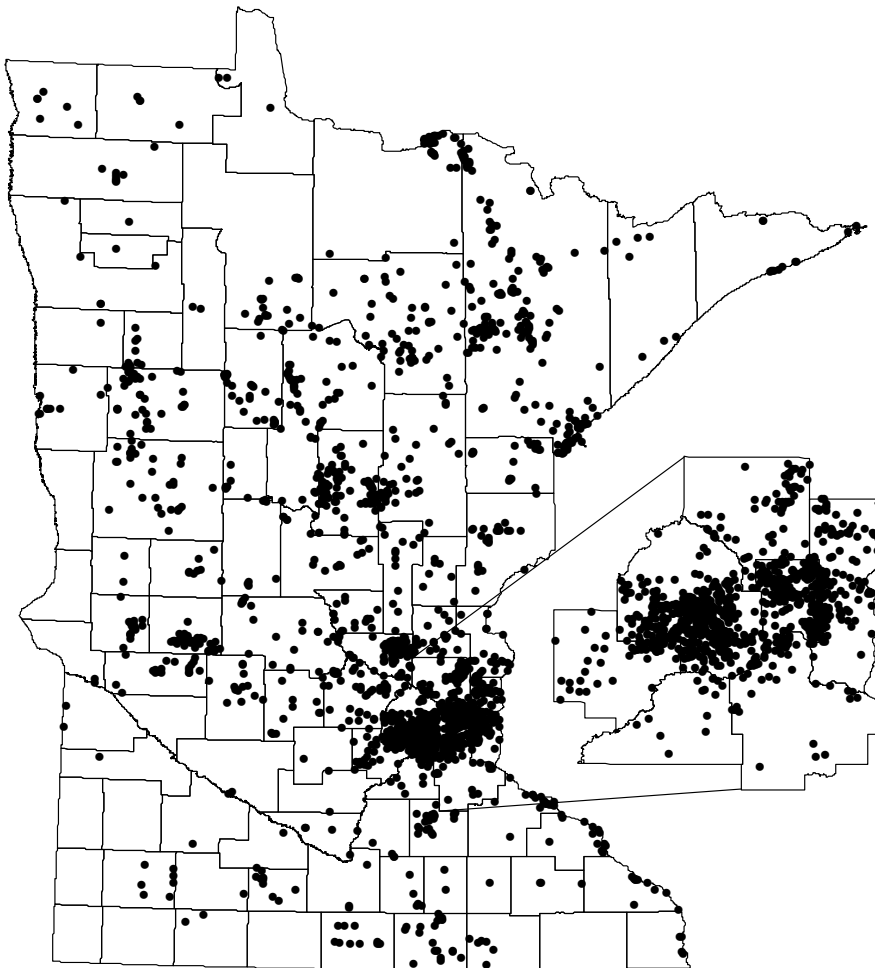


Figure 15. Purple loosestrife infestations in Minnesota as of December 2007.

Table 17. Purple loosestrife infestations in Minnesota recorded by the DNR in 2006 and 2007.

Site Type	Total sites 2006	New sites 2007	<u>Total sites 2007</u>
Lake	702	9	711
River	219	4	223
Wetland	739	15	754
Roadsides and ditches	503	2	505
Other ¹	165	0	165
Total	2328	30	2358

¹Includes gardens and other miscellaneous sites.

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

Research by the University of Minnesota, under contract to the DNR, demonstrated that long-established stands of loosestrife develop very large and persistent seed banks (Welling and Becker 1990). Herbicide treatments kill the existing loosestrife population only, creating space for additional seeds to sprout. Consequently, small and recently established populations of loosestrife, which are likely to have small seed banks, are given the highest priority for treatment. In addition, because seeds of this species are dispersed by water movements, the DNR tries to keep loosestrife from infesting downstream lakes. Sites located in the upper reaches of watersheds with small loosestrife infestations are treated before those located in watersheds with large amounts of loosestrife. Implementation of the prioritization scheme in 1991 resulted in fewer large sites (> 1,000 plants) being treated.

Between 1989 and 2007, the number of sites, number of plants, and total cost of treating purple loosestrife with herbicide has generally decreased (Table 18). 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 2007, only DNR staff was used to treat purple loosestrife stands statewide. DNR staff visited 57 purple loosestrife stands for herbicide control work (Figure 14, Table 18). At two sites, workers found no loosestrife plants to treat. A total of 55 sites were treated with herbicides. Most of the sites were very small: 92% had fewer than 100 plants. Ten purple loosestrife plants were hand-pulled from three locations. This work took a total of 510 worker hours, and only 1.1 gallons of Rodeo. The total cost for this effort was \$12,400.

Effectiveness of chemical control

Effectiveness of control efforts will be based on short-term and long-term objectives. Control or eradication of small infestations statewide with herbicides is the primary short-term objective. Each year, a small number of purple loosestrife infestations (two in 2007) 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 18. Historical herbicide applications performed by DNR and applicators contracted by DNR in Minnesota (1989-2007).

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

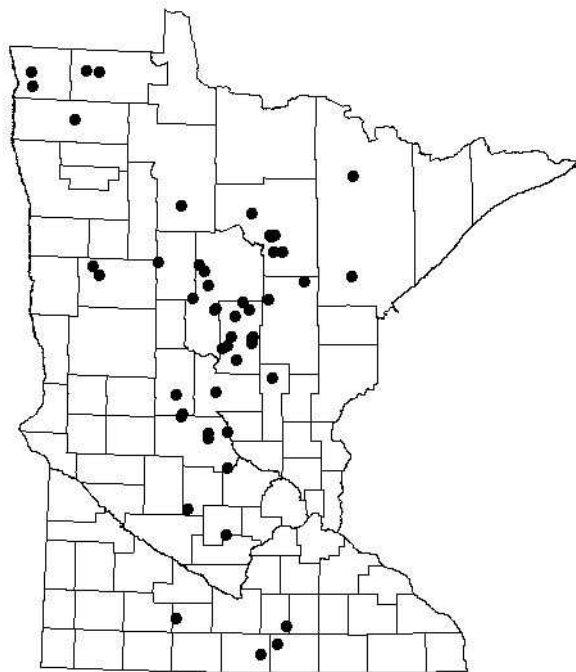


Figure 16. Locations where DNR staff used herbicides to control purple loosestrife in 2007.

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 californiensis* and *G. pusilla*; a root-boring weevil, *Hylobius transversovittatus*; and a flower-feeding weevil, *Nanophyes marmoratus*, have been released as potential biological controls for loosestrife in Minnesota.

Leaf-Eating Beetles: In 1997, the DNR initiated an insect rearing program by providing county agricultural inspectors, MDA field staff, 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 2007, this cooperative effort has had a significant effect on total number of insects released (Figure 15).

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 2007, an estimated 31,216 leaf-eating beetles were collected and released on 29 sites. To date, the leaf-eating beetles have been released on 824 sites statewide (see Figure 16, Table 19).

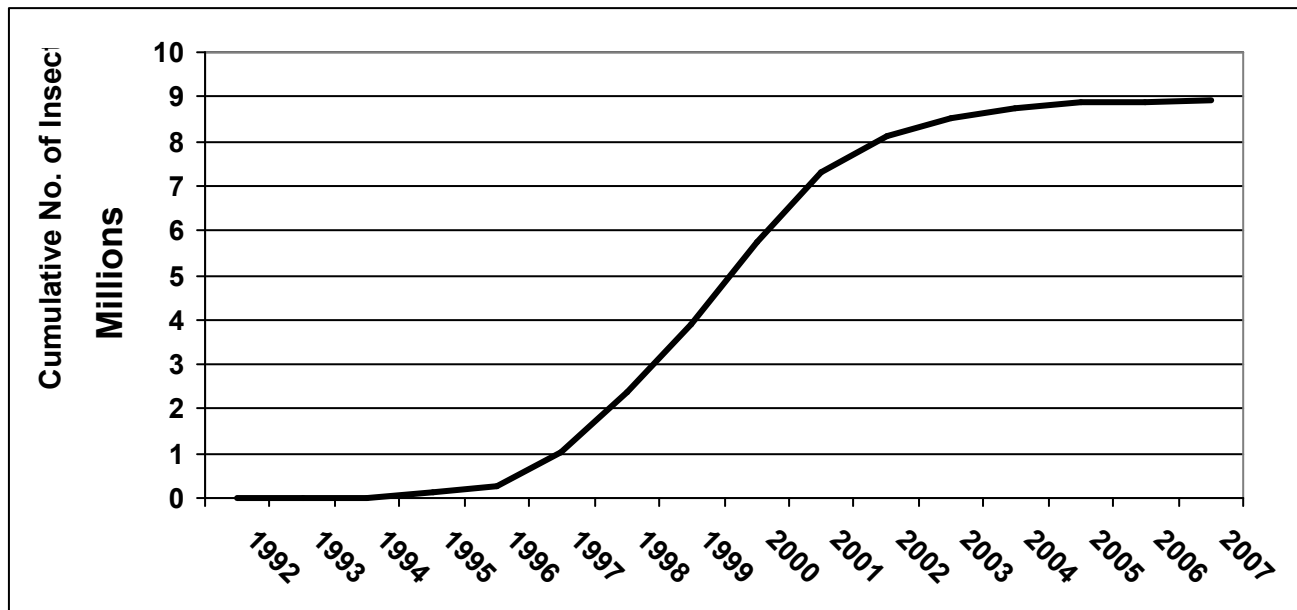


Figure 17. Cumulative number of insects released to control purple loosestrife by year.

Table 19. Summary of number of insects released in each region to control purple loosestrife (1992-2007).

Minnesota DNR Regions	Number of Release Sites	Number of Insects Released
1 – Northwest	133	1,361,560
2 – Northeast	214	1,622,503
3 – Central	412	5,187,832
4 – South	65	705,304
Totals	824	8,877,199

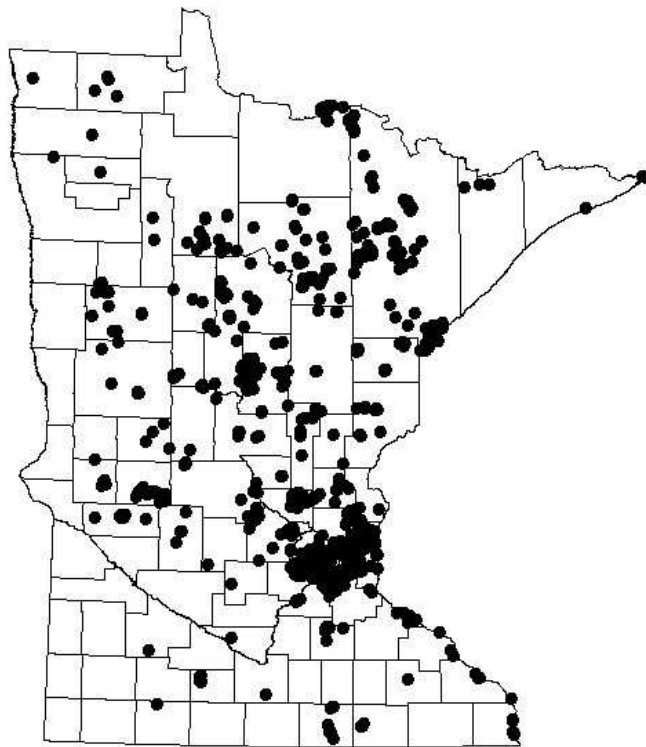
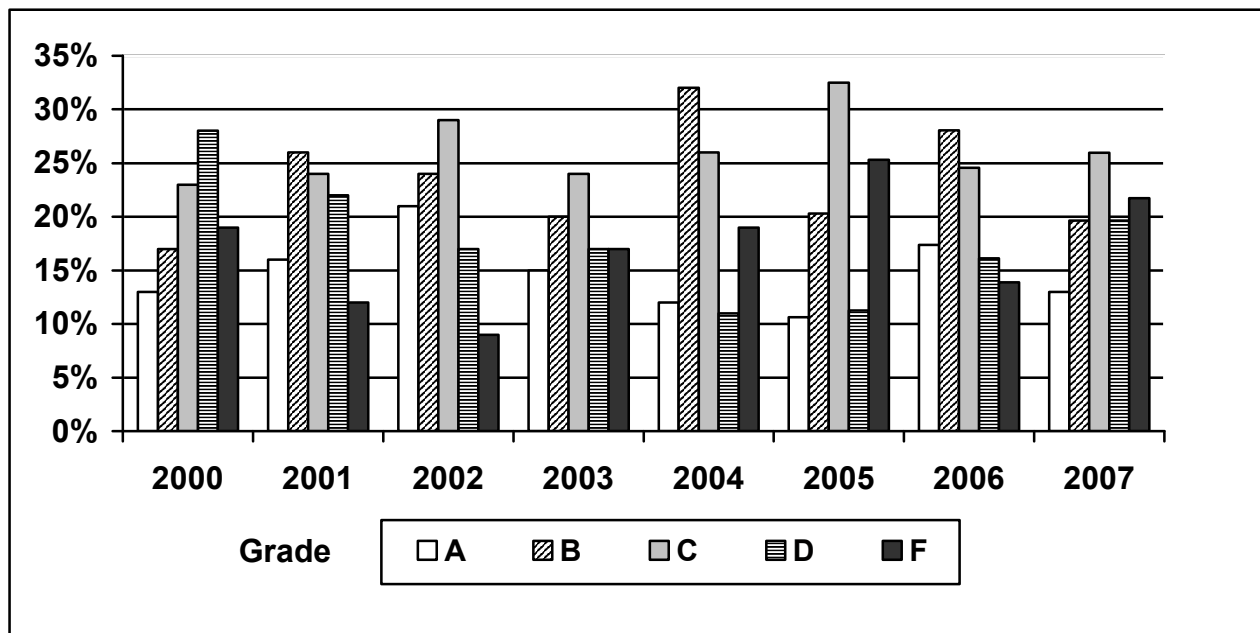


Figure 18. Locations of insects released to control purple loosestrife in Minnesota through 2007.

Biological control insects released between 1992 and 2007 have established reproducing populations at more than 84% of the sites visited. Insect populations increased significantly at many locations with pronounced damage to loosestrife plants. In the summer of 2007, 331 insect release sites were assessed for insect establishment and level of control achieved. At 78% (259 sites) of the sites surveyed, insect populations were increasing and causing damage to the loosestrife infestations. At 12% (43 sites) of all visited sites, the loosestrife was severely defoliated (90-100%) (Figure 17).

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 2007 demonstrated that *Galerucella* introductions have caused moderate to severe defoliation of loosestrife populations on 58% (194 sites) of 331 sites visited in 2007 (Figure 17).



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 19. 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. californiensis* 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

Three research projects at the University of Minnesota were completed in the spring of 2007 to 1) evaluate monitoring techniques; 2) monitor agent establishment and control success; and 3) test cold hardiness of leaf-beetles.

University of Minnesota graduate student, Michele Yoder, completed her Master's thesis in the spring of 2007 where she assessed the establishment of purple loosestrife biological control agents. Mrs. Yoder's research topics included 1) evaluating monitoring techniques; 2) monitoring agent establishment and control success; and 3) testing cold hardiness of leaf-beetles.

Evaluating monitoring techniques. Accurately determining species composition is important in understanding the role each species plays in controlling purple loosestrife. The objective of this study was to test two relative sampling methods, hand collecting and pheromone trapping, for their ability to accurately estimate *Galerucella* spp. species ratios in the field. In 2005 and 2006, experiments were conducted in nine purple loosestrife infestations to test the sampling techniques when over-wintering adults (collected May-June) and F₁ adults (collected July-August) were present. Initial results from 2005 indicated that pheromone traps captured 25% more *G. californiensis* than hand collections. However, pheromone trap data combined over the two-year period showed no bias toward *G. californiensis* when compared to hand sampling. *Galerucella* species ratios from pheromone trap sampling were not significantly different between over-wintered and F₁ adults. As part of a post-release monitoring program, both sampling methods accurately estimate species composition and can provide important information in determining the role each *Galerucella* spp. plays in biological control of purple loosestrife.

Monitoring Galerucella spp. establishment. Post-release monitoring of biological control agents is important in understanding factors that affect their establishment and the successful control of the targeted pest. This three-year statewide study (2004-2006) was conducted to assess the establishment of *G. californiensis* and *G. pusilla* in Minnesota and to identify environmental factors that might favor one *Galerucella* spp. over the other. *Galerucella* spp. were collected from 137 sites throughout Minnesota. There are significantly more *G. californiensis* in sites located in the north, and a predominance of *G. pusilla* in southern locations. Water level was found to affect the rearing success of both species on potted purple loosestrife plants. In further experimentation, *G. pusilla* seems to tolerate more saturated pupation sites than *G. californiensis*. Understanding how different environmental factors affect *Galerucella* spp. establishment and control of purple loosestrife will foster development of release protocols for specific site characteristics to maximize successful control of this invasive perennial weed.

Cold hardiness of Galerucella spp. Insects utilize different cold hardiness strategies for survival at low temperatures during winter conditions. Successful control of purple loosestrife over its extensive northern range, including Minnesota, will depend on the two species' ability to withstand extreme cold temperatures. We investigated the supercooling point (SCP) or the point at which the insect will spontaneously freeze to help understand the limitations on establishment for *Galerucella* spp. The overall mean (\pm SE) SCP for *G. californiensis* males and females were $-14.4 \pm 0.4^{\circ}\text{C}$, while the mean SCP for *G. pusilla* males and females are $14. \pm 0.3^{\circ}\text{C}$ and $-13.4 \pm 0.4^{\circ}\text{C}$, respectively. Researchers also investigated the effects of long-term exposure to low temperatures on beetle mortality to understand their tolerance to cold temperatures above the SCP. Cold-acclimated beetles showed little mortality throughout the duration (6-40 days) of the experiment at all temperatures tested (at -12 , -6 , and 0°C). End survival rates

ranged from 60 to 98% throughout the experiment. These studies show that *G. calmariensis* and *G. pusilla* have very similar abilities to withstand cold temperatures, typical of purple loosestrife's northern range in North America.

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 ongoing efforts. The species listed in Table 20 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.

Brittle Naiad (*Najas minor*)

Brittle naiad was first noted in Minnesota in 2001 in Lac Lavon, a small lake in Dakota County. It has not been found in any other Minnesota lakes since that time. Brittle naiad resembles the Minnesota rare species spiny naiad (*Najas marina*), but unlike *N. marina* it is not native to Minnesota. Brittle naiad is native to Europe and was first reported in the United States in the Hudson River in 1934 (McFarland et al., 1998).

Brittle naiad spreads by seeds carried on plant fragments. The primary means of reproduction in brittle naiad is by seed, and it is highly fertile (McFarland et al., 1998). During the late summer or early fall, the stems of brittle naiad become brittle, and the top portions of the stem break into small fragments. Seeds remain attached in the leaf axils of these fragments, and the fragments are dispersed by water currents (U.S. Army Corps of Engineers, 2002). In 2007, brittle naiad occurred at 29% frequency in Lac Lavon. (Wendy Crowell DNR, unpublished data, 2007).

Brittle naiad can be a severe nuisance in shallow water but does not generally cause problems in deeper water. Brittle naiad grows to about four feet in height, and has stems that are profusely branched toward the top of the plant. In shallow water, brittle naiad can grow so densely it can completely clog the water column, which can result in negative impacts to native aquatic plants and recreation (Vermont Agency of Natural Resources and The Nature Conservancy of Vermont, 1998, U.S. Army Corps of Engineers, 2002). In deeper water, brittle naiad may become abundant but not cause nuisances. In 2007, in Lac Lavon brittle naiad formed dense stands near the bottom of the lake in several areas. Because of the water depth these stands did not cause a nuisance (Wendy Crowell DNR, unpublished data, 2007).

In 2007, brittle naiad was classified as a *prohibited invasive species*, and waters infested with the species are designated *infested waters* (M.R. 6216).

Brazilian elodea (*Egeria densa*)

Brazilian elodea, an invasive, non-native aquatic plant new to Minnesota waters, was discovered in Powderhorn Lake in south Minneapolis at the end of August 2007. The plant was noticed by a limnologist with the Minneapolis Park and Recreation Board, who surveyed the aquatic vegetation in the lake. Brazilian elodea is similar in appearance to Canada waterweed, *Elodea canadensis*. Brazilian elodea is a submersed, freshwater perennial aquatic plant native to Brazil, Argentina, and Uruguay (McFarland et al. 1998).

It is suspected that someone may have dumped the contents of an aquarium, including the Brazilian elodea, which is widely sold in the aquarium trade, into the lake. Goldfish, which are commonly sold in the aquarium trade and are not native to Minnesota, also have been seen in Powderhorn Lake. This observation suggests that past aquarium releases have occurred there. Brazilian elodea also has been reported as an un-ordered or incidental receipt in a shipment of plants purchased by Maki and Galatowitsch (2004) for a study of invasive aquatic plants moving into Minnesota through the horticultural trade. For more information about options for disposal of aquarium plants and pets, please visit: www.dnr.state.mn.us/habitattitude/index.html.

Only male Brazilian elodea plants are present in the United States, so reproduction occurs by fragmentation. This plant grows in lakes, ponds, and streams of 31 states including New York, Illinois, Kansas, and Washington. The potential for Brazilian elodea to invade Minnesota waters was evaluated by the U.S. Army Corps of Engineers Aquatic Plant Control Research Program almost ten years ago (McFarland et al. 1998). Using a simulation model, CLIMEX, they estimated the likelihood that the plant would become established in the state if it was released to be low or marginal. Unfortunately, Brazilian elodea appears to be well established in Powderhorn Lake. In early September, the lake was inspected by the DNR and Brazilian elodea was found to be widely distributed and abundant in a few small areas. It seems highly unlikely that the plant could have been introduced into the lake during 2007 and subsequently spread so far and grown so much biomass during the same season. The wide distribution of the plant suggests that Brazilian elodea likely was introduced before the summer of 2007 and probably survived at least one winter, if not more.

Brazilian elodea can cause problems similar to those caused by Eurasian watermilfoil and other invasive aquatic plants. These problems result when the invasive plant produces mats at the water's surface and interferes with activities such as boating and swimming, as well as displacement of native plants. To date, Brazilian elodea has become abundant in other states or areas where climates are milder than Minnesota's. Brazilian elodea senesces in the fall and over winters in an evergreen state near the lake bottom.

It is important to limit the spread of Brazilian elodea 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 applied herbicide to the Brazilian elodea in Powderhorn Lake during October. Inspection of the lake next spring will indicate whether this effort was successful.

In 2007, permanent Minnesota rules were adopted that classified Brazilian elodea as a *regulated invasive species* (see Risk Assessment and Risk Management).

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Table 20. Other Aquatic Invasive Plant Species in Minnesota.

Species	Status	Legal Status	Last annual report to include info on this species
Yellow iris (<i>Iris pseudacorus</i>)	Commonly sold; public education has focused on preventing people from planting it in natural water bodies.	Regulated	2002
Hardy hybrid water lily (<i>Nymphaea</i> spp. hybrid)	Four known wild populations in Minnesota. One new location found in 2007.	Regulated	2004
Water lettuce (<i>Pistia stratiotes</i>)	Plants found in the wild in 2007.	Unlisted	2001
Reed canary-grass (<i>Phalaris arundinacea</i>)	Widespread in Minnesota.	Unlisted	2004
Salt cedar (<i>Tamarix ramosissima</i>)	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 (<i>Phragmites australis</i> ssp. <i>australis</i>)	Only a few known populations in the state; distribution information is lacking.	Unlisted	

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. A combination of State Wildlife Grant, General fund and Heritage Enhancement funding totaling \$365,000 was available to DNR land managers from January 2006-June 2007 and \$435,660 will be awarded to DNR land managers from October 2007-June 30, 2008. The overall goal of this project is to improve and/or protect habitats of wildlife species in greatest conservation need 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 Operations Order; and 3) planning and implementation of invasive plant management efforts.

Outcome Report 2006 Granting Cycle:

Four divisions in FY06/07 completed 31 management grant projects (Table 21). Some of these projects were initiated in FY05/06, but completed in FY06/07. These projects implemented treatment or inventory for more than seven different invasive plant species. The 31 funded grant projects accomplished management at 74 locations and inventoried over 3,670 invasive species plant locations.

Thirty-one projects were funded, totaling \$349,000, for the management of terrestrial invasive plant species on state managed lands. The funded proposals included 18 proposals for controlling invasive plants, four proposals for invasive plant inventories, and 10 proposals to do both (inventories and control). Most projects were initiated in FY05 but completed in FY06. During FY06, \$221,000 was spent on control, management and inventory work on DNR-managed state lands.

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 21). 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 2008:

In the current 2007-2008 grant cycle, 46 proposals totaling more than \$642,500 were submitted for funding in response to a request for proposal for terrestrial invasive plant management. Thirty-seven projects were funded, totaling \$435,660, for the management of terrestrial invasive plant species on state-managed lands (Table 22). The funded proposals included 18 proposals for controlling invasive plants, four proposals for invasive plant inventories, and ten proposals to do both inventories and control.

Table 21. Overview of the outcomes of funded terrestrial invasive plant inventory/management projects FY06-07.

Division/Section	Number of Projects	Inventory	Acres	Management and Control	Acres
Fisheries	3	<ul style="list-style-type: none"> Invasive species inventory 	46	<ul style="list-style-type: none"> Buckthorn control (2) 	37
Forestry	6	<ul style="list-style-type: none"> Invasive species inventory 	1,500	<ul style="list-style-type: none"> Buckthorn control (4) Garlic mustard control (2) 	182
Parks	13	<ul style="list-style-type: none"> Invasive species inventory and mapping (part of 6 projects) 	245	<ul style="list-style-type: none"> Primarily woody invasives control (buckthorn, honeysuckle, Siberian elm, caryana); Some Canada thistle, spotted knapweed and garlic mustard control 	544
Trails and Waterways	4	<ul style="list-style-type: none"> Invasive species inventory 	32	<ul style="list-style-type: none"> Buckthorn control (2) Tansy control (1) Leafy spurge and spotted knapweed control Canada thistle control (1) 	52
Wildlife	5	<ul style="list-style-type: none"> Invasive species inventory (2) 	22,855	<ul style="list-style-type: none"> Woody invasives control (2) Bio-control (17 locations) 	1,882
TOTAL	31		24,678		2,697

Table 22. Funded terrestrial invasive plant inventory/management projects FY07.

Division/Section	Number of Projects	Project Type	Subtotal
Forestry	4	<ul style="list-style-type: none"> Buckthorn control (2) Invasives inventory and purchase of inventory equipment (2) 	\$ 32,000
Parks	21	<ul style="list-style-type: none"> Primarily woody invasives control (buckthorn, honeysuckle, Siberian elm, caryana); some Canada thistle, spotted knapweed and garlic mustard control Invasives mapping and equipment purchase part of 10 projects 	\$ 130,260
Trails and Waterways	2	<ul style="list-style-type: none"> Buckthorn control (1) Tansy control, leafy spurge and spotted knapweed control (1) 	\$ 33,000
Wildlife	6	<ul style="list-style-type: none"> Mainly invasive species control Invasives inventory a part of (2) 	\$ 128,900
Ecological Resources	4	<ul style="list-style-type: none"> Invasives inventory and equipment a part of (3) Invasive species control (2) 	\$ 111,500
TOTAL	37		\$ 435,660

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, 2008. Results of the management and inventory efforts from the current grant cycle will be provided in the 2008 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. Please see discussion on the Invasive Species Operations Order in the Risk Assessment/Risk Management section of this report.

Inventory

Using standardized protocols developed by the DNR, 15,000 locations of invasive plant species on state-managed lands have already been mapped using GPS/GIS technologies (Figure 18). This includes surveys conducted in over 20 state parks, 160 wildlife management areas, and along 160 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

Seven, one-day workshops entitled "Invasive Plants of Minnesota Forests: information and educational tools for professionals" were held in Grand Rapids, Detroit Lakes, Bemidji, Duluth, St. Cloud, Brainerd, and Wabasha. The workshops were designed to help foresters and resource managers become familiar with resource materials and management techniques used to control invasive species and introduce the Invasive Species Operations Order. 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.

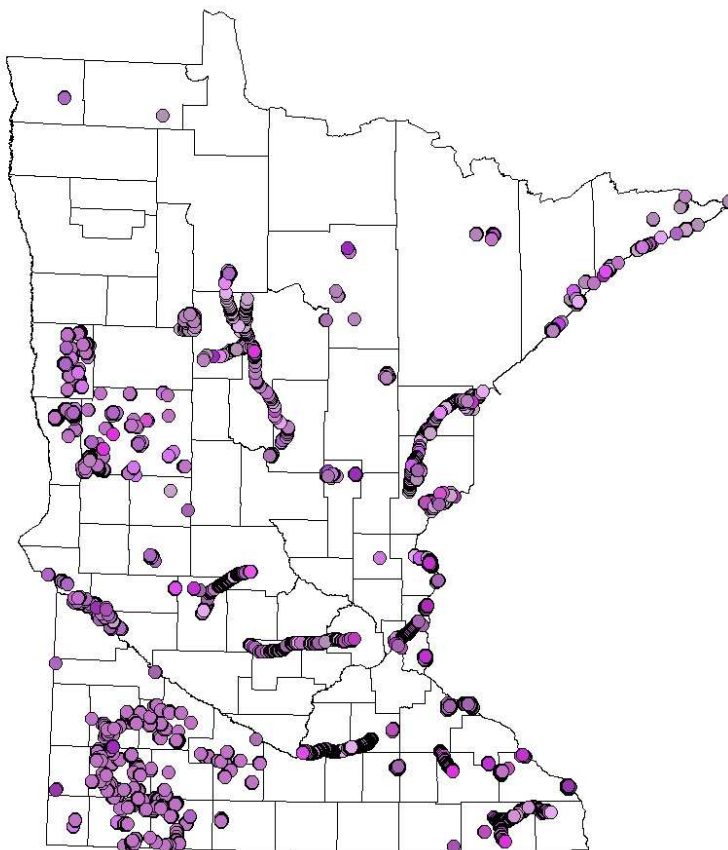


Figure 20. Terrestrial invasive plant inventories (all species), 2007.

Highlights of the workshop 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 Operations 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.

The workshop focused on the most common Minnesota invasive species: common and glossy buckthorn, exotic honeysuckles, garlic mustard, spotted knapweed, leafy spurge, and other invasive plants.

The workshops were funded by a Minnesota DNR Forest Stewardship grant (funding from Forestry and Ecological Resources) to the Institute of Agriculture and Trade Policy

(IATP). The workshops were planned and carried out in conjunction with the Minnesota DNR Invasive Species Program. IATP's Community Forestry Resource Center and Ann Pierce, DNR Invasive Species Program, lead the all-day session with both classroom and field components. The Division of Forestry Regional Forest Health Specialist presented information on forest insect and diseases and a representative from the Division of Parks helped present portions of each program. A total of 210 people participated in the seven workshops. Most of the participants were DNR staff from Forestry, Wildlife, Parks, Ecological Resources, and Trails and Waterways. The remaining participants were county foresters, Natural Resources Conservation Service and Soil and Water Conservation District staff, Red Lake and White Earth Tribal staff, and others.

The next step will be to work with the participants to put on their own workshops or presentations at meetings.

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.

Canada Thistle Research

The Canada thistle research was carried out under contract with the University of Minnesota. University scientists conducted the research in cooperation with DNR Wildlife staff from the Talcot Area office. Sites used for testing the BMPs included the West Graham Wildlife Management Area and Timber Lake U.S. Fish and Wildlife Service Waterfowl Protection Area. These BMPs were designed to balance the needs of managing wildlife habitat, to benefit desired native prairie species, and to decrease or eliminate the presence of Canada thistle. Clopyralid (Transline formulated product) is used because clopyralid is the most effective product on Canada thistle and offers non-target forb tolerance. To date, data indicate that spot treatment may not be feasible, and mowing two times per season would likely result in inadequate control of Canada thistle. Clopyralid application at labeled rates in the pre-bud stage provided good control. However, early season herbicide applications may harm nesting and survival of desired waterfowl. Waiting until after July 15 resulted in higher levels of Canada thistle. Below label rates of clopyralid, that would provide a greater margin of safety for sensitive forbs, did not control Canada thistle. Fall application of transline provided good control with minimal impact to native forbs. The current recommendation is to treat Canada thistle in the fall (when feasible).

Buckthorn Biological Control Research

Research in Europe. The DNR has initiated a research project on biological control of European buckthorn, conducted by the Center for Applied Bioscience International in Switzerland (CABI). 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 the state of 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 developed for submission to USDA-APHIS to allow state agencies to field release *C. scrobicollis* in the United States.

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.

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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 also 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.

At present, no populations of Asian carp are known to have established in Minnesota. 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 19). It is the second bighead carp caught in Lake Pepin. The closest known 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.



Figure 21. Bighead carp caught by commercial fisherman in Lake Pepin in 2007.

Progress in Management of Asian Carp - 2007

- DNR prepared a plan “Preventing the Introduction of Asian carp into Minnesota” and made it available to the public and chairs of Legislative Environment Committees on November 1, 2007. It can be downloaded at this Web page: www.dnr.state.mn.us/invasives/aquaticanimals/asiancarp/index.html. The prevention plan 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. The plan describes ongoing and new strategies to address those pathways.
- The DNR continued to work with the Minnesota Congressional Delegation 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 desires to have fish barriers installed in conjunction with one Mississippi River lock and dam such as Lock and Dam 11 (see Figure 20).
- The Water Resources Development Act was passed by Congress in fall of 2007. It calls for the U.S. Army Corps of Engineers 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.” The act also authorizes \$4 million for the project, although Congress has not appropriated funds to carry out the project.
- A new state law became effective on August 1, 2007 that requires anglers to report to DNR if they catch an Asian carp.

- DNR issued a press release on August 7, 2007 that encouraged the public to report catches or sightings of the fish in Minnesota waters and one report was called in to the Invasive Species Program on September 27. That report was of numerous jumping minnows in the Mississippi River. Metro Fisheries staff followed up and determined they were native gizzard shad, emerald shiners, and unidentified shiners. A second report occurred on October 3 when a bighead carp was caught in Lake Pepin by a commercial fisherman.

Participation of Others

Federal Regulations-Injurious Wildlife

The USFWS began a process in 2002 to determine if it will list black carp as an injurious wildlife species. A similar process was initiated in 2003 to determine if bighead and silver carp should be listed as injurious wildlife species. On July 10, 2007, USFWS published a notice that it had listed silver and large-scale silver carp as injurious wildlife. On October 18, 2007, USFWS published a notice in the *Federal Register* that it had listed black carp as injurious wildlife. As of December 2007, the USFWS has not designated bighead carp as injurious wildlife.

National Asian Carp Management and Control Plan

The USFWS formed an Asian Carp Work Group (ACWG) to develop a national Asian Carp Management and Control Plan. In November 2007, the Federal Aquatic Nuisance Species Task Force approved the final plan titled, *Management and Control Plan for Bighead, Black, Grass, and Silver Carps in the United States*. It is available at: www.anstaskforce.gov/Documents/Asian_Carp_Final.pdf.

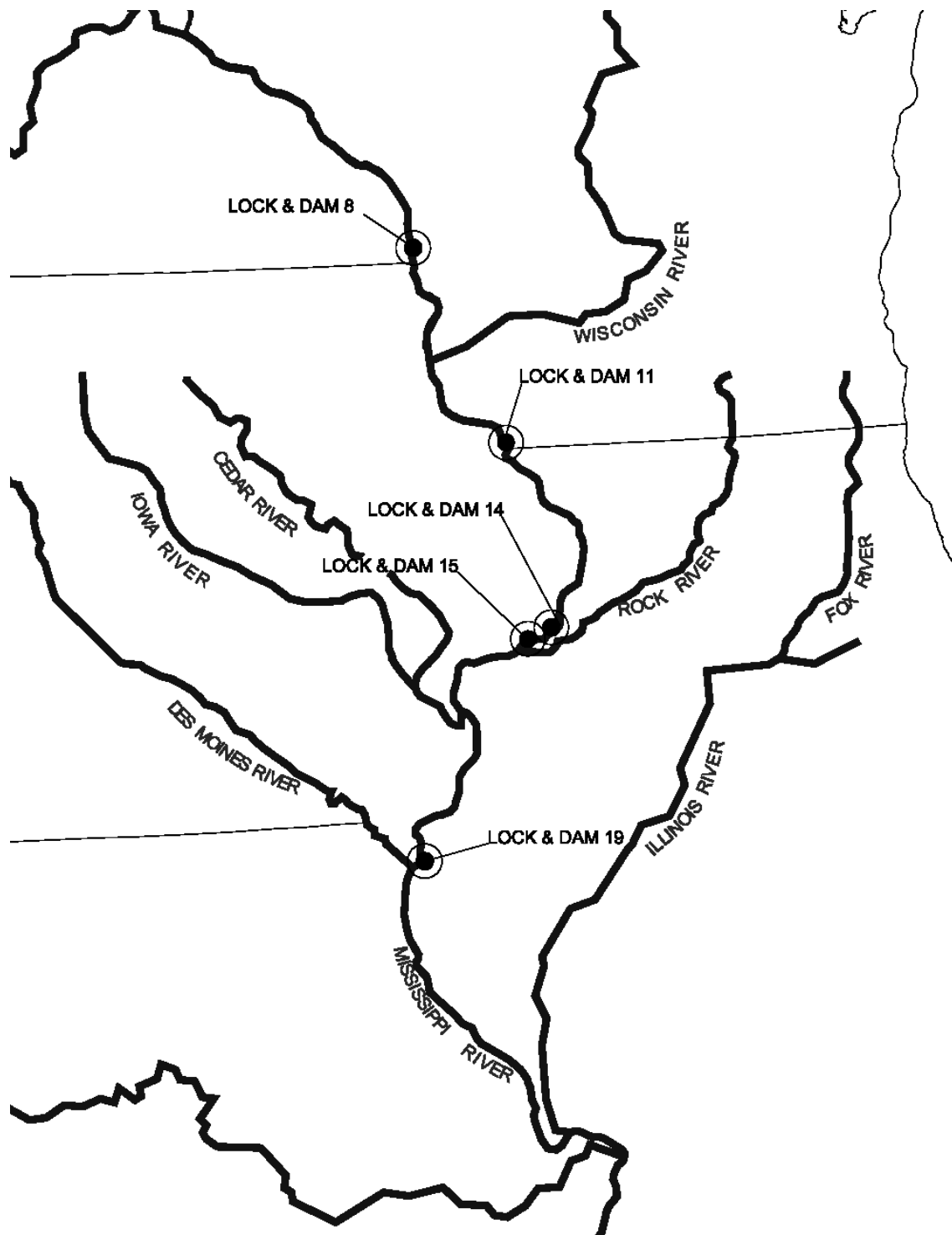


Figure 22. Locations of selected locks and dams on the Mississippi River.

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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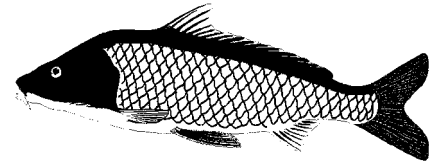
FishPro Consulting Engineers and Scientists. 2004. Feasibility Study to Limit the Invasion of Asian Carp into the Upper Mississippi River Basin (Final Report - March 15, 2004). Prepared for the Minnesota DNR in cooperation with the Wisconsin DNR and the U.S. Fish and Wildlife Service (Region 3). Available at: www.dnr.state.mn.us/invasives/aquaticanimals/asiancarp/index.html.

Management of Common Carp

Introduction

Issue

Common carp (*Cyprinus carpio*) were intentionally introduced into Minnesota waters before 1900. They remained relatively unnoticed as a threat to environmental quality until after the drought of the 1930s. The drought caused many wetlands and wetland areas around lakes to dry up and set the stage for an explosion of aquatic vegetation and invertebrates. The early wetland drainage efforts also provided connections into many wetlands and shallow lakes previously inaccessible to fish. With the recovery of precipitation and subsequent increase in water levels in wetlands, lakes, and streams, the common carp found an abundance of food and spawning habitat. As early as the 1940s, carp had noticeably damaged aquatic habitat in famous waterfowl lakes such as Heron Lake in southwestern Minnesota. By the 1960s, common carp were recognized as a major factor in the deterioration of aquatic habitat across southern Minnesota. 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. Their feeding activity disrupts shallowly rooted plants and suspends bottom sediments in the water column. In addition, their consumption of invertebrates translocates nutrients from invertebrates into the water column. Carp have high metabolic and growth rates and their excretion contributes to internal nutrient loading in a lake. 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 eliminate competition from fish that do, including those that would prey on young carp.

Common carp are a carrier of a new disease in the state, spring viremia of carp. All *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 - 2007

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 100 shallow lakes by DNR Wildlife and Ecological Resources staff in 2007. 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 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 2007. New barriers are planned on several lakes and wetlands including Augusta Lake in Cottonwood County and Fulda Lake in Murray 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, 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 lakewide Rotenone treatment was done in fall 2006. In 2007, water levels remained low until fall and no carp have been found post-treatment test netting.

In 2007, 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 through the summer. Rotenone was used in refuge areas under the ice in the winter of 2007 at Lake Maria. A planned rotenone treatment on Lake Geneva has been postponed due to high water levels.

In 2007, additional drawdowns to control carp were also conducted on several other lakes and wetlands across the state including North and South Badger Lakes in Murray County and August Lake in Cottonwood County.

Research

In 2005, the LCMR recommended and the Legislature provided additional funding of \$550,000 for a project titled "Integrated and Pheromonal Control of Common Carp." This funding will allow Dr. Sorensen, University of Minnesota, to continue research on common carp management during FY 06-09. The DNR is a partner on the proposed

project and will contribute staff and equipment from DNR Fisheries and \$60,000 over a three-year period from the Invasive Species Program. This project initiated work this year on three objectives: 1) to develop sensory attractants for female common carp so that efforts might focus on their removal via trapping; 2) to elucidate spawning habitat preferences of wild common carp in Minnesota so that their spawning habitats, and young, might also be targeted for removal; and 3) to develop a population dynamics model to explore how best to control local populations of common carp. It is hoped that the findings will allow development of an integrated approach to carp management. Dr. Sorensen reported the following regarding his lab's research in their July 2007 report to DNR (Sorensen, Bajer, and Brown 2007):

“Briefly, preliminary analysis of 40 otoliths from four lakes suggests that these otoliths will be somewhat difficult to age precisely although many options for improvement exist. Nevertheless, limited though it is, data from these 200 suggest that recruitment of carp is surprisingly sporadic in Minnesota and therefore amenable to control. Otolith data also clearly demonstrate carp grow rapidly in our waters with males exhibiting similar growth rates as females. Finally, Minnesota carp are very long lived in Minnesota (>50 years); it seems reasonable to remove such large fish because of the enormous damage they inflict. A scheme is proposed for further aging.”

Effectiveness of Carp Management

Common carp management has been only moderately effective in all types of waters within Minnesota, which is why more 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. Participation on common carp management projects often includes Ducks Unlimited, Minnesota Waterfowl Association, USFWS, DNR Fisheries, and local lake associations.

Future needs for management of common carp

- Continue support for funding of research related to: the use of pheromones, 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 8 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 2007. 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 eight locations in the state. A total of 10 birds were reported in the wild in seven counties (Table 23). Sources of the reports include: conservation officers, birders, the public, and other DNR staff who observed unconfined birds.

Progress in Management of Mute Swans - 2007

During 2007, DNR conservation officers removed three mute swans from the wild in Anoka County and one at Big Carnelian Lake in Washington County.

Table 23. Unconfined mute swans reported in Minnesota counties during 2007.

County	Number of Mute Swans Reported	Months Reported
Anoka	2 - small roadside pond in Coon Rapids 1 - Columbus Township	September (2) November (1)
Blue Earth	2 - unspecified location	August (2)
Fillmore	1 – unspecified location	May (1)
Meeker	1 - Pigeon Lake	April (1)
Scott	1 - Minnesota Valley Nat'l Wildlife Refuge	November (1)
Swift	1 - Lake Hassel	June (1)
Washington	1 - Big Carnelian Lake	October (1)
Total for all counties	10	

Future needs for management of mute swans

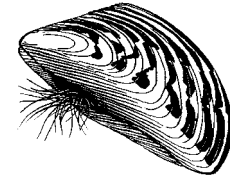
- Encourage reporting and verify occurrences of mute swans in the state.
- Take appropriate actions to have the birds confined under game farm licenses or remove the birds from the wild.
- Develop and distribute informational materials about mute swans and related state and federal laws.

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 - 2007

Monitoring

New Infestations: In September 2007, staff from the St. Paul Regional Water Services (SPRWS) pumping plant on Vadnais Lake reported finding some zebra mussels on a screen at their plant. Vadnais Lake is part of a four-lake chain that serves as SPRWS reservoir system. Water is pumped from the Mississippi River, enters Charley, then Pleasant, Sucker, and finally Vadnais before being pumped to the treatment plant. After confirming the identification, DNR biologists surveyed shorelines along Sucker Lake, north of Vadnais. Scattered small young-of-the-year zebra mussels were found attached to rocks and concrete canal walls on the north end of Sucker, where conduits from Pleasant Lake enter Sucker Lake. Additional finds were made on the north shore of Sucker Lake, and midway in a canal connecting Sucker and Vadnais. A final

Distribution Figures 23 and 24.

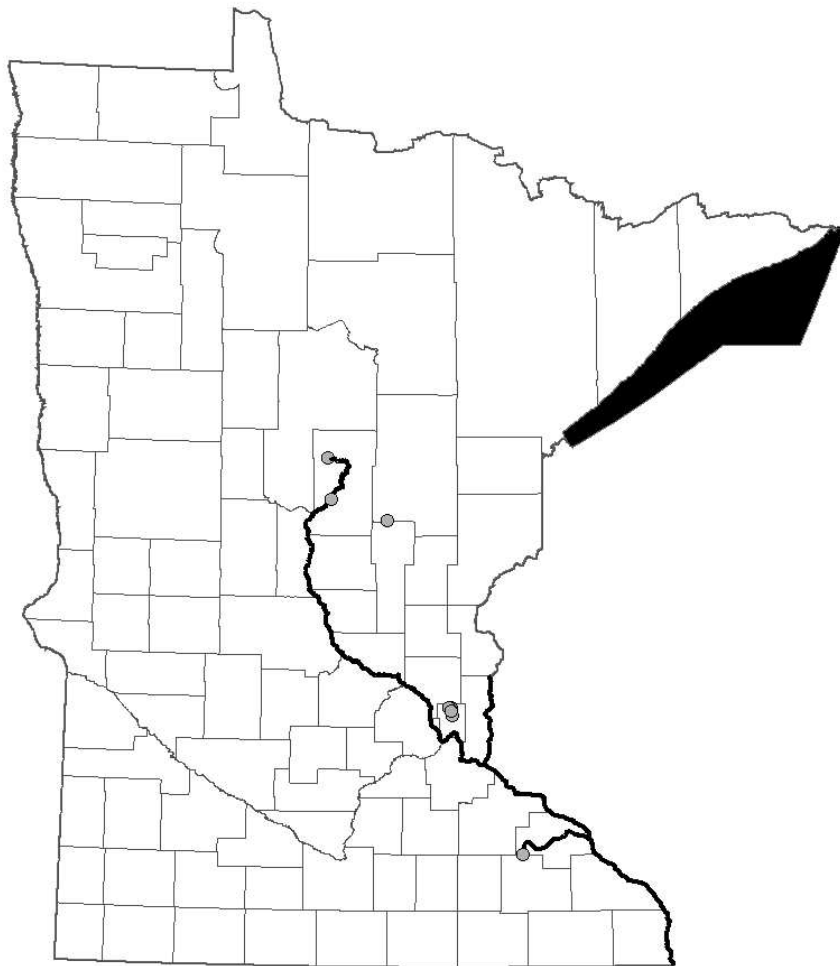


Figure 23. Zebra mussel infestations in Minnesota recorded by the DNR. Gray dots indicate inland lakes; bold black lines indicate infested river areas and Lake Superior.

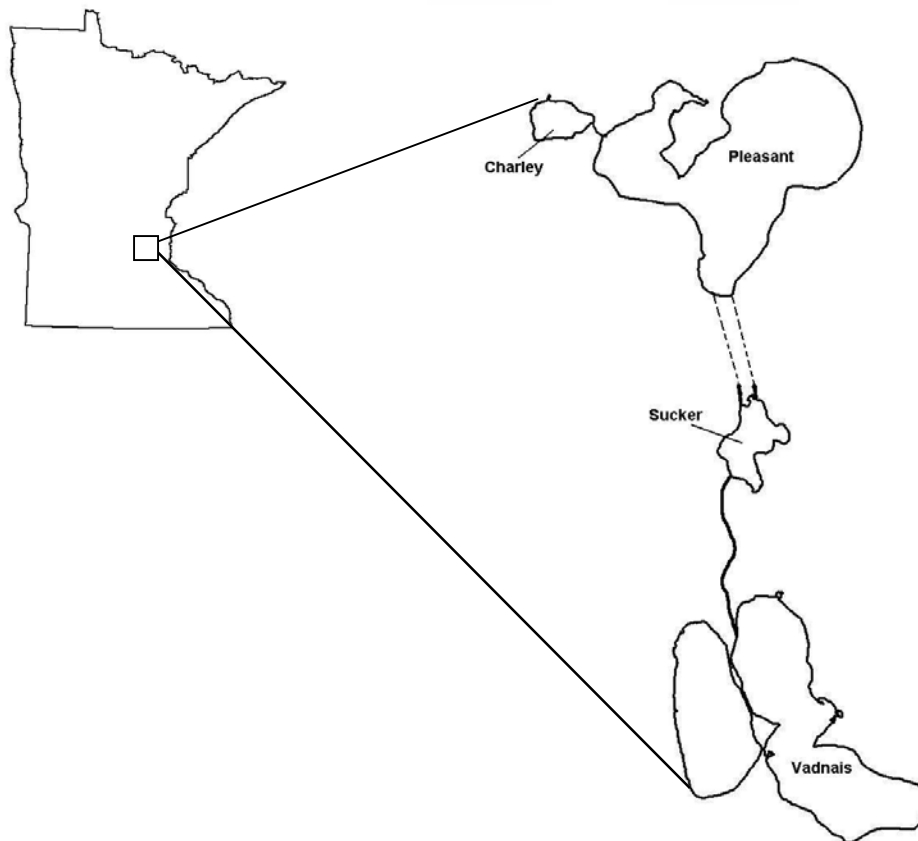


Figure 24. The four-lake chain in Ramsey County where zebra mussels were found in 2007.

discovery by SPRWS found two mussels attached to monitoring equipment in Pleasant Lake. On the basis of these discoveries, all the lakes in this chain were listed as infested. Shoreline surveys were also done on Snail Lake, which receives water pumped from Sucker Lake to maintain water levels. However, no zebra mussels were found in the search in Snail Lake.

The findings represent a setback in the cooperative efforts of the SPRWS and DNR to prevent movement of zebra mussels. After consultation with biologists, SPRWS had been treating water pumped from the Mississippi River continuously with copper sulfate for the past two seasons (2006-2007) in an effort to kill veligers. It is difficult to know how the zebra mussels entered this lake chain. It is possible that the treatments may have been ineffective, that zebra mussels were in the system prior to treatments, or that they were moved inadvertently by recreational boating. There are no public access sites on Sucker and Vadnais lakes, and the public is not permitted to boat on these waters. Two access sites are on Pleasant Lake, and lakeshore residents are able to boat on the lake. It is unlikely that the source of these new infestations will ever be known.

Existing infestations: 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 expanding in the lake. Invertebrate sampling in Pelican Brook recorded isolated small zebra mussels attached to woody debris below the outlet area. Sampling further downstream failed to find any attached mussels, and sampling at the boat access on the Pine River (approximately 16 miles downstream from the lake) failed to document any zebra mussels.

Diving during routine fisheries survey work in Lake Mille Lacs found over 100 zebra mussels attached to rocks in several sites along the northern shore. Water samples taken during the summer documented only two veligers. The size of Lake Mille Lacs may prevent finding clusters of reproducing zebra mussels and, in early stages of infestation, veligers may be so dispersed and diluted that samples may easily miss this life stage.

Zebra mussel populations in Rice Lake showed a dramatic increase in reproduction and settlement from the previous year. The numbers in this lake are increasing much more rapidly than seen in Lake Ossawinnamakee. Surveys documented zebra mussels attached to native mussels in the area of Crow Wing State Park. This downstream settlement can be expected to increase in future seasons, eventually establishing new reproductive “pools” further downstream in slower current areas.

Flooding and turbid water conditions prevented dive surveys on a long-term site in Lake Zumbro. Veliger sampling during the summer indicated that, despite last season’s die-off, reproduction and settlement was still occurring in the lake. 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.

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. No zebra mussels were found on the slides examined for 2007, suggesting that this invasive has not been moved upstream within these waters.

Prevention of spread

Public awareness and education efforts continued to be focussed in the Brainerd lakes area in response to zebra mussel populations in Lake Ossawinnamakee as well as at Lake Mille Lacs. 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 increased (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.

In late fall, officials at a highway weigh station found thousands of zebra mussels attached to a large circulating pump being transported to a private company in North Dakota. The pump unit had been used in Vermont and was being moved for routine maintenance. DNR conservation officers stopped the truck and would not allow it to proceed under Minnesota laws preventing movement of zebra mussels on state roads. The pump was cleaned with high-pressure hot water at an area truck wash and the hauler was permitted to continue. A citation was issued for the occurrence and the event received significant media coverage. The alert actions by the weigh station officials and the conservation officers helped highlight the regulations and concerns about the transport of invasive species such as zebra mussels. The company that manufactures and services the circulation pumps is revising their protocols to address such transport laws.

Effectiveness of Management

Minnesota has eight inland lakes that contain this invasive. Zebra mussels in Mille Lacs Lake continue to expand numbers 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 new infestations in the Vadnais chain place populations in the metropolitan area. While public boating access is limited on these lakes, the infestations will force SPRWS to implement control efforts to prevent problems in their water supply operations. The low numbers found suggest that the infestation is in the early stages, allowing SPRWS time to plan and implement effective control operations.

Participation of Others

Monitoring efforts for zebra mussels continued by lakeshore residents throughout Minnesota. Approximately 200 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 continue with the National Park Service. Funding for dive survey operations and analysis of slides from monitoring locations aids in cooperative efforts to document abundance and distribution of zebra mussels in the St. Croix River area.

St. Paul Regional Water Services continues to work with the Invasives Program to develop methods to prevent movement of invasive species through its operations. While zebra mussels have already moved into the water reservoir lakes, other invasives may enter the Mississippi River and efforts are needed to prevent more species from moving into Vadnais and other lakes.

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 24 presents a summary of other invasive animal species in Minnesota.

Discovery of New Non-native Species

Aquatic animal species - During 2007, the DNR received a report from the U.S. Environmental Protection Agency in Duluth that its monitoring efforts during 2006 in the Duluth–Superior Harbor revealed some new species that had not been detected there or in other state waters in previous years: Cnidaria, Annelida, and possibly European ear snail.

Cnidaria (*Cordylophora caspia*) is an invasive invertebrate (a hydroid) that is known in other Great Lakes to be attached to substrates including zebra mussels. It is native to the Black and Caspian seas in Europe. According to Smith et al. (2002), cnidaria is a 'benthic colonial predator' that preys upon chromonids and other larval insects. Ecological impacts of cnidaria have not been well studied. Some studies have suggested that cnidaria may contribute to a restructuring of benthic and pelagic freshwater communities (Folino 1999) and competition for space (e.g., suitable substrate for colonization) may occur between zebra mussel and cnidaria (Folino 1999).

Annelida (*Pristina acuminata*) is an oligochate that was first noted as a non-native to the Great Lakes in the late 1970s in Lake Erie.

The big-eared radix or European ear snail (*Radix auricularia*) may have been collected, but it is not confirmed. This snail has been present in other Great Lakes for some time.

Terrestrial animal species - University of Minnesota Research Associate, Lee Frelich, reports that 1 or 2 non-native earthworm species from Asia have been found in the Twin Cities area of the state. The species have not been identified to species but have been confirmed to be in the genus *Amyntas*. Various species of earthworms in this genus are sold and distributed for composting, and are known to be invasive in the eastern U.S.

There is also a non-native slug that is invading forests. Specimens from the Wood-Rill Scientific and Natural Area (SNA) near Long Lake, MN, were confirmed to be *Arion fasciatus*, a European species. This slug is well established at this site and is a strong herbivore on various understory wildflower species. Similar specimens have been observed at several other SNAs as well as some sites in the Chippewa National Forest.

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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 32 Minnesota counties from 1999 to 2006: Big Stone, Blue Earth, Brown, Carver, Chippewa, Clay, Dakota, Freeborn, Goodhue, Hennepin, Houston, Jackson, Kandiyohi, Koochiching, Lac qui Parle, Lyon, Martin, Nicollet, Otter Tail, Pennington, Pipestone, Redwood, Renville, Rock, Roseau, Sibley, Stearns, Swift, Traverse, Wabasha, Winona, and Yellow Medicine.

In 2007, Eurasian collared-doves were reported for the first time in Pope County in the town of Lowry (eight birds), Grand Rapids in Itasca County, Climax in Polk County (four birds), and in Breckenridge in Wilkin County. Reports this year include more birds per sighting and suggest reproduction of the doves is occurring in the state. Eight birds were reported in Paynesville, Stearns County, and ten birds were observed in Plainview, Wabasha County. A report of 41 Eurasian collared-doves at Olivia in Renville County during November is the first time a large flock has been recorded in the state. 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

Species and origin - Two and possibly four species of mystery snails exist in the state and another is present in the Wisconsin portion of the St. Croix watershed. The Chinese mystery snail (*Bellamya [=Cipangopaludina] chinensis*) is native to Eastern and Southeastern Asia. This large olive-colored snail has small depressions above the shell opening and rows of fine, short stiff hairs parallel to the whorl of the shell that may wear off with age and abrasion.

The Chinese mystery snail was originally brought to California in 1892 as a food source (Wood 1892), and was later found in Massachusetts in 1915 after a suspected aquarium release (Johnson 1915). It has since been found in several states (Jokinen 1982), presumably dispersed by people.

The Japanese mystery snail (*Bellamy [=Cipangopaludina] japonica*) is native to Japan and Southeast Asia (Clench and Fuller 1965). It is very similar in appearance to the Chinese mystery snail, except it has a more pointed, pronounced spire (set of whorls). This snail was introduced as a food source to the United States in California in 1911 (Hannibal 1911).

The banded mystery snail (*Viviparus georgianus*) is a viviparid gastropod, which has red bands that are parallel to the whorl of the shell. The snail's historic range is in the southeastern United States, primarily in the Mississippi River system up to Illinois (Clench 1962, Burch and Jung 1988), but it now has invaded lakes and slow moving waterways in Minnesota.

The river snail, *Viviparus viviparus*, is native to Europe and is nearly indistinguishable from the banded mystery snail.

Impacts - Under the correct conditions, they can form dense aggregations. This may interfere with other benthic grazers and filter feeders, but the extent to which the Chinese mystery snail competes with other aquatic species is not known. In Asia, this snail can transmit human intestinal flukes (Ingles 1930, Chung and Jung 1999), however, no reported cases have been documented in the United States. It also is a carrier of unionid parasites that have been reported in mussels in the St. Croix River drainage (Williams, 1978).

The banded mystery snail has been shown to cause significant mortality of largemouth bass (*Micropterus salmoides*) embryos when they invade nests (Eckblad and Shealy 1972). It has been suggested that some North American populations could be the river snail, *Viviparus viviparus*, since the two species are nearly indistinguishable.

Distribution - There are 82 reported occurrences for the Chinese mystery snail in Minnesota waters. Most records are from lakes and areas 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. Some of the lake residents that DNR staff has spoken with had only noticed the snails in the last few years. DNR Fisheries staff and others continue to report new infestations to the Division of Ecological Resources.

Japanese mystery snail was found in Wisconsin waters for the first time in 2004 at five sites in the Namekagon River (St. Croix River drainage). This species could occur in other areas of the St. Croix River drainage, and given its close proximity, possibly in Minnesota waterways. However, it has not yet been recorded in Minnesota. It follows the same seasonal migrations in lakes like the Chinese mystery snail and the banded mystery snail. The Japanese mystery snail has been recorded to reach high densities; in Lake Erie, fishermen have retrieved over two tons in just one seine haul (Wolfert and Hiltunen 1968). These densities have not been recorded in Wisconsin waterways.

There are 45 occurrences for the banded mystery snail in Minnesota waterways 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. Other areas of concentration are in the St. Croix River drainage.

Management - Chinese mystery snails, Japanese mystery snail, and other snails in the genus *Cipangopaludina* have been designated as *regulated invasive species* in Minnesota Rule 6216. State statute prohibits the introduction of regulated invasive species into the wild.

Future needs - Future needs for this and other mystery snails include: 1) increasing public awareness of the state regulations regarding introduction and spread; and 2) assessment of control methods that may be permitted in Minnesota.

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New Zealand Mudsnaail

Species and origin - The New Zealand mudsnaail (*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 mudsnaails 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 2007.

Management - In 2007, DNR designated the New Zealand mudsnaail 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 mudsnaails. The designation as *prohibited* means the mudsnaails 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.

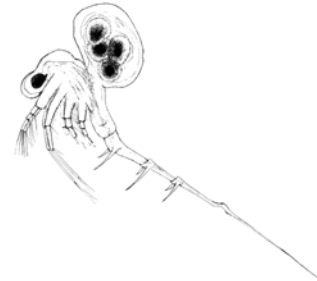
Distribution - These crayfish have been reported from more than 40 lakes and eight rivers in the state, scattered from northeast to south-central Minnesota. DNR Fisheries staff encounter rusty crayfish in their lake sampling gear and report findings. Judging from the widespread reported distribution,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

Management - There are currently no selective and 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. An ongoing Wisconsin study found that intensive continual trapping coupled with strict fisheries regulations reduced the population of rusty crayfish in a small lake to

approximately 10% of the original level. However, research has not been completed on what the population will do once the trapping and regulations are ended. This may be ineffective in larger lakes, due to the practical constraints on the effort needed to trap the crayfish. With the lack of any selective or even effective control methods, the Invasive Species Program does not conduct any active management of rusty crayfish.

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. Ehippia (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, while remaining in Island Lake. However, in the past few years more northern waters have been discovered with populations of *Bythotrephes longimanus*. Beginning with Saganaga Lake a few years ago, over a dozen large lakes in northern Minnesota have been confirmed as infested. Recent infestations 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 (Figure 23). Additionally, reports from Canadian fisheries researchers documented large numbers of *Bythotrephes* sp. carried downstream in the Rainy River below Rainy Lake. Targeted sampling by Grand Marais area fisheries staff in high-risk lakes may discover even more infestations. Most of the infested waters are large, deep and support cool- or cold-water fisheries communities. Spread may be occurring through natural water movement between lakes, via fish or wildlife spreading ehippia, or inadvertently by recreational anglers or boaters.

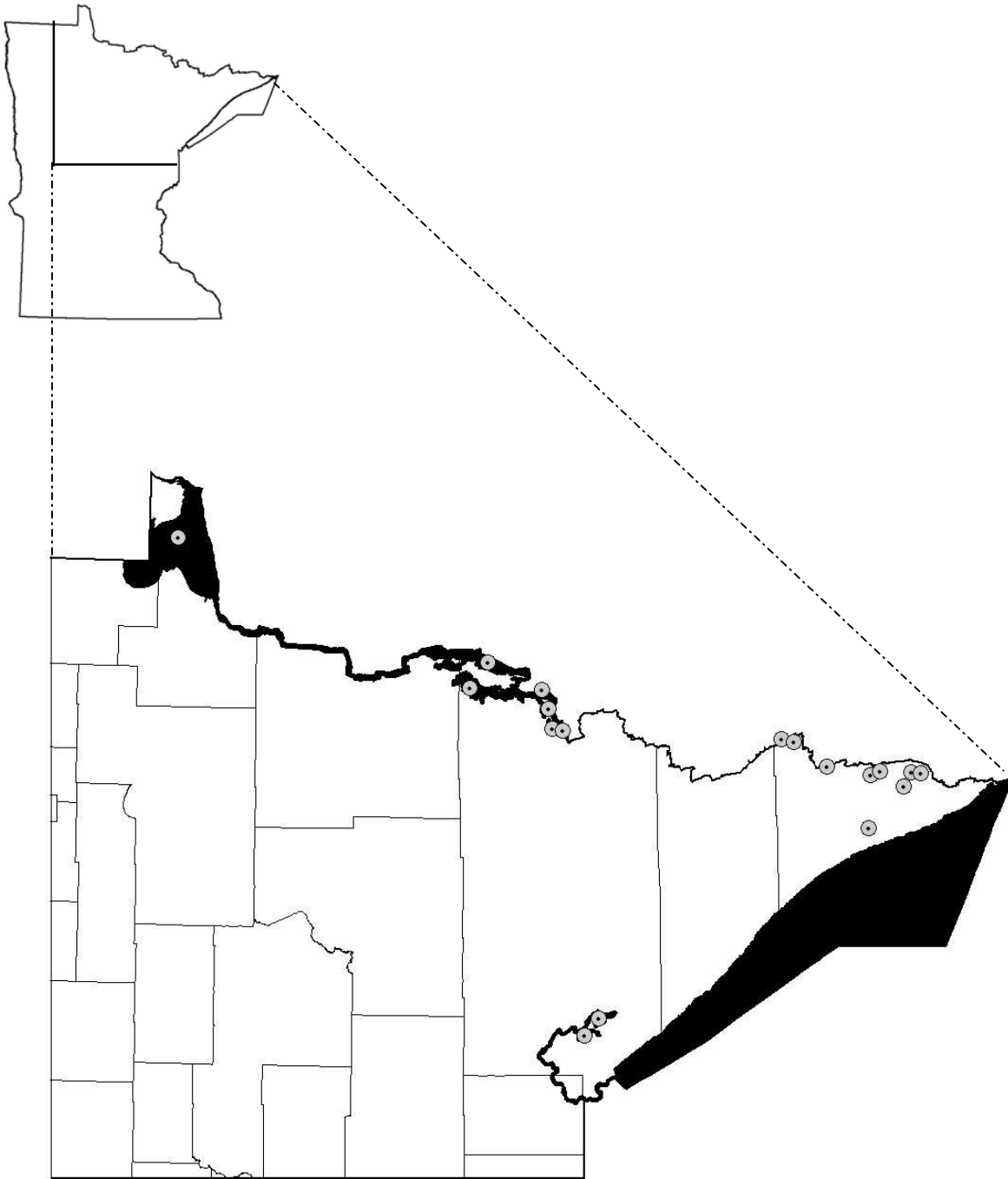


Figure 25. Distribution map of where spiny waterflea (*Bythotrphes longimanus*) has been found as of November 2007. Bold black lines indicate rivers that are infested, black polygons indicate large lakes that are infested, and gray dots indicate other lakes that are infested.

Research - DNR biologists are assisting National Park Service staff from Voyageurs National Park in processing zooplankton samples collected prior to *Bythotrephes* sp. invasion in the Rainy Lake-Lake of the Woods system. These samples will help to provide valuable baseline zooplankton community data that can be used to compare future zooplankton data. These comparisons can help determine if *Bythotrephes* sp. are altering zooplankton community dynamics and assist in assessing potential negative impacts to the fisheries community. Zooplankton samples collected over the summer by Baudette area fisheries staff were 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. Baitfish stomach samples are being examined by area fisheries staff to determine if common baitfish are consuming *Bythotrephes* sp.

Prevention - In 2007, the DNR and others took many steps to help prevent the spread of spiny waterfleas to additional waters in northern parts of the state. A variety of public awareness efforts were conducted to educate the boating public on procedures to prevent spread (see Education and Public Awareness). Signs, newspaper articles, and billboards were some of the tools used to raise awareness on this issue. New DNR watercraft inspection teams were established for the border waters. Cross-border cooperation on issues such as watercraft inspection and coordination between state, local, federal, and Canadian biologists and managers helped enhance such efforts. More details on these actions can be found in the Watercraft Inspections and Awareness Events section. 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. DNR staff also met with border-area bait dealers to discuss proposed regulations on harvest of bait from spiny waterflea infested waters and provided training for dealers who wanted to harvest from infested waters. In fall of 2007, new restrictions were established for nets and gear used during sport gill-netting in some large infested lakes.

Table 24. Other invasive and non-native species that have been found in the wild in Minnesota.

Species	Status	Legal Status	Last annual report to include info on this species
<i>Daphnia lumholtzi</i>	<i>D. lumholtzi</i> 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 and Asian earthworms (various genera)	Continued public education has focused on preventing the release of earthworms. Two Asian species, used in composting, have been found in the state.	Unlisted	2003
Eurasian swine (<i>Sus scrofa</i>)	Reported release of two at Carlos Avery WMA in Columbus Township, Anoka County.	Prohibited	2002
Fallow deer (<i>Dama dama</i>)	Several escapes in past years.	Unlisted	2001
Red deer (<i>Cervus elaphus</i>)	Reports to DNR of six escaped in 2005. They were dispatched by DNR.	Unlisted	1999
Round goby (<i>Neogobius melanostomus</i>)	No new water bodies in 2007.	Prohibited	2005
Ruffe (<i>Gymnocephalus cernua</i>)	No new water bodies since 1988.	Prohibited	2002
Sika deer (<i>Cervus nippon</i>)	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 (<i>Gasterosteus aculeatus</i> and <i>Apeltes quadracus</i>)	In Lake Superior.	Unlisted	2000
Tubenose goby (<i>Proterorhinus marmoratus</i>)	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 Staff

Title / Area of Responsibility	Name	Phone	E-mail
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 - coordination of prevention efforts including education and public awareness, regulations efforts and state representative on regional aquatic invasive species panels	Jay Rendall	651-259-5131	jay.rendall@dnr.state.mn.us
Eurasian Watermilfoil Coordinator - technical and financial assistance for management of milfoil, and technical assistance for other invasive aquatic plants	Chip Welling	651-259-5149	chip.welling@dnr.state.mn.us
Invasive Species Biologist - technical assistance for management of milfoil, curly-leaf pondweed, and other invasive aquatic plants	Wendy Crowell	651-259-5085	wendy.crowell@dnr.state.mn.us
Invasive Species Biologist - technical assistance for management of milfoil, flowering rush, and other invasive aquatic plants	Vacant		
Invasive Species Biologist - invasive species issues in northern portions of the state	Dan Swanson	218-833-8645	dan.swanson@dnr.state.mn.us
Invasive Species Ecologist - invasive species issues in northern portions of the state; purple loosestrife database management	Rich Rezanka	218-833-8646	richard.rezanka@dnr.state.mn.us
Invasive Species Ecologist - technical assistance for management of terrestrial invasive species and biological control programs	Ann Pierce	651-259-5119	ann.pierce@dnr.state.mn.us
Watercraft Inspection Program Coordinator - supervises watercraft inspection interns; awareness events at water accesses	Heidi Wolf	651-259-5152	heidi.wolf@dnr.state.mn.us
Watercraft Inspection Program Assistant - awareness events at water accesses	Elizabeth Condon	651-259-5146	elizabeth.condon@dnr.state.mn.us
Aquatic Invertebrate Biologist - zebra mussels, rusty crayfish, and other invasive aquatic invertebrates	Gary Montz	651-259-5121	gary.montz@dnr.state.mn.us
Conservation Officer - statewide enforcement of invasive species regulations for aquatic plants and wild animals	Ken Soring	218-999-7809	ken.soring@dnr.state.mn.us
General Information		651-259-5100	

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

Department of Natural Resources - Forest Pest Program

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

Forestry Division Contacts

Metro Forest Health Specialist	vacant	651-772-7927
Southern Forest Health Specialist	Ed Hayes	507-285-7431
Northeast Forest Health Specialist	Mike Albers	218-327-4115
Northwest Forest Health Specialist	Jana Albers	218-327-4234
Forest Health Program Coordinator	Val Cervenka	651-259-5296
Silvaculture Lands and Roads Supervisor	Al Jones	651-259-5271

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
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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, 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 Resources Management 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 - Jean Ciborowski, MDA - Integrated Pest Management Coordinator, Ag Development 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.