Lower Wisconsin River Basin Aquatic Invasive Species Strategic Plan

River Alliance of Wisconsin
We Save Rivers

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created by

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EXECUTIVE SUMMARY

The interconnectedness of river systems presents unique and complex challenges with regard to aquatic invasive species (AIS) management; challenges not applicable to isolated waterbodies such as lakes and ponds. Large river systems such as the Mississippi are particularly susceptible to AIS invasion, due to the proliferation of habitats in which AIS may establish. The Lower Wisconsin River basin is at risk of being deeply and negatively impacted by a suite of harmful AIS, due to both its physical connection with the Mississippi River, a "source waters" of an estimated 135 invasive species (United States Geological Survey, 2009), and its status as a regional recreational destination.

The outdoor heritage of hundreds of thousands of waterfowl and wildlife hunters, boaters, paddlers, wildlife watchers, cold and warmwater anglers, and others that recreate in the basin—as well as the local economies that these recreationalists support—hinges on the health of the Lower Wisconsin River system and its ability to sustain a diversity of native species and ecosystems. The establishment of AIS such as Asian carp, faucet snails, zebra mussels, or didymo could forever alter the natural landscape of the basin, resulting in a scenes vastly different from those familiar today, with recreational boating rendered dangerous, sandbars polluted with dying waterfowl and razor-sharp mussel shells, streambeds smothered by thick mats of algae, and native fisheries marred. Many of these scenarios are preventable, however, and hinge upon the willingness of stakeholder groups to take action in AIS prevention, containment, and control efforts.

> *The outdoor heritage (of those that recreate in the basin) hinges on the health of the Lower Wisconsin River system and its ability to sustain a diversity of native species and ecosystems...* ***The establishment of AIS could forever alter the natural landscape of the basin.***

Since 2010, the creation of this Plan and its ongoing implementation has been supported by a unique partnership of stakeholders with a vested interest in preserving the integrity of the basin. The River Alliance of Wisconsin developed the Plan and facilitated the contributions of several key partners from the following organizations or institutions: the Wisconsin Department of Natural Resources (WDNR), the United States Fish and Wildlife Service (USFWS), the University of Wisconsin-Madison Center for Limnology, Friends of the Lower Wisconsin Riverway (FLOW), the Lower Wisconsin State Riverway Board, Dane County, and Southwest Badger Resource Conservation and Development.

Through this partnership, the Plan was developed to prevent future introductions of AIS and to contain or control AIS already present in the basin. The intent of the Plan is to guide future efforts of these partners and other stakeholders in the basin which include but are not limited to state, county and local governments; non-governmental organizations, and citizen conservation, sporting, and recreation groups. To that end, three specific goals and associated management strategies and actions have been identified.

We recommend management strategies and actions to *prevent new introductions or dispersal of AIS into Lower Wisconsin River basin waterbodies* (Goal 1). Engaging the above stakeholder groups in education, outreach, and partnership efforts can serve as an effective method of preventing the introduction and spread of AIS into and throughout the Lower Wisconsin River basin. Increased monitoring and reporting of incidental findings of AIS can enable rapid response efforts. Finally, increased enforcement of state AIS regulations on the part of state, county, municipal, and WDNR law enforcement agencies is necessary.

We also recommend management strategies and actions to *limit the spread of established populations of aquatic invasive species to and from the Lower Wisconsin River basin waterbodies* (Goal 2). We outline means in which to establish clearly-defined roles and responsibilities, and coordinate between the various government agencies, non-governmental organizations, and citizen groups working on AIS issues in the Lower Wisconsin River basin, specifically by organizing a regional Lower Wisconsin River Basin AIS Working Group. We recommend that robust consideration of aquatic resource issues, including AIS, be incorporated into all aspects of Lower Wisconsin State Riverway plans and management objectives. In the following pages, we make the case for the need to establish and maintain regional AIS coordinator positions in the Lower Wisconsin River basin. Finally, we call for an economic analysis of an ecologically healthy Lower Wisconsin River basin and encourage further research of AIS of concern to the Lower Wisconsin River basin.

Lastly, we advance management strategies and actions to *abate, and where possible, eliminate harmful ecological, economic, social and public health impacts resulting from the infestation of aquatic invasive species in Lower Wisconsin River basin waterbodies* (Goal 3). We recommend that a regional Lower Wisconsin River basin AIS control plan modeled after the statewide plan be written. We also recommend strengthening existing statewide AIS policies (or establishing new statewide AIS policies) to more strongly protect against AIS invasions via vendor importation of plants, fishes and invertebrates, and encourage the development of new AIS control strategies and technologies to abate the negative effects of established AIS populations on native species.

Over the past two years (and beyond), the aforementioned partners have made great progress toward the coordination and mobilization of AIS stakeholders in the basin; the publication of this Plan is a continuation of this work. We now move to implement the Plan, with the River Alliance of Wisconsin implementing certain components of the Plan, and serving as a catalyst and advocate for remaining components. The success of this next phase ultimately relies on the involvement and support of all of the partners who have contributed thus far to this effort, as well as partners that will contribute in the future.

INTRODUCTION

In June 2010, the River Alliance of Wisconsin received an Aquatic Invasive Species Control Grant for Education, Planning, and Prevention from the Wisconsin Department of Natural Resources (WDNR) to develop a strategic plan for limiting the introduction and spread of aquatic invasive species (AIS) in the Lower Wisconsin River basin. A basin-wide approach to the issue was utilized due to the prevalence of waterbodies (mainly rivers and streams, but also floodplain lakes, sloughs, impoundments and wetlands) in the region and the connections between them. Additionally, the connections between waterbodies via the movement of recreational users also necessitated a regional approach to the issue. A basin-wide approach entails consideration of the myriad stakeholder groups, ecosystem types, and species affected by AIS.

The Lower Wisconsin River basin is an ecological, economic, and cultural gem in the southwestern part of Wisconsin. However, given its proximity and physical connections to the "AIS source waters" of the Mississippi River and other regional destination waterbodies, as well as its status as a popular recreational destination, the Lower Wisconsin and surrounding waterbodies are quite vulnerable to AIS invasion, and to this point, due attention has not been paid to the issue. The *State of the Lower Wisconsin River Basin* (Wisconsin Department of Natural Resources [WDNR], 2002) identified the control and eradication of non-native and invasive species as one of the top ten priorities for the basin. AIS issues are well "on the radar" for many waterbodies—mainly lakes—in the northern half of Wisconsin, but the southern half of the state, particularly the riverine Driftless Area in the southwest (of which the Lower Wisconsin River basin is a large part), lags behind in AIS preparedness and planning.

It is out of this void that the River Alliance of Wisconsin recognized an opportunity and applied for a WDNR AIS grant to develop a strategic AIS plan for the Lower Wisconsin River basin. The grant was awarded in June of 2010 for developing the plan. A second WDNR grant was awarded to River Alliance in November of 2011, funding implementation of this plan through February 2013.

River Alliance of Wisconsin

The River Alliance of Wisconsin is a statewide non-partisan, 501c3 non-profit organization that advocates for the protection, enhancement, and restoration of Wisconsin's rivers and watersheds. River Alliance is guided by the following core principles:

- Advocating respectfully but assertively for rivers.
- Bringing people to rivers so they experience their beauty and understand their threats.
- Partnering with, when appropriate, and challenging, when necessary, the government agencies entrusted with protecting rivers.
- Developing the ability of ordinary citizens and grassroots groups to organize their passion for rivers.

Purpose

The primary purpose of this plan is to coordinate Lower Wisconsin River basin stakeholders in achieving the goals detailed below (prevention, containment, and control of AIS and their impacts). In coordinating between stakeholders, we hope to raise the profile of AIS issues in the Lower Wisconsin basin, and build the institutional capacity of stakeholder groups to prepare for and respond to AIS issues. Proposed AIS management objectives should be evaluated by stakeholder groups, organizations, and institutions, and incorporated into their respective work and practices as appropriate.

Scope

The geographical scope of this plan is the 2,500 square miles of the Lower Wisconsin River basin, as defined by the main stem of the Wisconsin River from the Prairie du Sac Dam downstream 92.3 miles in a westerly direction to the Mississippi River, as well as tributary streams, rivers, floodplain lakes, sloughs, and wetlands within the watershed. Due to the biotic diversity of the Lower Wisconsin River, its multitude of recreational users and variety of recreational opportunities, and existence of the Lower Wisconsin State Riverway—a unique swath of 79,275 acres with state protection—a significant body of literature about the Lower Wisconsin exists relative to other waterbodies in the basin. This report follows a similar path—while encompassing the entire river basin, a significant focus of the plan remains on the Lower Wisconsin River itself, for the aforementioned reasons.

Goals

The goals of this plan are threefold, the first and foremost of which is preventing the introduction of new AIS to the basin. The second and third goals are applicable in planning for and responding to new introductions of AIS. Goals for this plan were adapted from *Wisconsin's Comprehensive Management Plan to Prevent Further Introductions and Control Existing Populations of Aquatic Invasive Species*, developed in 2003 (see "Appendix N - Relevant Lower Wisconsin River Basin Plans And Reports").

Goal I – Prevention: Implement procedures and practices to prevent new introductions or dispersal of aquatic invasive species into Lower Wisconsin River basin waterbodies.

Goal II – Containment: Develop management strategies to limit the spread of established populations of aquatic invasive species to and from Lower Wisconsin River basin waterbodies.

Goal III – Control: Abate, and where possible, eliminate harmful ecological, economic, social and public health impacts resulting from the infestation of aquatic invasive species in Lower Wisconsin River basin waterbodies.

LOWER WISCONSIN RIVER BASIN BACKGROUND INFORMATION

The Lower Wisconsin River basin holds significant ecological, economic, and cultural importance to the southwestern region as well as the entire state of Wisconsin. The majority of the 2,500 square mile basin is in the Western Coulee and Ridges Ecological landscape, which is characterized by its highly eroded, "driftless" (untouched by glacial drift) topography. The basin is a patchwork of municipalities, forests, farms, prairies, rivers, lakes, and wetlands. Dozens of studies and reports have been created for the basin see "Appendix N - Relevant Lower Wisconsin River Basin Plans And Reports".

Summary of basin and unique resources threatened by AIS

Coldwater Streams

The unglaciated Driftless Area, of which the Lower Wisconsin River basin is part, boasts the highest concentration of coldwater streams in Wisconsin. Coldwater streams are best described as flowing waters with maximum summer water temperatures that are typically below 71.6°F. These communities contain relatively few fish species and are dominated by trout and sculpin. Brook trout (*Salveninus fontinalis*) are the only trout species native to Wisconsin. Nonnative brown (*Salmo* trutta) and rainbow trout (*Oncorhynchus mykiss*) have been stocked in many of these streams since the late 1800s.

West Fork of the Kickapoo River in the Driftless Area

Warmwater Rivers

At the heart of the basin is the Lower Wisconsin River, an ecologic, economic, and cultural gem that spans 92.3 river miles from Prairie du Sac to the confluence with the Mississippi River. The Lower Wisconsin River is one of the most highly-visited regions in the state and the numerous recreational opportunities it provides, including fishing, boating, hunting, trapping, hiking, canoeing, and wildlife watching, generates significant economic activity for the region.

In addition to its economic importance, the Lower Wisconsin State Riverway also supports critical and unique ecological populations. According to the Wisconsin Natural Heritage Inventory Program, the Lower Wisconsin State Riverway supports 43 rare plant species (including four state endangered species, five state threatened species, and 34 state special concern species). Of these, five species are associated with floodplain forests, and directly susceptible to displacement by encroachment of AIS. Additionally, 121 rare animals species rely on the Lower Wisconsin State Riverway, including 15 state endangered species, 21 state threatened species, 84 state special concern species, and three federally listed or candidate species. More information about these designation and listed species may be found in [“Appendix N - Relevant Lower Wisconsin River Basin Plans And Reports”.]

Numerous sensitive fish species are an indicator of the biotic integrity of the Lower Wisconsin River, but may be directly impacted by the encroachment of AIS such as Asian carp or mosquitofish (*Gambusia* species). The main stem of the Lower Wisconsin supports “probably the largest remaining populations in Wisconsin of the state threatened paddlefish (*Polyodon spathula*), blue sucker (*Cycleptus elongates*) and black buffalo (*Ictiobus niger*) along with the exceedingly rare goldeye (*Hiodon alosoides*), crystal darter (*Crystallaria asprella*) and river redhorse (*Moxostoma carinatum*). In all, there are 20 rare fishes known from the Lower Wisconsin State Riverway, 10 species of special concern, six state threatened species, and four state endangered species. Many of the populations represent some of the last remaining strongholds for large river fishes in the Upper Midwest,” (WDNR, 2011b).

Wetlands
A diversity of wetland types dot the Lower Wisconsin River basin being most prevalent in the river valleys. Adjacent to the streams and rivers are small wet meadows, floodplain forests, springs, and spring runs. These are home to several state endangered species (eastern massasauga rattlesnake, *Sistrurus catenatus*) and species of special concern (four-toed salamander, *Hemidactylium scutatum*). Riverine wetlands are susceptible to invasion as invasive species are transported by flow, especially during high flow events. Many today are already heavily impacted by reed canary grass (*Phalaris arundinacea*), a well-established invasive plant species.

Lakes and Impoundments
According to the WDNR’s Ecological Landscapes of Wisconsin, the Western Coulee and Ridges region has no natural lakes, with the exception of floodplain lakes, which will be addressed separately. Impoundments in the basin are sizeable and surrounded by public land, providing motor boat access and receiving heavy use. These include White Mound Lake, Twin Valley Lake, Cox Hollow Lake, and Blackhawk Lake. Impoundments are commonly afflicted with poor water quality due to the modification of their hydrology resulting in the accumulation of nutrients and sediment. For this reason, often their native communities are highly disturbed, making them vulnerable to infestation by AIS.

Floodplain Lakes and Sloughs
Floodplain lakes and sloughs are found adjacent to the river along the entire length of the Lower Wisconsin State Riverway, providing refuge to state endangered species (starhead topminnow, *Fundulus dispar*) and state special concern species (pirate perch, *Aphredoderus sayanus*; lake chubsucker, *Erimyzon sucetta*; mud darter, *Etheostoma asprigene*; weed shiner, *Notropus texanus*). Sloughs, lakes that the river has made, serve as spawning habitat for fish and amphibians, as shelter for various life stages of a variety of species, and as nesting habitat for birds. Many of the native fish found here are particularly sensitive to water quality which also might be compromised by invasion. See Appendix C - Detailed maps of Lower Wisconsin State Riverway AIS for names and locations of the multitude of sloughs found here.

Outstanding and Exceptional Resource Waters
The Lower Wisconsin River basin abounds with water resources of the highest quality, featuring several state-designated Outstanding Resource Waters (ORWs) and dozens of Exceptional Resource Waters (ERWs). WDNR designates ORWs and ERWs as being “surface waters which provide outstanding recreational opportunities, support valuable fisheries and wildlife habitat, have good water quality, and are not significantly impacted by human activities.” These waterbodies are afforded additional anti-degradation protections, designed to prevent the

lowering of water quality. Only 18.6% of the over 42,000 stream and river miles in the state receive either of these designations. In the Lower Wisconsin River basin, portions or all of 10 waterbodies have been listed as ORWs and 60 waterbodies have been listed as ERWs by WDNR. See “Appendix H - Lower Wisconsin River Basin Outstanding and Exceptional Resource Waters” for a list of ORWs and ERWs in the basin.

Impaired Waters

Amongst the many high quality waters in the basin, parts of 15 rivers or streams are on the Clean Water Act 303(d) list as impaired. The habitat of 12 of these waterbodies is degraded due to sediment or total suspended solids, most likely the result of past or current poor land use management.   The Wisconsin River below the Prairie du Sac Dam, and the Kickapoo River are listed as impaired as a result of fish tissue being contaminated by mercury (and PCB in the case of the Lower Wisconsin River).   Impaired waters are often more susceptible to invasion. See “Appendix I - Lower Wisconsin River Basin “Impaired” Waters” for a list of impaired waterbodies in the basin.

Overview of AIS in the Lower Wisconsin River basin

The Lower Wisconsin River basin, as described above, encompasses a significant portion of southwestern Wisconsin and is characterized by diverse landscapes and ecosystems. The myriad different terrestrial and aquatic habitats of the basin provide an ecological niche for an abundance of native species, as well as invasive species. Though this plan addresses "aquatic" invasive species, included in it—and considered "aquatic" for these purposes—are riparian terrestrial species, or species that are found on lands bordering waterways (such as Japanese hops—*Humulus japonicus*).

Common Names	Year Found in LWR Basin	NR 40 Status	Impoundments and Lakes	Warmwater Rivers and Streams	Coldwater Streams	Riparian Areas	Wetlands	Sloughs
Invertebrates								
Chinese mystery snail	1999	restricted	x	x			x	x
Rusty crayfish	?	restricted	x	x	x			x
Zebra Mussels	2009	restricted	x	x	x			x
Fishes and Pathogens								
Bighead carp	2011	prohibited	x	x				x
Brown trout	before 1900	restricted			x			
Common carp	before 1900	restricted	x	x			x	x
Grass carp	2011	prohibited	x	x				x
Rainbow trout	before 1900	restricted			x			
Plants and Algae								
Cattail hybrid	?	restricted	x	x	x	x	x	x
Common buckthorn	?	restricted				x	x	
Curly-leaf pondweed	1970	restricted	x	x	x		x	x
Eurasian watermilfoil	1965	restricted	x	x			x	x
Japanese hops	2011	prohibitied/restricted				x	x	
Japanese knotweed	1974	restricted				x	x	
Moneywort	2008	none				x	x	
Phragmites	?	restricted	x	x	x	x	x	x
Purple loosestrife	1985	restricted				x	x	

Table 1: AIS present in the Lower Wisconsin River basin, with associated dates of discovery, NR 40 classification, and susceptible ecosystems per species.

Summary of threats and impacts posed by AIS

The potential impacts of invasive species—both aquatic and terrestrial—are significant and widespread, ranging from ecological to economic to cultural.

Ecological Impacts

Native species are regularly displaced by invasive species, which in the absence of natural predators, outcompete native species for habitat and food resources. The habitat of the Blanding's turtle (*Emydoidea blandingii*), a state threatened species found in the Lower Wisconsin River, is degraded by invasive species like reed canary grass (*Phalaris arundinacea*) and phragmites (*Phragmites australis*).

An example of an invasive species displacing native species in the Lower Wisconsin River is the zebra mussel (*Dreissena polymorpha*), which competes for habitat with the 15 rare (state or federally listed and special concern) mussel species, including the federally endangered Higgin's eye pearlymussel (*Lampsilis higginsii*). Mussel habitat in the sandy-bottomed Lower Wisconsin River is scarce, and only 13% the river's shoreline area features the rock or gravel substrates necessary for mussels. These hot spots of invertebrate species diversity occur where the main channel flows adjacent to an upland bluff and the substrate shifts from the loose sand to firm gravel, rubble or even bedrock bottom. These areas are especially important for mussels, as well as for fish that require rock substrates for spawning.

Blanding's turtle, a state threatened species

The grass carp (*Ctenopharyngodon idella*), another AIS of concern, indiscriminately feeds on native and nonnative aquatic plants, with the potential to significantly alter aquatic habitats, particularly the floodplains and sloughs that abound in the LWR basin. This could have a momentous impact on native fish species that are reliant on aquatic plants for spawning, refuge for rearing young, food or habitat, such as the state endangered starhead topminnow (*Fundulus dispar*).

In addition to directly outcompeting native species for food, spawning, and rearing habitat, invasive species also have the capacity to interrupt or alter ecosystem services, such as flood attenuation, erosion control, and water purification. These impacts could be momentous.

Economic impacts

The economic impacts of invasive species—particularly their removal—have been widely studied and measured, and can be considerable. Pimentel, Zuniga, and Morrison (2005) estimated that the damages and losses resulting from invasive species in the U.S. approached an amount of $120 billion. Lodge & Finnoff (2008) estimated annual financial losses in the Great Lakes region due to ship-borne invasive species to be upwards of $200 million per year. In 2001, the Wisconsin Electric Power Company reported spending $1.2 million per year in the control of zebra mussels on their Lake Michigan power plants (WDNR, 2011a). Specific industries that may be negatively affected by invasive species include: fisheries, recreation, power generation, agriculture, forestry, tourism, and trade.

In the Lower Wisconsin River basin, the economic impact of recreation is significant—particularly, fishing, hunting, and recreational boating. The economic impact of trout angling in the Driftless Area of the Midwest (southwestern Wisconsin, southeastern Minnesota, northeastern Iowa, and northwestern Illinois) is an estimated $1.1 billion annually. Waterfowl hunting is also a large contributor to the local economy, given the proliferation of sloughs and wetlands in the Lower Wisconsin basin that provide waterfowl habitat. In 2006, 66,000 statewide Wisconsin waterfowl hunters spent an estimated $19 million on trip expenditures and equipment, and contributed to a total output of approximately $26 million associated with waterfowl hunting, including 444 jobs. Though the figures aren't recent, a 1992 survey estimated that over 130,000 recreational hours were spent on the shore of the Lower Wisconsin River between late June and late September (WDNR, 2006). During this same time period, over 6,900 motorboats and 16,800 canoes visited as well. The economic impact of river visitors—for whatever objective—to the local economy is significant.

Cultural impacts

Harder to quantify, but no less important, are cultural impacts of invasive species. Family vacations to the beach can be impaired if the beach is littered with razor-sharp zebra mussel shells. Fishing, boating, or other watercraft-based recreation is hampered by the presence of jumping Asian carp in waterbodies—this is a particularly acute threat on the Lower Wisconsin River and tributaries such as the Kickapoo River, both of which see heavy recreational fishing and watercraft usage.

Past and current AIS management practices in Lower Wisconsin River basin

The management of AIS issues and concerns in the Lower Wisconsin River basin occurs at varying levels, from statewide to local, and consists of a preventative statewide policy framework supported by local monitoring/surveying efforts to contain known AIS populations.

1. Applicable statewide policy and regulations – NR 40. NR 40, Wisconsin's "Invasive Species Identification, Classification, and Control" rule, established in 2009, classifies invasive species into "prohibited" or "restricted" categories. It is illegal to transport, possess, transfer, and introduce prohibited species in Wisconsin (with certain exceptions), but possession of restricted species is allowed for some species.

2. Applicable statewide policy and regulations – (parts of) NR 19 and NR 20. Viral hemorrhagic septicemia (VHS) is an invasive fish virus that threatens and can potentially kill more than 25 native Wisconsin fish species. It spreads via infected water or fish. NR 19 and NR 20 were amended to include provisions making it illegal to transport water or live fish. The Lower Wisconsin River is considered a "VHS Suspected Waters" by WDNR due to its manmade water connection with the VHS-infected Great Lakes, via the Chicago Sanitary & Ship Canal, the Des Plaines River, the Illinois River, and the Mississippi River.

3. Precautionary plan to prevent movement of AIS upstream through Prairie du Sac Dam – In a 2002 provision of its Federal Energy Regulatory Commission (FERC) license, Alliant Energy was directed to provide for upstream fish passage at the Prairie du Sac Dam, designed specifically for four target species: lake sturgeon (*Acipenser fulvescens*), shovelnose sturgeon (*Scaphirhynchus platorynchus*), paddlefish (*Polyodon spathula*), and blue sucker (*Cycleptus elongatus*). As such, an upstream fish passage facility is scheduled to be operational by 2015. In preparation for the fish passage facility, an AIS prevention plan (currently in draft form, with a final draft expected in 2012) for the facility has been developed by WDNR, addressing concerns such as the upstream movement of invasive fish such as Asian carp species, as well as VHS-infected fish.

4. Surveying and monitoring – Several agencies and organizations currently conduct surveying and/or monitoring activities in Lower Wisconsin River basin waterbodies. Some of the surveying/monitoring activities listed below are explicitly for AIS, but the majority report AIS on an incidental basis—e.g. AIS populations are observed while looking for native species.

a. WDNR Bureau of Science Services and WDNR Fisheries VHS testing in the Lower Wisconsin River – WDNR Bureau of Science Services researchers and Fisheries staff conduct annual VHS testing in early April in the Lower Wisconsin River, downstream from the Prairie du Sac Dam. As part of the test, fish are electroshocked, collected, and tested 28 days later to determine if the VHS virus is present. All tests to date— 2008, 2010, and 2011—have come back negative.

b. Southwest Badger Resource, Conservation, & Development AIS surveying in Lower Wisconsin River waterbodies – Southwest Badger RC&D staff surveyed seven rivers and five lakes in the Lower Wisconsin River basin from May to October 2011. Monitoring occurred for plant and invertebrate invasive species. Monitoring efforts will continue through 2012.

c. WDNR Lakes monitoring in the Lower Wisconsin River basin – WDNR Lakes and Rivers Section biologists annually conduct AIS surveying at waterbodies across the state, including the Lower Wisconsin River basin. In 2011, an early detection aquatic plant AIS program was initiated, involving careful inspection of likely AIS habitats—piers, rocks, plants—at boat landings. Numerous lakes were sampled using this protocol, including several in the Lower Wisconsin basin: Cox Hollow and Twin Valley lakes in Iowa County, Lee Lake (Cazenovia Millpond) in Richland County, and White Mound Lake in Sauk County.

d. WDNR Bureau of Water Quality and Watershed Management Lower Wisconsin River fish, invertebrate, aquatic plant, stream and bank habitat, and water quality monitoring—WDNR biologists conduct stream, lake, and floodplain lake monitoring from May to November each year (with some winter water quality monitoring), evaluating stream health using indices of biotic integrity. Monitoring data will inform whether the waterbody should be listed as impaired (303d), listed as Outstanding or Exceptional Resource Waters (ORWs and ERWs), and also whether the waterbody is meeting its “designation,” (for example, “coldwater trout stream” or “warmwater forage fishery”). Long-term trend stream sites within the Lower Wisconsin basin are visited monthly, and other streams within the basin are visited on a rotational or randomly selected basis

e. WDNR Bureau of Science Services Lower Wisconsin River fish monitoring and sampling

   - Annual electroshocking on the Lower Wisconsin River fish species since 1999, at ten one-mile-long sites from Prairie du Sac to the Mississippi River

   - Monitoring for lake and shovelnose sturgeon (*Acipenser fulvescens* and *Scaphirhynchus platorynchus*), blue sucker (*Cycleptus elongatus*), and redhorse spawning between April and May via electroshocking between Sauk City and Blackhawk landing near Mazomanie since 2007

   - Sampling for juvenile game fishes and rare species from June to September via trawling and seining along the entire length of the Lower Wisconsin River since 2011

   - Sampling for biotic integrity/fish community indices between August and September via electrofishing, along the entire length of the Lower Wisconsin River

   - Surveying for juvenile game fish via electrofishing, below Prairie du Sac Dam since 1987

– Since 1999, biologists from the WDNR Fish and Aquatic Research Section have monitored fish in the LWR to document spatial and temporal variation and possible trends in fish community structure and composition. Fish community data are assessed via an index of biotic integrity (IBI) developed for large rivers in Wisconsin. The IBI provides an estimate of the overall biological condition or ecological "health" of the LWR. During these surveys only one non-native fish species, the common carp (*Cyprinus carpio*), has been encountered during the monitoring (Lyons, 2011).

– On a more ad hoc basis since 1975, miscellaneous other forms of fish sampling occur annually from May to September along the entire length of the Lower Wisconsin River (and backwaters and sloughs), including electroshocking, hoop netting, angling, dip netting, and seining.

f. Wisconsin WDNR Bureau of Fisheries biologists tag lake sturgeon (*A. fulvescens*) between September and October via gill nets, below the Prairie du Sac Dam.

g. WDNR Bureau of Endangered Resources Lower Wisconsin River mussel monitoring – WDNR biologists annually monitor mussel beds in the Lower Wisconsin River and conduct counts of native mussel populations. Invasive zebra mussels (*Dreissena polymorpha*) are often found on the shells of native mussels during these monitoring efforts, and reported as 'incidental' findings.

h. Valley Stewardship Network mussel and Project RED monitoring in Kickapoo Valley – Valley Stewardship Network (VSN) is a Kickapoo River Valley-based citizen group that participates in projects to survey for both AIS as well as native mussels on the Kickapoo River. VSN participated in the River Alliance of Wisconsin's Project RED (Riverine Early Detectors) program in 2010, actively surveying the Kickapoo for 15 different AIS. They also participated in the Mussel Monitoring Program of Wisconsin in 2010.

Mussel monitoring on the Lower Wisconsin River

LOWER WISCONSIN RIVER BASIN AIS OF CONCERN

Process of identifying high-priority AIS of concern for the Lower Wisconsin River basin

To guide development of this plan, the River Alliance of Wisconsin convened a Technical Advisory Committee (TAC), consisting of federal, regional, and local resource managers, biologists, and citizen recreation group representatives. Beginning in August 2010 and lasting over the course of several subsequent months, the TAC, working primarily from NR 40, Wisconsin's list of prohibited and restricted species, provided feedback on AIS that were a high-priority concern for the Lower Wisconsin River basin, via a species ranking system that evaluated what species were most likely to become established within the basin, and/or have substantial ecological or economic impacts. Forty species,divided into three categories were evaluated: 16 plants and/or algae, 11 fish and/or crayfish, and 13 invertebrates (not including crayfish). TAC members provided feedback on these species per their respective areas of expertise.

The TAC eliminated (and added) AIS of concern to the list, based on a number of factors: the likelihood of introduction (and relatively proximity of the species to the Lower Wisconsin River basin), the rate a nd impact of spread, cost of eradication, and assessment of ecosystems affected. Based on TAC feedback, River Alliance of Wisconsin staff selected 26 of the original 40 species as "high priority" species (10 plants and/or algae, 9 fish and/or crayfish, 6 invertebrates, 1 pathogen), and created comprehensive species profiles (see "Appendix D - Full species profiles, AIS of concern to the Lower Wisconsin River basin").

Several NR 40 species that exist in the Lower Wisconsin River basin, such as curlyleaf pondweed (*Potemogeton crispus*) and brown trout (*Salmo trutta*) were eliminated from the "AIS of Concern" list in this Plan. The rationale behind this is that for particular species like *P. crispus,* higher-profile species such as Eurasian watermilfoil (*Myriophyllum spicatum*) are listed in the Plan—the best preventative practices for which also apply to several other plant species, such as *P. crispus*. The case of eliminating *S. trutta* from the list is slightly different, as it is a prized game fish, and is actively stocked by WDNR. While this species is widespread and likely has impacts on native fish species, it is not likely that WDNR will cease stocking this fish, nor will anglers stop pursuing it. Therefore, the value of its listing in this Plan was questionable.

It is also noteworthy that in two instances in the species selection process, River Alliance consolidated two different (but characteristically similar species based on habitat, physical traits, etc.) species into one species profile. The eastern (*Gambusia holbrooki*) and western mosquitofish (*Gambusia affinis*) were consolidated into one species profile, as were the spiny water flea (*Bythotrephes cederstroemi*) and fishhook water flea (*Cercopagis pengoi*).

Listed below are the 26 AIS of concern for the Lower Wisconsin River basin followed by an abbreviated one-page summary that details each species' relevant characteristics (distribution, transport mechanism, impact potential, and prevention/control techniques) as it pertains to the Lower Wisconsin River basin. Full species profiles for each of the AIS (entailing greater depth and detail than the following fact sheets) can be found in "Appendix D - Full species profiles, AIS of concern to the Lower Wisconsin River basin".

High Priority AIS not yet present in basin (prevention)

- Black carp
- Brazilian waterweed
- Didymo/rock snot
- Faucet snail
- Flowering rush
- Eastern and western mosquitofish
- New Zealand mudsnail
- Quagga mussel
- Red swamp crayfish
- Round goby
- Silver carp
- Viral Hemorrhagic Septicemia
- Fishhook and spiny waterflea
- Yellow floating heart

High priority AIS/present in basin (containment/control)

- Bighead carp
- Grass carp
- Japanese hops
- Zebra mussel

Low priority AIS/present in the basin (containment/control)

- Eurasian watermilfoil
- Purple loosestrife

Asian clam
Corbicula fluminea

High priority AIS not yet present in Lower Wisconsin River basin as of January, 2012

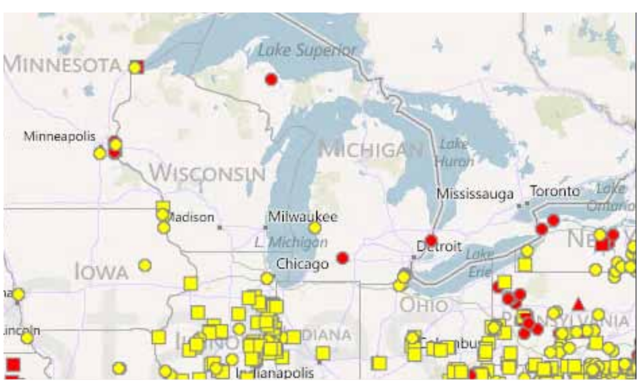
What is it?
Asian clams are small light-colored clams with shell ornamented by distinct, concentric rings.

Where is it?
The Asian clam is native to the temperate and tropical regions of southeastern China, Korea, and southeastern Russia. From its native range, is has spread around the world.

It was first reported in the St. Croix River in 1977 and in the Mississippi River in 1981. Populations have been found in the Mississippi River near Prairie du Chien and La Crosse.

How does it spread?
The main vector for the spread of Asian clam is human movement and activities. It is believed that they first were brought to North America for food, and have since been introduced to new areas through bait bucket releases, ballast water transport, aquarium/water garden releases, as hitch-hikers with imported aquaculture species, and intentional introductions for food

Why do we care?
Due to their voracious filter feeding, Asian clams tend to out-compete both native mussels and juvenile fishes for food. Food competition coupled with competition for space has lead to decreased abundances and diversity of native mussels and clams in waterbodies where Asian clams are introduced.



Asian clam Midwest regional distribution as of January, 2012. Red=established population, yellow=specimen(s) collected. (*USGS, 2011*)

The Asian clam can have large economic impacts on industrial and power plants that intake water from rivers and lakes. Alive and dead clams clog the intake pipes and it is costly to remove them; an estimated one billion US dollars each year is spent removing clams from industrial and power plant pipes.

What can we do?
There are many different techniques to remove Asian clams from industrial pipes. However, these methods are not very suitable for natural areas. A labor-intensive approach for removing isolated populations is to scrape the clams from the substrate, but this does not remove the floating veligers (larvae), which will quickly re-colonize.

Prevention of new introductions is really the key in limiting the spread of the Asian clam. Since humans are the primary vector, public education on not transporting adult specimens, and the necessity of emptying live wells and drying out boats and equipment is essential. Waterfowl hunters and anglers who move between the Mississippi River and the Lower Wisconsin River should be targeted.

STOP AQUATIC HITCHHIKERS!
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Asian clam, with scale in inches (*Wisconsin Sea Grant Institute*)

Black carp
(Mylopharyngodon piceus)

High priority AIS not yet present in Lower Wisconsin River basin as of January, 2012

What is it?
The black carp is one of four Asian carp that pose a threat to the Lower Wisconsin River basin. It closely resembles the grass carp. The two species are similar in overall body shape, size and placement of fins, and both have very large scales. In contrast to grass carp, the black carp is slightly darker in coloration (not black). Black carp also have a somewhat pointed snout.

Where is it?
The black carp is native to China, parts of far eastern Russia, and possibly northern Vietnam. The typical habitat includes large rivers, channels of lowland rivers, and associated floodplain lakes and backwaters. The species also occurs in artificial habitats, and some populations survive in lakes and reservoirs, although they require flowing water to reproduce. They have been found as far up the Mississippi River as Clarksville, Missouri.

How does it spread?
Black carp were first brought into the United States in the early 1970s as a "contaminant" in grass carp stocks imported to Arkansas. The first known record of an introduction of black carp into open waters occurred in Missouri in 1994, when thirty or more black carp along with several-thousand bighead carp reportedly escaped into the Osage River, Missouri River, and Mississippi River drainages.

Eastern U.S. distribution of black carp. Red=established, yellow=specimen(s) collected, green=population unknown (*USGS, 2011*)

Why do we care?
Black carp can grow as long as five feet and weigh up to 150 pounds. They eat mussels and snails. The Mississippi River and the Lower Wisconsin River are home to many endangered mussel populations that would be threatened if the black carp became established.

What can we do?
Preventing black carp from becoming established is the key to protecting the Lower Wisconsin River and its unique mussel populations. At this time there is no feasible means of controlling Asian carp if they were to become established in the Lower Wisconsin River. It is important that we continue to monitor the region for all four species of Asian carp to make certain that there is not a breeding population. Angler outreach should occur to ensure that they are not harvesting bait, which is currently prohibited on the Lower Wisconsin River and the Mississippi River (as a measure to ensure that young Asian carp are not being transported to other waterbodies).

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Black carp (*Leo Nico*)

Brazilian waterweed
(Egeria densa)

High priority <u>AIS not yet present</u> in Lower Wisconsin River basin as of January, 2012

What is it?
Brazilian waterweed (also referred to as Brazilian elodea) looks much like a larger, more robust version of its more commonly-found native relative Elodea. Brazilian waterweed leaves are 0.4 to 1.2 inches long, up to 0.2 inches wide, and are in whorls of four to eight.

Where is it?
Brazilian waterweed is native to South America—Brazil, Uruguay, and Argentina. Brazilian waterweed is generally rooted on the bottom in depths of up to 20 feet or drifting. It is found in both still and flowing waters, in lakes, ponds, pools, ditches, and quiet streams. It has been established in most southern, east coast, and west coast states in the United States. A population was reported by Wisconsin DNR staff in 2009 in a small Portage County fish pond. In the Mississippi River basin, a population was reported in Powderhorn Lake, in Minneapolis, MN.

How does it spread?
Brazilian waterweed is introduced worldwide through the aquarium trade—sold widely as good "oxygenator" plant and dispersed secondarily by boat trailers and vegetative dispersal downstream. It fragments easily. A new population can be established by a small piece transported between waterbodies by boaters.

Midwest distribution of Brazilian waterweed (Portage County, WI infestation not shown). Red = established population, yellow = specimen(s) collected. (*USGS, 2011*)

Why do we care?
Dense stands may restrict water movement, trap sediment, and cause fluctuations in water quality. It affects aquatic plant community composition, impacting both native plants and animals. Severe infestations may impair recreational uses of a waterbody including navigation, fishing, swimming, and water skiing.

What can we do?
Preventing future introductions by regulating the aquarium and water garden trades is important. Local potential vendors should be educated on the threat of such invasive plants, and the existing NR40 regulations that apply to them.

Large infestations of Brazilian waterweed can be controlled with herbicides. In near-shore locations like docks and swimming areas, an opaque fabric can be laid over the substrate to prevent the growth of all rooted aquatic vegetation. Brazilian waterweed can be mechanically removed, but this should only be used when all other available approaches are exhausted, as it spreads via fragments.

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Brazilian waterweed (*Virginia Tech University*)

Didymo/rock snot
(Didymospenia geminata)

High priority <u>AIS not yet present</u> in Lower Wisconsin River basin as of January, 2012

What is it?
Didymo is a diatom, a type of single-celled algae with a stalk. The stalk may attach to rocks, plants, or any other submerged substrates. When the diatom cell divides, the stalk also divides, eventually forming a dense mass see the picture below.

Where is it?
There has been an expansion in the range and number of nuisance populations of didymo in North America. Near Wisconsin, didymo is well established in Lake Superior, near the mouth of the Knife River north of Duluth, MN, but not yet growing at nuisance levels along Lake Superior's shores. Nuisance blooms annually occur in Rapid Creek, South Dakota are present over a six-mile reach of the stream, at 30 to 100 percent coverage, for over four months of the year.

How does it spread?
Recreational anglers are suspected to be the primary vector for the spread of didymo. Cells can remain viable in cool, damp, dark conditions for at least 40 days. Fishing equipment, boot tops, neoprene waders, and felt-soled wading boots in particular, all provide a site where cells remain viable, at least during short-term studies.

Why do we care?
This alga is capable of producing such stalk densities that the mats covering the streambed change the ecology of the stream, including invertebrate diversity. In addition, high growth rates and extensive mats of Didymo may impact nutrient cycling. Algal, invertebrate, and fish species diversity and population sizes may be altered as a result.

Nationwide *didymo* distribution (*Hermann, 2008*)

The introduction of didymo in Wisconsin may have a large economic impact. The 600-plus coldwater spring-fed creeks of the Dritftless Area (and the world-class trout fishery they support) are a large economic engine for southwestern Wisconsin and are vulnerable to Didymo infestation. Trout angling generates $1.1 billion each year in the Driftless Area, strongly benefiting the local economy.

What can we do?
Cleaning gear before traveling between bodies of water, whether between nearby streams or to international destinations, is crucial. Decontamination of gear—via drying completely for several days, or freezing—is the best way to prevent the spread. If these measures aren't possible, gear should be disinfected by washing with a 2% bleach solution (one cup of bleach per three gallons of water) for at least a minute. A public awareness campaign, directed at freshwater anglers, boaters, professional guides, water managers, and fisheries biologists is needed.

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***Didymo* on a streambed (*Tim Daley, Pennsylvania DEP*)**

Faucet snail
(Bithynia tentaculata)

High priority <u>AIS not yet present</u> in Lower Wisconsin River basin as of January, 2012

What is it?
The faucet snail (Bithynia tentaculata) is a small invasive snail, native to Europe that is dark-brown to black in color, up to ½" in length, and features 4-6 whorls. It has a cover or 'operculum' on its shell opening with concentric circle markings in adults and spiral markings in juveniles.

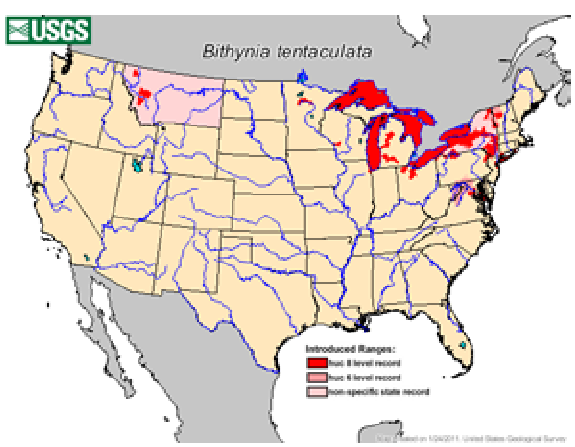
Where is it?
The faucet snail can be found in shallow lakes, ponds, canals, or sloughs. It prefers shallow, near-shore habitats featuring submerged vegetation or other structure such as rocks, gravel, and other coarse substrates.

Near to the Lower Wisconsin River basin, it has been found in the Mississippi River from Lake Pepin to the Wisconsin/Illinois border, with particularly robust populations being found near La Crosse. The snail has also been found in Shawano Lake, in the Wolf River basin.

How does it spread?
The faucet snail can spread by attaching to aquatic plants, boats, anchors, and other recreational gear and equipment. It may also spread to new waterbodies via migrating waterfowl that have ingested infected snails, and potentially by the downstream movement of submerged vegetation to which they've attached in high flows. The gear and equipment of waterfowl hunters are also a potential vector of transport and spread, particularly between the Mississippi River and Lower Wisconsin River sloughs.

Why do we care?
The environmental impacts of the faucet snail are significant. The snail has been linked to the deaths of an estimated 75,000-100,000 waterfowl in the Upper Mississippi Wildlife Refuge since 2002. It can also out-compete native snails that are a critical food source for fish, birds, and other wildlife.

The snail can also cause negative economic impacts. The Lower Wisconsin and Upper Mississippi regions are hot spots for waterfowl hunting, and could be negatively impacted if the faucet snail continues to spread. In 2006, 66,000 Wisconsin waterfowl hunters spent an estimated $19 million on trip expenditures and equipment, and contributed to a total output of approximately $26 million associated with waterfowl hunting, including 444 jobs.



Nationwide *Bithynia tentaculata* distribution (*USGS, 2011*)

What can we do?
Recreational users, including waterfowl hunters, of waterbodies infected by the faucet snail must learn to identify the snail, and inspect and remove it from all of their gear upon leaving a waterbody. The snail can be killed by exposure to 125°F water for five minutes.

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Faucet snail (*USGS*)

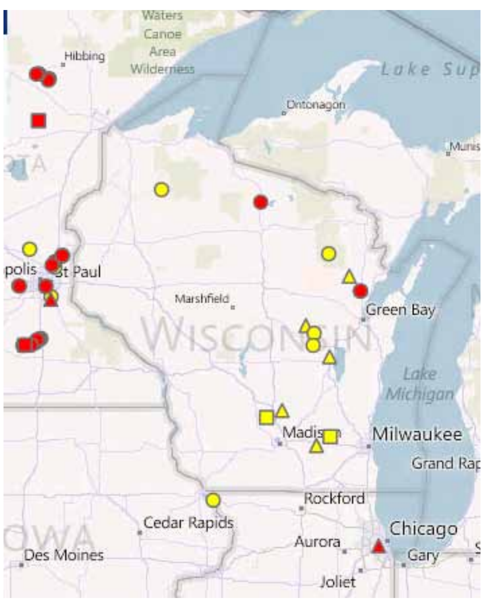
Flowering rush
(Butomus umbellatus)

High priority AIS not yet present in Lower Wisconsin River basin as of January, 2012

What is it?
Flowering rush is an emergent perennial aquatic herb that is native to Eurasia. Its leaves are sedge-like above the water surface and limp if they stay submerged beneath the water. Flowering rush grows in shallow, slow moving waters; it is typically found in marshes, lakes, ponds, and slow-moving areas of rivers. It can grow up to three feet tall above the water surface. When not in bloom, flowering rush is hard to distingish from native bur-reed.

Where is it?
Flowering rush has spread into many temperate regions around the world. In the Midwest, it established populations can be found in the Upper Mississippi River basin, as well as throughout the Great Lakes region. Flowering rush has been found in Lake Wisconsin in the Wisconsin River basin.

How does it spread?
Flowering rush was intentionally brought to North America as an ornamental plant. From the intentional plantings, it has been moved to new locations unintentionally by muskrat, waterfowl, and boater movement. Viable pieces of the plant can also be transported by movement of water and ice.



Wisconsin distribution of flowering rush. Red=established population, yellow=specimen(s) collected. (*USGS, 2011*)

Why do we care?
Flowering rush can quickly colonize a disturbed area, which gives it an advantage over native plant species in ecosystems that have repetitive disturbances. Once it has established, flowering rush tends to form large stands that can impede boat traffic and outcompete native plants. In high densities, flowering rush has negative impacts on economically valuable wild rice and native species of willows and cattails.

What can we do?
Currently, the most frequently used method of control for flowering rush is manual cutting of the plant below the water surface. However, this is labor-intensive and must be done multiple times a year because the plants grow back from their roots. If the infestation is very small, eradication may be possible by carefully removing all of the plant and root material. However, extreme care must be taken when removing the roots because disturbance of the root can cause reproductive bulbets to break off and establish in a new location. Current research is being done on different herbicides for flowering rush treatment. Diquat and Aquathol K are showing promise, but more research is still needed.

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Flowering rush (*Gary Fewless*)

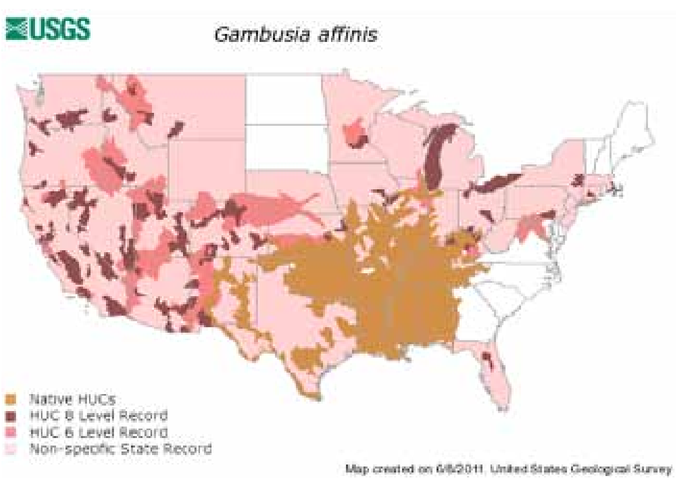
Eastern and western mosquitofish
(Gambusia holbrooki and Gambusia affinis)

High priority <u>AIS not yet present</u> in Lower Wisconsin River basin as of January, 2012

What is it?
Eastern mosquitofish and western mosquitofish are usually referred to collectively as mosquitofish.

Where is it?
Mosquitofish have been stocked in Minnesota, Illinois, Indiana, Iowa, Ohio, and Wisconsin. A few unsuccessful introductions of mosquitofish have occurred in Wisconsin since the 1920s; their failure to establish was likely due to harsh winter conditions. In 2009, established populations of western mosquitofish were discovered in the lower end of Pool 11 of the Mississippi River (which begins 2.5 miles upstream of the IL/WI border and extends without physical barriers 32 miles upstream, north of Cassville). Western mosquitofish are also in the Sugar River near Brodhead, WI.

How does it spread?
Mosquitofish were moved around the world as a cheap and effective way to control mosquito larvae and fight malaria. Accidental and intentional introductions by bait-bucket release, aquarium releases, and escapees from private ponds are likely to blame for their spread. Mosquitofish have been found mixed in with shipments of fathead minnows, which were being shipped to Wisconsin for baitfish. Mosquitofish have also escaped from private ponds. Once a population has established from stocking, natural dispersal has occurred to surrounding areas.



Nationwide distribution of western mosquitofish. Populations recently found in Pool 11 of Mississippi River and the Sugar River not shown. (*USGS, 2011*)

Why do we care?
Invasive mosquitofish have a negative effect on many different native species including aquatic invertebrates, fish, and amphibians. In Wisconsin, the three fish species that are most threatened by mosquitofish introduction are the blackstripe topminnow, the special-concern banded killifish, and the state-endangered starhead topminnow. The starhead topminnow has been found in several floodplain lakes adjacent to the Lower Wisconsin River.

What can we do?
Although fairly easy to capture individually, the small size, abundance, and use of difficult-to-sample habitats by mosquitofish makes their populations highly resistant to elimination by netting or electroshocking. Another physical control method that has been tried is to completely drain the waterbody which is only practical in small, controlled waterbodies.

Piscicides have been used in attempts to eradicate mosquitofish, with mixed results. The use of piscicides is most effective in small waterbodies where high chemical concentrations can be reached and the fish cannot escape. Rotenone, Antimycine A, liquid chlorine, and calcium hydroxide have all been used in mosquitofish control, but none of these poisons are species-specific.

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Western mosquitofish (*John Lyons, WDNR*)

New Zealand mudsnail
(Potamopyrgus antipodarum)

High priority AIS not yet present in Lower Wisconsin River basin as of January, 2012

What is it?
New Zealand mudsnails are very small (less than 0.25 inch) snails with 5 to 8 whorls. Their oval opening is on the right-side and its height is less than the height of the spire. Some morphs, including many from the Great Lakes, exhibit a keel in the middle of each whorl. Shell colors vary from gray and dark brown to light brown.

Where is it?
They occur amongst aquatic plants and prefer shallow areas in lakes or slow streams with silt and organic matter substrates, but tolerate high flow environments where it can burrow into the sediment. New Zealand mudsnails have been found in popular trout fishing destinations in the west and many tributaries to the Great Lakes. They have been documented in all of the Great Lakes, except Huron. In 2005, an established population was found in the St. Louis River estuary and the Duluth-Superior Harbor.

How does it spread?
New Zealand mudsnails were likely introduced to the Great Lakes via ballast water discharge. In the western United States where they were likely introduced through fish stocking, they have spread via angling equipment and birds. They have been observed to pass through the gut of fish unscathed, indicating that fish themselves are capable of dispersing them. In the Great Lakes, this might be a viable means of them becoming established in tributaries as fish, such as salmon, move into interior waters. Inland sites close to population centers and blue ribbon fisheries have been vulnerable due to their heavy use by anglers. This would indicate that popular fisheries near Madison, such as Black Earth Creek, may be at high risk for invasion. Once established in a river or stream, it has been estimated that the snails can move upstream on their own over 0.5 mile per year.

Nationwide New Zealand mudsnail distribution. Red=established population. (*USGS, 2011*)

Why do we care?
Densities have reached over 500,000 individuals per square meter. A species as prolific as this has the potential to clog pipes at facilities drawing from infested waters. It also may compete for food and space occupied by native snails. It is suspected that they can alter primary production of streams impacting fisheries and native invertebrates.

What can we do?
There is no known means of eradication of New Zealand mudsnails once they are introduced to a waterbody. Therefore, containment is necessary. To prevent the spread, inspect and remove visible plants, animals, and mud from boats, waders, hip boots, and other gear before transporting, and drain all water from equipment. Rinse gear with hot water (113°F/45°C) or freeze gear before reuse. Fishermen are encouraged not to use felt-soled wading boots as they are more likely to harbor mudsnails and other AIS. An education campaign directed at anglers and hunters to prevent them from introducing any specimens by properly cleaning their equipment prior to moving between waterbodies is warranted.

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New Zealand mudsnails (*Dan Gustafson*)

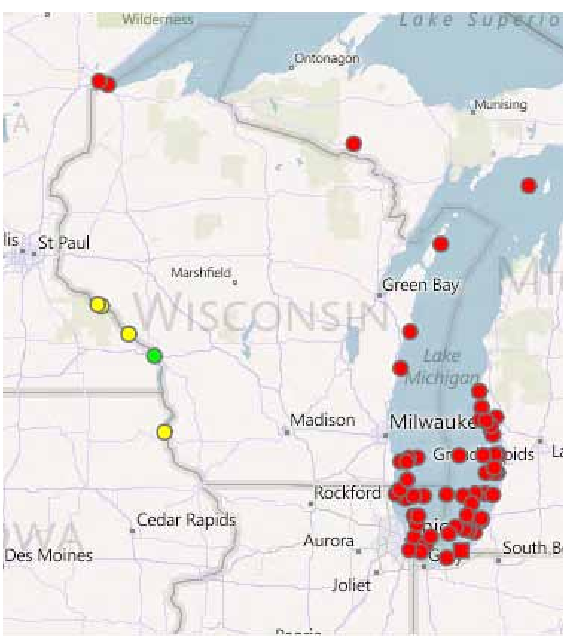
Quagga mussel
(Dreissena bugensis)

High priority AIS not yet present in Lower Wisconsin River basin as of January, 2012

What is it?
The quagga mussel is a close relative of the zebra mussel. Quagga mussels are similar in size to zebra mussels; the shells of quagga mussels are rounder and without ridges. They have dark concentric rings on the shell and are pale in color near the hinge. A single female mussel can produce more than 1 million eggs per year.

Where is it?
The quagga mussel was first sighted in the Great Lakes in September 1989, when one was found near Lake Erie. In 2005 the first quagga mussel was confirmed from Lake Superior in Duluth-Superior Harbor. The first reports of quagga mussels in the Mississippi River basin were in 2004. Quagga mussels have been found in the Mississippi River near Prairie du Chien, near La Crosse, and in Lake Pepin.

How does it spread?
Quagga mussels are primarily spread by boaters. Their eggs hatch into a larval form, called veligers, which are free-floating, unlike any of the native mollusks found in the Great Lakes. This larvae can be unintentionally transported in the live wells or bilge water of recreational boats, and they easily attach to boat hulls and trailers. Quagga mussels also cling to vegetation or any other object taken from water where they are present.



Wisconsin distribution of quagga mussel. Red=established population, yellow=specimen(s) collected, green=population unknown. (*USGS, 2011*)

Why do we care?
Quagga mussels tolerate a wider range of extremes in temperature, water depth and substrates than the zebra mussel. Quagga mussels are extraordinary water filterers, able to remove large amounts of phytoplankton and suspended particulates from lakes and streams. This ability decreases food sources for native species altering the delicate balance of the aquatic food web.

Quagga mussels clog water structures such as pipes and screens, which reduces pumping capabilities for water treatment and power plants—creating huge problems for industries and communities burdened with removal and clean-up costs. Recreation and industry may also be negatively impacted by quagga mussels when docks, buoys, boats, beaches, and breakwalls are heavily colonized by the species.

What can we do?
To prevent spreading this invasive mussel, boaters should drain water from boat motors, live wells, bilges, and transom wells and any other areas of boats and recreational equipment while on land before leaving a lake or waterbody. Take time to clean vegetation from boats, trailers, and motors, and thoroughly dry all objects including swimsuits and wet suits before entering uninfested waters.

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Quagga mussel (*Michigan Sea Grant Institute*)

Red swamp crayfish
(Procambarus clarkii)

High priority AIS not yet present in Lower Wisconsin River basin as of January, 2012

What is it?

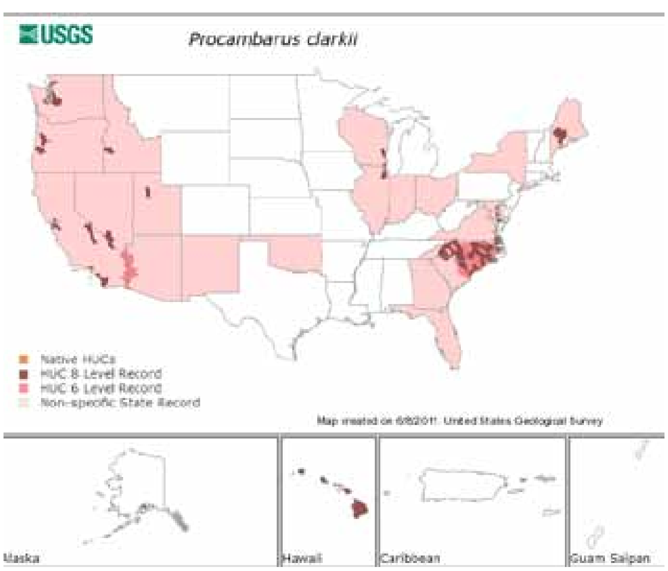
Red swamp crayfish are dark red in color, with raised bright red spots covering the body and claws and a black wedge-shaped stripe on the top of the abdomen. They may vary in length between 2 to 5 inches. Occasionally, a genetic mutation may turn the body and/or claws blue.

Where is it?

The red swamp crayfish is native to northeastern Mexico and south-central United States including the Lower Mississippi River drainage and parts of Illinois. Within the Midwest, it has been introduced to northern Illinois, Indiana and Ohio. In 2009, two isolated populations of red swamp crayfish were discovered in urban ponds in southeastern Wisconsin. The ponds were located in Germantown, Washington County, and Kenosha, Kenosha County.

How does it spread?

The red swamp crayfish has been introduced to new areas through many ways: natural expansion, aquaculture, food commerce, bait-bucket releases, and pet trade. They have also been introduced to new areas by humans seeking to enhance the local fishery. Another vector of concern has been release of crayfish after the completion of school science programs and escapees from golf course ponds where they are used for aquatic plant control. Once released, red swamp crayfish are able to travel long distances overland between waterbodies.



Nationwide red swamp crayfish distribution (*USGS, 2011*)

Why do we care?

Most of the Lower Wisconsin River watershed is susceptible to red swamp crayfish invasion. They have the potential to negatively impact native lakes and rivers at multiple levels. Red swamp crayfish have been found to cause large decreases in native plant populations and have negative impacts on native invertebrates. Red swamp crayfish pose a serious threat to many native amphibians, as well as native crayfish species. Additionally, the red swamp is a carrier of crayfish plague.

What can we do?

No eradication methods are known for red swamp crayfish. However, there are physical, biological and chemical methods of controls for red swamp crayfish that have varied in success. Enforcement of existing laws to prevent crayfish movement into and around the state is needed. In addition, early detection through monitoring will be important for containment and control.

STOP AQUATIC HITCHHIKERS!

Wisconsin law requires you to:

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- **Remove all attached aquatic plants and animals.**
- **Drain all water from boats, vehicles and equipment.**
- **Never move plants or live fish away from a waterbody.**

If you suspect that you have found an invasive species call 1-888-WDNR-INFO (1-888-936-7463) to report it.

Red swamp crayfish (*WDNR*)

Round goby
(Neogobius melanostomus)

High priority <u>AIS not yet present</u> in Lower Wisconsin River basin as of January, 2012

What is it?
The round goby has a frog-like head with raised eyes, spineless dorsal fin and is usually less than seven inches in length. It has a distinctive black dot on its front fin. The color of its scales lightens when threatened, but is usually black and brown. It also has a distinctive fused pelvic fin on its underside that distinguishes it from native sculpin.

Where is it?
The round goby is native to Eurasia, but has aggressively invaded the Great Lakes and tributary rivers. The round goby is a bottom dweller that lives in the near-shore region of rivers and lakes. It prefers rocky habitats in addition to mussel beds, piers, and sunken objects. The round goby has been found in 26 of 73 streams in the Wisconsin tributaries of Lake Michigan. Round gobies are present in Great Lakes river tributaries, including the Chicago River, which could potentially lead to an invasion of the Mississippi River. They are also in the Illinois River south of Peoria, IL.

Why do we care?
The round goby can displace native fish, eat their eggs and young, take over optimal habitat, spawn multiple times a season, and survive in poor quality water—giving them a competitive advantage over most native fish species. The round goby has contributed to the decline of the mottled sculpin and logperch in the Great Lakes.

Distribution of round goby in Wisconsin. Red=established population, yellow=specimen(s) collected. (*USGS, 2011*)

How does it spread?
The round goby is easily transported by ballast water, as well as by anglers.

What can we do?
Often, anglers are the first to discover round gobies because these aggressive fish are commonly caught by hook and line. The assistance of anglers in reporting new sightings and preventing the spread of round gobies is vital.

Electrical barriers and chemicals are being used as control measures to deter movement. The NR 40 ban of using round goby as live bait may limit their spread. More generally, the public must be informed on how to identify this species, to never transport water or bait from one body of water to another, and to dispose of bait in trash.

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Round goby (*Dave Jude*)

Silver carp
(Hypophthalmichthys molitrix)

High priority __AIS not yet present__ in Lower Wisconsin River basin as of January, 2012

What is it?
Silver carp (one of four carp we refer to as "Asian carp" and the notorious flying variety) are fast growing and become very large, weighing up to 60 pounds and measuring up to four feet. They migrate up streams and rivers to breed producing about 265,000-2,000,000 eggs in their lifetime.

Where is it?
Silver carp were imported into the United States by an Arkansas fish farmer in 1973. They are now present in large numbers in the Mississippi River in Iowa. Only three have been collected in the Upper Mississippi River adjacent to Wisconsin near Ferryville, Crawford County (WI) in 2011 and in the backwaters of the Mississippi River near the city of La Crosse in 2008 and 2009. No silver carp have been found in the Lower Wisconsin River.

How does it spread?
Dispersal of bighead and silver carp appears to be occurring naturally, especially during high-flow events which enable them to swim around barriers in the Mississippi River and Great Lakes region, looking for spawning habitat.

In addition to spread from fish farms, people also spread carp, intentionally and unintentionally, via bait, aquaculture, and sport.

Upper Mississippi River distribution of silver carp. Red=established population, yellow=specimen(s) collected, green=population unknown. (*USGS, 2011*)

Why do we care?
In numbers, the silver carp has the potential to cause enormous damage to native species because it feeds on plankton required by fish such as gizzard shad and bigmouth buffalo, all larval fish species, and native mussels which are important to the Lower Wisconsin River ecosystem.

Silver carp pose a threat to human safety due to their jumping behavior when startled. These "flying carp" have caused numerous personal injuries to recreational boaters and anglers. In addition to personal injury, silver carp also cause property damage: broken generators, radios and depth finders. When a silver carp lands in a boat, even if it does not break anything of value, it leaves behind unpleasant slime, scales, and feces.

What can we do?
Harvesting bait is currently prohibited on the Lower Wisconsin and Mississippi rivers. It is important that the public is aware of this regulation to prevent the unintentional movement of young silver carp between waterbodies in bait buckets. It is also important that we continue to monitor the Lower Wisconsin River for all species of Asian carp.

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Silver carp (*Auburn University*)

Viral Hemorrhagic Septicemia (VHS)

High priority <u>AIS not yet present</u> in Lower Wisconsin River basin as of January, 2012

What is it?
VHS is a virus that can be fatal to 28 species of fish native to North America.

Where is it?
Wisconsin waters infected with VHS include Lake Michigan, Lake Superior, and the Lake Winnebago system. Connecting waters suspected (but not yet confirmed) of being infected with VHS include the Mississippi River and all of its tributaries upstream to the first dam or barrier impassable to fish, including the Lower Wisconsin River to the Prairie du Sac Dam. Testing for VHS has annually occurred in the Lower Wisconsin River since 2006. No positive tests have been found.

How does it spread?
It is not known exactly how VHS was initially introduced to the Great Lakes system; however, ballast water and aquaculture activities are implicated in the spread of the virus. The virus is spread in water between fish through their urine and reproductive fluids. The virus can spread between waterbodies in trace amounts of water or in infected fish that sometimes do not exhibit any symptoms.

Wisconsin distribution of VHS. Red = established, yellow = collected (*USGS, 2011*)

Why do we care?
VHS is fatal to 28 species of fish in North America, many of which are prevalent in the Lower Wisconsin River, including shorthead redhorse, gizzard shad, and emerald shiner. Also affected are valuable game species that are present in the Lower Wisconsin River and its tributaries, including brown trout, channel catfish, smallmouth bass, and walleye.

What can we do?
WDNR is taking steps to prevent the spread of VHS, including VHS testing and monitoring of wild and hatchery fish and water supplies, and VHS screening in the bait industry. Another important step is the prevention of moving and collecting bait from VHS-infected waters.

Boaters and anglers should take necessary precautions not to move water between waterbodies in bilges, bait buckets, motors, and other gear. In Wisconsin, waters infected with or suspected to be infected with VHS are closed to all minnow harvesting (currently these include Lower Wisconsin River, Lake Michigan, Lake Superior, the Mississippi River, Lake Winnebago, Fox River from Lake Winnebago to Green Bay, and all connecting waters upstream to the first barrier impassible to fish).

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A fish infected with VHS. Bulging eyes are a symptom (*WDNR*)

Fishhook and spiny waterflea
(Cercopagis pengoi and *Bythotrephes cederstroemi)*

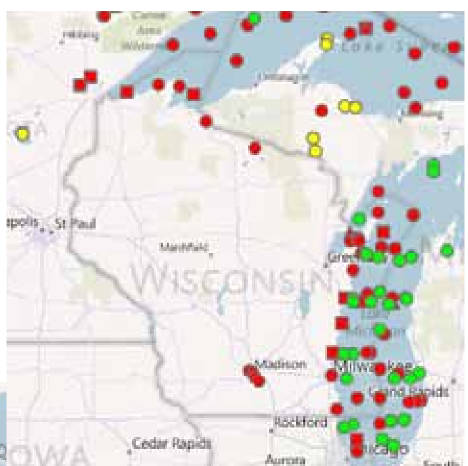
High priority <u>AIS not yet present</u> in Lower Wisconsin River basin as of January, 2012

What are they?
The spiny waterflea is a large zooplankton distinguished by a long, straight tail spine that is twice as long as its body and has one to three pairs of barbs. The fishhook waterflea similarly has a tail with three pairs of barbs, but with a characteristic loop near the end.

Where are they?
Both waterfleas entered the Great Lakes in ship ballast water from Europe – the spiny waterflea arrived in the 1980s, followed in the 1990s by the fishhook waterflea. Spiny waterfleas have been found in Wisconsin in the Gile Flowage (Iron County) in 2003, Stormy Lake (Vilas County) in 2007, and in the Yahara chain of lakes (Dane County) in 2009. No fishhook waterfleas have been found inland in Wisconsin.

How do they spread?
Spiny and fishhook waterfleas were probably introduced to the region from ship ballast water. Both species are likely to be spread secondarily to inland waters by recreational boaters.

Wisconsin distribution of spiny waterflea (top) and fishhook waterflea (bottom). Red = established population, yellow = collected specimen, green = unknown. (*USGS, 2011*)



Why to do we care?
In the Great Lakes, waterfleas have caused changes in the zooplankton community structure, with potentially significant effects on food webs. The tail spines of spiny and fishhook waterfleas also hook on fishing lines, fouling fishing gear. The ecological impact on Wisconsin's inland lakes is not yet well understood. Researchers at the University of Wisconsin-Madison Center for Limnology are currently monitoring Stormy Lake and the Yahara chain of lakes to understand the effect of spiny waterfleas on water quality, fish populations, and lake ecosystems as a whole.

What can we do?
There is currently no known method of eradication or control for these two species. Prevention of establishment and spread are the only means of management. Strengthening and improving existing ballast water regulations and promoting awareness of these species would help in preventing the spread. Bait or bait water should not be released into waterbodies or transported from one waterbody to another. Rinsing boat and equipment with hot water (>104°F), high-pressure water spray, and drying boat and equipment for at least 5 days before re-entering water body will help to control the spread of adults. Thoroughly draining and cleaning motor; bilge, transom and live wells; bait buckets; and fishing apparatus and gear will help to control the spread of adults and resting eggs.

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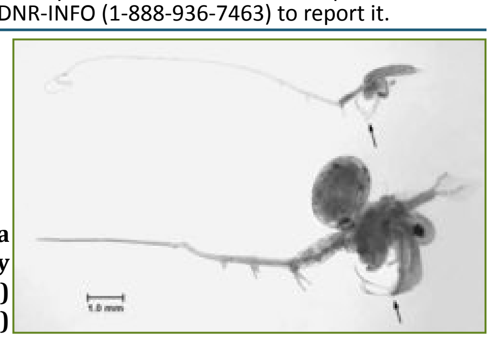


Fishhook waterflea (top) and spiny waterflea (bottom) (*Jim Liebig, NOAA*)

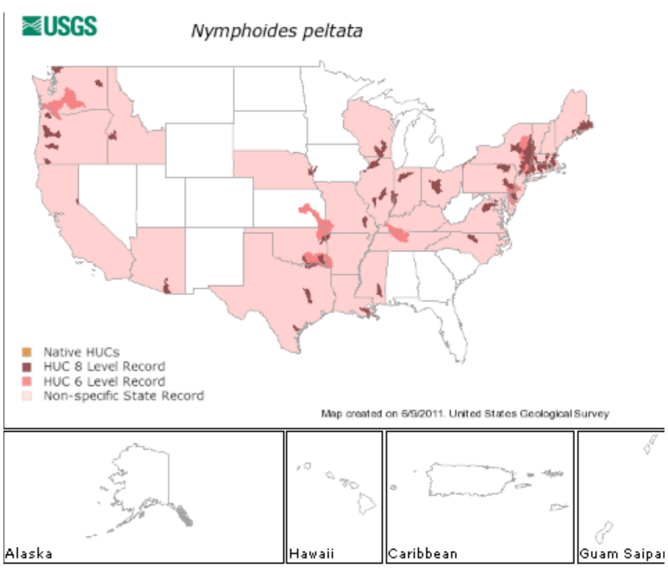
Yellow floating heart
(Nymphoides peltata)

High priority AIS not yet present in Lower Wisconsin River basin as of January, 2012

What is it?
Yellow floating heart is a perennial, aquatic plant that has long, branching stems up to 0.1 inch thick. It often covers the water surface with long-stalked heart-shaped leaves. Its leaves are shaped like a rounded heart, and measure 2-6 inches in diameter. It has bright yellow flowers that rise a few inches above the leaves. Its flowers have five petals with fringed edges, and measure 1-1.5 inches in diameter.

Where is it?
There are five known occurrences of yellow floating heart in Wisconsin, all of which have been in ponds. One pond in Walworth County (found in 2008), two ponds in Marinette County (found in 2010), a pond in Waukesha County (found in 2010) and one pond in Dane County (found in 2006) contained established populations of the species.

How does it spread?
Humans are primarily responsible for the spread of yellow floating heart. It is commonly cultivated as a water garden plant, and has been sold as an ornamental pond species in the United States since 1891. From the established populations as planted water garden species, it can then spread by escaping during flood events, natural dispersal by seed and fragmentation, and hitchhiking on watercrafts, waterfowl and mammals to new locations.



Nationwide distribution of yellow floating heart (*USGS, 2011*)

Why do we care?
Yellow floating heart plants grow at such great densities that they can create extensive mats that can shade out native plants and in some cases, create a stagnant area with low oxygen levels that can be harmful to aquatic wildlife. The mats can also cause problems for recreational activities such as fishing, boating, and swimming.

What can we do?
Yellow floating heart plants are easily cut by hand; however, the plants will quickly recover. If the sediment is soft and the infestation covers a small area, raking out the rhizomes may be a viable option. Aquatic glyphosate (Rodeo®) and dichlobenil may be effective, but permits and special licenses are required. Glyphosate is thought to be less effective than dichlobenil.

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Yellow floating heart

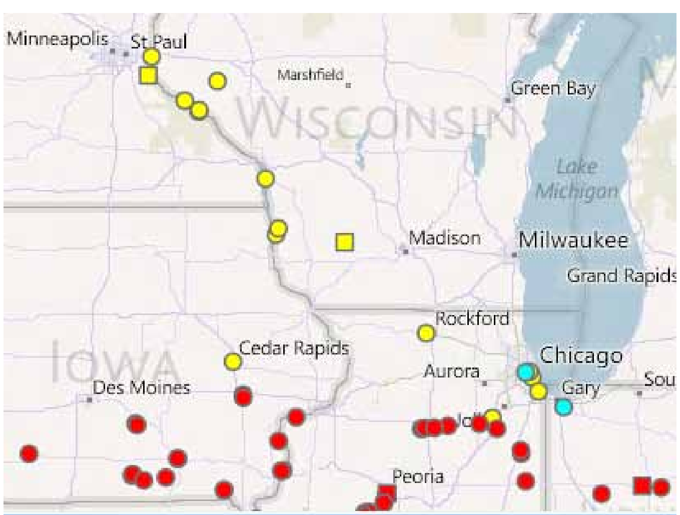
Bighead carp
(Hypophthalmichthys nobilis)

High priority AIS <u>present</u> in Lower Wisconsin River basin

What is it?
Bighead carp are one of four Asian carp species of concern to the Lower Wisconsin River. They are fast growing and become very large, weighing over 100 pounds and measuring up to five feet long.

Where is it?
The bighead carp is native to large rivers in eastern China, eastern Siberia, and northern North Korea. They are established in the Mississippi River south of Rock Island, Illinois; however, several individuals have been found as far north as the St. Croix River. Three bighead carp were captured in the Lower Wisconsin River in 2011: the first, a 30-pound adult, was reported by an angler in July; the second, a large 47-pound adult, was captured in October by WDNR fisheries biologists gill netting for sturgeon at the Prairie du Sac Dam; the third, a 39-pound adult, was caught by an angler below the Prairie du Sac Dam in November.

How does it spread?
The bighead carp was first imported into the United States in the early 1970s. Soon after, it escaped confinement during flood events and is now well established with reproducing populations in much of the Mississippi River Basin. Dispersal of bighead (and silver) carp appears to be occurring naturally, especially during high flow events which enable them to swim around or through barriers in the Mississippi River and Great Lakes region. People also spread carp, intentionally and unintentionally, for bait, aquaculture, and sport.



Regional Wisconsin distribution of bighead carp. Red=established population, yellow=specimen(s) collected, blue=extirpated/eradicated. (*USGS, 2011*)

Why do we care?
In numbers, the bighead carp has the potential to cause enormous damage to native species because it feeds on plankton required by fish, such as gizzard shad and bigmouth buffalo, and native mussels.

Bighead carp, to a lesser extent than silver carp, has the potential to thrash around the surface when spawning, and on rare occasions leap in response to boats.

What can we do?
At this time there is no feasible means of controlling bighead (and other Asian) carp if they were to become established in the Lower Wisconsin River. It is important that we continue to monitor the Lower Wisconsin River to make certain that there is not a breeding population. Angler outreach should be conducted to ensure that they are not harvesting bait (which is currently prohibited), to ensure that young Asian carp, if present, are not being transported to other waterbodies.

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Bighead carp (*USGS*)

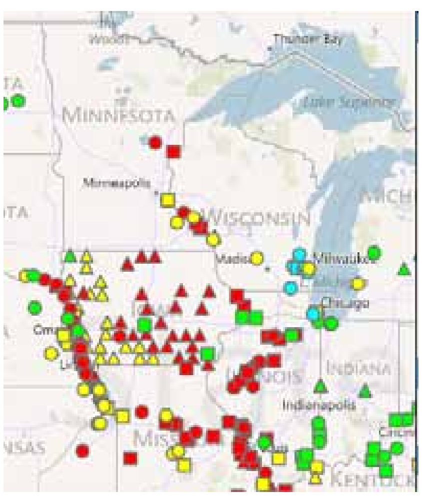
Grass carp
(Ctenopharyngodon idella)

High priority AIS <u>present</u> in Lower Wisconsin River basin

What is it?
Grass carp are one of the four Asian carps of concern to the Lower Wisconsin River. They can grow up to four feet long and weigh up to 40 pounds. They are dark olive, shading to brownish-yellow on the sides, with a white belly and large, slightly outlined scales.

Where is it?
Grass carp prefer quiet waters, such as lakes, ponds, pools, and backwaters of large rivers. Three adult grass carp were captured from the Lower Wisconsin River in 2011 near the Prairie du Sac Dam, in a backwater lake near Lone Rock, and near Mazomanie. There is no evidence for any reproduction or establishment of grass carp in the Lower Wisconsin River (the only Lower Wisconsin fish that was tested was sterile, or "triploid"). The presence of these fish is probably the result of high water in the spring of 2011 that allowed the specimens to migrate north from the Mississippi River system. It is also noteworthy that carps capable of reproduction ("diploid") have been found in the Mississippi River.

How does it spread?
Grass carp were introduced to the United States in the 1960s to control aquatic vegetation. The species is still being stocked today in many states; however, it is illegal to do so in Wisconsin. The majority of released fish are sterile. During floods, escapees from stocked ponds and aquaculture facilities disperse naturally from introduction sites. It is thought that the grass carp captured in the Lower Wisconsin River were originally stocked downstream, perhaps in Iowa. Grass carp migrate great distances during their spawning season in the spring. People also spread carp, intentionally and unintentionally, for bait, aquaculture, and sport.



Midwest regional distribution of grass carp. While specimens have been captured in Mississippi River along the Wisconsin border, no proof establishment yet exists (Lyons, personal communication). Red=established population, yellow=specimen(s) collected, green=population unknown, blue=extirpated/ eradicated. (*USGS, 2011*)

Why do we care?
Grass carp are voracious eaters that can quickly eliminate large volumes of vegetation (up to 40% of their body weight in one day), destroying native fish habitat and degrading water quality. They are also known to consume terrestrial vegetation by digging into banks and uprooting riparian vegetation, causing erosion to banks. The presence of a single adult grass carp in the sloughs of the Lower Wisconsin River could be devastating to this unique and delicate ecosystem.

What can we do?
It is important that we continue to monitor the Lower Wisconsin River to make certain that there is not a breeding population. Anglers should be engaged to ensure that they are not harvesting bait, which is currently prohibited on the Lower Wisconsin and Mississippi rivers. This will ensure that young Asian carp, if present, are not being transported to other waterbodies.

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Grass carp caught in the Lower Wisconsin River (*WDNR*)

Japanese hops
(Humulus japonicus)

High priority AIS <u>present</u> in Lower Wisconsin River basin

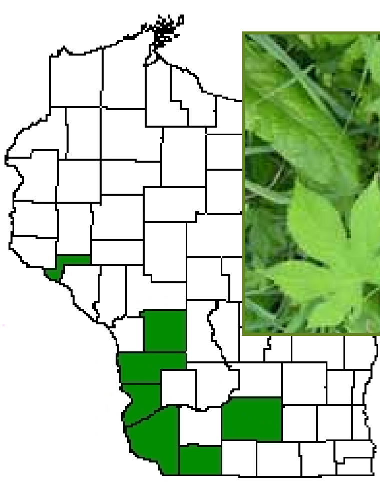
What is it?
Japanese hops is a herbaceous annual, twining, shallow-rooted vine that can climb to heights of ten or more feet with the help of rough-textured stems covered with short, sharp, downward pointing prickles that can be very irritating to the skin. Its leaves typically have 5-7 lobes.

Japanese hops may be confused with the common hop (which looks like Japanese hops but is usually 3-lobed or unlobed) and native bur cucumber (which lacks prickles, has tendrils, and the leaves have much less-pronounced lobes).

Where is it?
Japanese hops have been observed in floodplains, stream corridors, pastures, and on roadsides in Missouri, Illinois, Michigan, southern Indiana, Ohio, and Wisconsin, southeastern Minnesota, and southern Canada. It is widespread in the Grant and Platte rivers (tributaries to the Upper Mississippi River) in Grant County, Wisconsin. It was recently discovered in the Blue River watershed (a tributary to the Lower Wisconsin River) in Grant County, WI, and Copper Creek, a tributary to the Mississippi River.

How does it spread?
Japanese hops seeds are dispersed by animals, wind, and water. It appears that flowing water is the primary dispersal mechanism along rivers. Anecdotal evidence in the Blue River watershed (specifically Pleasant Valley Creek) suggests that mowing or baling equipment and bales transported for feed may be responsible for its spread between watersheds.

Japanese hops (*David Eagan*)



Wisconsin Japanese hops distribution (*WDNR, 2011*)

Why do we care?
The vines grow rapidly during the summer, climbing up and over everything in their path and can form dense mats several feet deep, blocking light to plants underneath. Hop vines also twine around shrubs and trees, causing them to break or fall over. It also displaces native vegetation and prevents the emergence of new plants.

Japanese hops are noxious due to its short prickly hairs on the stems and leaves. It is unpleasant to walk through and can scrape and cut unprotected skin. Its pollen has been known as one of the important causes of hay fever and allergies in other countries where it is better established.

What can we do?
Educating owners and managers of property infested with Japanese hops is important in the prevention of the spread. Early detection of small isolated patches that may be treated prior to the seeds being spread downstream may help to contain the spread. It is likely that hops are more widespread than we know, though increased monitoring is necessary.

Hops seeds are viable for three years. Therefore, control is feasible; however, it will take multiple years to accomplish. Chemical and manual treatments are possible.

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Zebra mussel
(Dreissena polymorpha)

High priority AIS <u>present</u> in Lower Wisconsin River basin

What is it?
Zebra mussels are small shellfish that can grow to 2 inches in length. Color patterns can vary to the point of having only dark or light colored shells and no stripes. They are typically found attached to objects, surfaces, or each other by threads underneath the shells. Although similar in appearance to the quagga mussel, the two can be distinguished. When placed on a flat surface, zebra mussels are stable on their flattened underside while quagga mussels, lacking a flat underside, will fall over.

Where is it?
Zebra mussels are native to the Black, Caspian, and Azov seas. By 1990, zebra mussels had been found in all the Great Lakes. The following year, zebra mussels escaped the Great Lakes basin and found their way into the Illinois River leading to their introduction into the Mississippi River drainage.

As of 2003, their distribution included the entire Wisconsin portion of the Mississippi River, extending up to Stillwater, MN and the St Croix River. In 2008, they were found by Alliant Energy and citizen monitors at the Prairie du Sac Dam on turbines and sampling plates upstream in Lake Wisconsin. Since, they have been detected immediately downstream of the dam and at the Orion mussel bed attached to native mussels. They have also been reported in 139 other inland lakes and rivers in Wisconsin.

Regional Wisconsin distribution of zebra mussels. The locations of several zebra mussels found in the Lower Wisconsin River not shown on map. Red=established population, yellow=specimen(s) collected, green=population unknown. (*USGS, 2011*)

How does it spread?
Zebra mussels were likely introduced to North America in the ballast water of ships traveling to the Great Lakes. Secondary spread has been the result of it being transported by recreational boaters, both adult mussels and their larvae (veligers).

Why do we care?
Zebra mussels pose a serious threat to the diverse native mussel populations of the Lower Wisconsin River, can pollute the popular beaches and sandbars of the river, and can easily be spread to surrounding waterbodies via boaters. According to research conducted by the University of Wisconsin-Madison Center for Limnology, the majority of nearby lakes, including Devil's Lake and the Madison lakes are susceptible to zebra mussel colonization. Once established, zebra mussels could cause an increase in utility rates throughout the region through their potential to clog intake pipes, turbines, and other equipment.

What can we do?
Containment is the best approach. Increased efforts to educate boaters about the new AIS transport laws and enforcement of these laws are needed. Clean Boats, Clean Waters inspections should continue to be conducted at heavily used landings. Boat washing stations could be a viable option at landings on Lake Wisconsin and below the dam on the Lower Wisconsin River, in locations such as the VFW landing in Prairie du Sac. To eradicate zebra mussels (and properly wash gear and watercraft), they should be exposed for a prolonged period of time to high-pressure water at a temperature above 140°F.

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Zebra mussels (*USGS*)

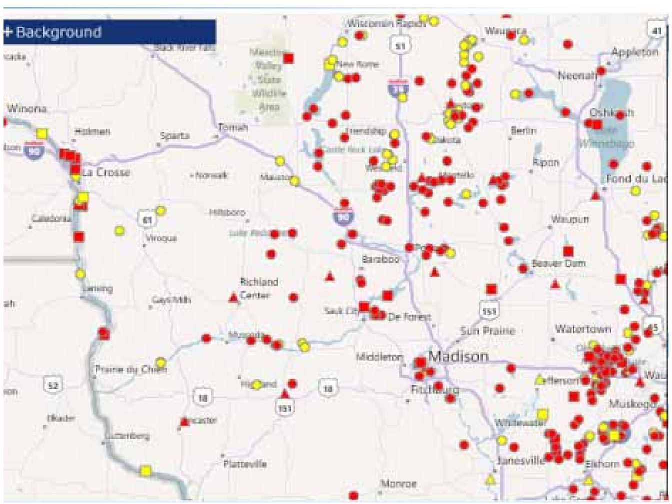
Eurasian watermilfoil
(Myriophyllum spicatum)

Low priority AIS <u>present</u> in Lower Wisconsin River basin

What is it?
Eurasian watermilfoil is an aquatic plant. Its stems tend to be limp, and may show a pinkish-red color. The leaves are typically divided into 12 or more pairs of threadlike leaflets. The most common native watermilfoil, northern watermilfoil, tends to have whitish or brownish stems, and leaves that divide into fewer than 10 pairs of leaflets.

Where is it?
Eurasian watermilfoil is one of the most widely distributed invasive aquatic plants, confirmed in 45 U.S. states, and in the Canadian provinces of British Columbia, Ontario and Quebec. It was first documented in the Lower Wisconsin River basin in 1965 in Avoca Lake. It has been found in 22 of the 100 Lower Wisconsin River floodplain lakes surveyed and other heavily visited nearby lakes, including White Mound Lake, Cox Hollow Lake, the Yahara chain of lakes in Madison, Devil's Lake, Lake Wisconsin, and Lake Delton.

How does it spread?
Eurasian watermilfoil was probably intentionally introduced to the United States. After being planted in waterbodies around the continent, its spread continued naturally as pieces of it were disseminated in flow and by motorboat traffic. Today, transport on boating equipment plays the largest role in introducing fragments to new waterbodies. It continues to spread through the aquarium and water garden trades as well.



Distribution of Eurasian watermilfoil in southern Wisconsin. Red=established population, yellow=specimen(s) collected. (*USGS, 2011*)

Why do we care?
Eurasian watermilfoil competes aggressively to displace and reduce the diversity of native aquatic plants, and it has less value as a food source for waterfowl than the native plants it replaces. The growth and vigor of warmwater fisheries can be harmed by the presence of dense Eurasian watermilfoil cover. Specifically, the growth of thick vegetation degrades water quality and depletes dissolved oxygen levels. Eurasian watermilfoil has also played a role in the spread of the invasive zebra and quagga mussels. Zebra mussels have been found attached to watermilfoil being transported on the trailers of recreational boaters from one waterbody to another.

What can we do?
Eradication is most likely impossible. Currently, herbicides or mechanical harvesting are most often used to control watermilfoil infestations. Small Eurasian watermilfoil infestations can be hand pulled. Drawdown of water levels may be another feasible option on impounded bodies of water. Biocontrol is not currently an option in flowing systems. The best defense against Eurasian watermilfoil is to ensure that waterbodies are not heavily impacted by nutrient pollution, and that native plants aren't removed (which occurs in the presence of voracious omnivores, such as the grass carp), and to minimize hydrologic disturbances.

STOP AQUATIC HITCHHIKERS!

Wisconsin law requires you to:

- **<u>Inspect</u> boats, trailers, and equipment.**
- **<u>Remove</u> all attached aquatic plants and animals.**
- **<u>Drain</u> all water from boats, vehicles and equipment.**
- **<u>Never move</u> plants or live fish away from a waterbody.**

If you suspect that you have found an invasive species call 1-888-WDNR-INFO (1-888-936-7463) to report it.

Eurasian watermilfoil (*Graves Lovell*)

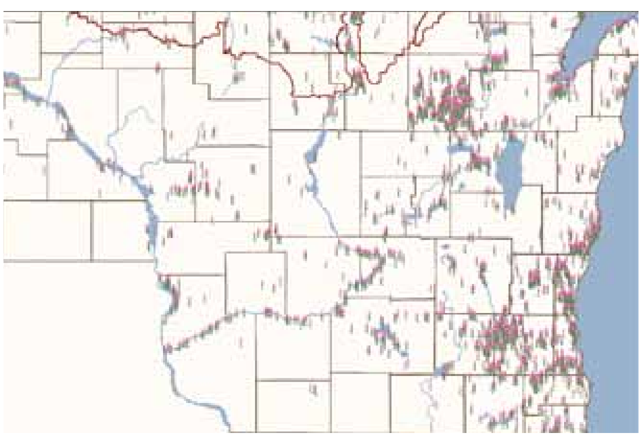
Purple loosestrife
(Lythrum salicaria)

Low priority AIS <u>present</u> in Lower Wisconsin River basin

What is it?
Purple loosestrife is a wetland plant, growing in freshwater wet meadows, marshes, river and stream banks, pond edges, reservoirs, and ditches. It prefers moist soils but can tolerate a wide range of conditions. It can withstand shallow flooding, and tolerates up to 50% shade. It flowers from July until September or October. A mature plant produces about 2,700,000 seeds a year.

Where is it?
Purple loosestrife is widely spread in Wisconsin, with 70 of the 72 counties reporting populations. It is found throughout the Lower Wisconsin River basin.

How does it spread?
Purple loosestrife was likely brought to North America in the 1800s both intentionally, as an ornamental plant, and unintentionally, by ships dumping ballast or European raw sheep wool that contained seeds. Humans have continued to transport it throughout the U.S. as a landscaping plant and as a food source for bees due to its nectar-producing capabilities. Purple loosestrife spreads naturally through either vegetative spread or through seed dispersal. Additionally, animals and humans can be a vector of transport when seeds stuck in mud are attached to bodies, equipment, or vehicles.



Southern Wisconsin distribution of purple loosestrife (*GLIFWC, 2011*)

Why do we care?
Purple loosestrife can form monotypic stands that outcompete native wetland plants and can change the soil and water chemistry of the ecosystem. It can have a negative impact on tadpoles and birds, such as black terns, least bitterns, pied-billed grebes and marsh wren. Additionally, other marsh birds that prefer to nest in native marsh grasses are negatively impacted by purple loosestrife stands since the native grasses, sedges and flowering plants supply a higher quality of cover, food, or nesting sites.

What can we do?
Removal by cutting and pulling before flowering begins and seeds are developed is recommended for small populations only. Herbicides, such as Rodeo or Roundup may be used. The best technique is to cut the purple loosestrife stems at knee level and then to apply the herbicide directly onto the stump of the cut stem. Biocontrol is recommended for heavy infestations. The rearing and release of Galerucella beetles, used for biocontrol, can be done by volunteers. Wisconsin's Purple Loosestrife Biocontrol is a long-standing, successful beetle-raising program.

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If you suspect that you have found an invasive species call 1-888-WDNR-INFO (1-888-936-7463) to report it.

Purple loosestrife (*USGS*)

RECOMMENDED MANAGEMENT STRATEGIES & ACTIONS SPECIFIC TO GOALS

Detailed below are recommended management strategies and actions, associated with the three goals for this Plan. Related to each goal are strategies, and associated to each of the strategies are specific management actions.

Goal I – Prevention

Implement procedures and practices to prevent new introductions or dispersal of aquatic invasive species into Lower Wisconsin River basin waterbodies.

Strategy: Increase monitoring and reporting of incidental findings of AIS as an effective way to protect the Lower Wisconsin River basin from the introduction and spread of AIS.

The most effective strategy to combat AIS is to implement preventative measures—the backbone of which is increased monitoring and reporting. Considerable on-the-ground monitoring of water resources occurs every year, performed by agency staff and citizens alike. Ensuring that these efforts include AIS documenting and reporting is an important step to protecting the integrity of waterbodies in the Lower Wisconsin River basin and in Wisconsin statewide.

AIS awareness sign on Elk Creek, Chippewa County

Action IA1: Integrate AIS reporting into state and federal agency field staff protocols to facilitate sharing of data and early detection and rapid response programs.

All current monitoring and surveying efforts conducted by WDNR bureaus (Watershed, Fisheries Management, Endangered Resources, Science Services) and federal agencies (U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, U.S. Geological Survey) in the Lower Wisconsin River basin—and elsewhere in Wisconsin—should promptly report discoveries of prohibited or restricted AIS made while in the field. Most of these discoveries will likely be incidental, in the absence of intentional and explicit monitoring for AIS. These findings should be reported immediately to the appropriate agency contacts and the general public, depending on the severity of the infestation. Additionally, the findings should be reported via Aquatic Invasive Plant Incident Reports (WDNR form 3200-125) or Aquatic Invasive Animal Incident Reports (WDNR form 3200-126) and submitted to the SWIMS database per existing WDNR Water Quality Bureau field staff protocols. WDNR and the River Alliance of Wisconsin have the capacity to provide this training to interested bureaus within WDNR.

Action IA2: Appoint a Lower Wisconsin State Riverway Aquatic Ecologist position.

The creation of a Lower Wisconsin State Riverway Aquatic Ecologist position could ensure that aquatic issues (including preventing the spread of AIS, and coordinating monitoring efforts) are integrated with the environmental protections inherent to the Riverway, as environmental quality issues have a profound effect on both native and invasive species. This position could provide a complementary "aquatic" perspective to the current "lands" perspective of the Lower Wisconsin State Riverway, and could be tasked with developing monitoring protocols, acquiring necessary equipment, and coordinating monitoring teams for annual native species monitoring and surveying efforts (which should include AIS). The position could potentially be placed under the jurisdiction of the Lower Wisconsin State Riverway Board.

Action IA3: Increase citizen monitoring efforts on Lower Wisconsin River Basin waterbodies.

Local citizen watershed, conservation, and sporting groups, such as Friends of the Lower Wisconsin Riverway and Sauk Prairie River P.A.L., as well as chapters of Trout Unlimited and Ducks Unlimited, should be further engaged in the monitoring of AIS in local waters through existing programs, such as the River Alliance of Wisconsin's Project RED and the Mussel Monitoring of Wisconsin program. Additionally, an "Adopt a Slough" program could be developed in conjunction with local county land and water conservation staff or school groups, tasked with monitoring for invasive and native plant species along the Lower Wisconsin State Riverway.

Action IA4: Implement zebra mussel surveying in main stem of Lower Wisconsin River.

Though zebra mussels (Dreisenna polymorpha) have been found on the tainter gates and turbine bays in the powerhouse of the Prairie du Sac Dam, and have been increasingly turning up on downstream native mussel beds such as the Orion bed, no systematic survey of the Lower Wisconsin River for the species has occurred to date. A significant effort should be undertaken by WDNR to survey the adult and veliger zebra mussel population in the river downstream of the dam and in other likely locations for their colonization. Known mussel beds are logical places to look for zebra mussels. If established, these mussels can endanger sensitive native mussel populations, recreational opportunities on the river, and infrastructure management expenditures.

Zebra mussels on a native mussel shell

Strategy IB: Engage stakeholders in education, outreach, and partnership efforts as an effective method of preventing the introduction and spread of AIS into the Lower Wisconsin River basin.

As awareness about the threat of AIS grows, new stakeholders are becoming involved with the issue, and should be engaged as partners by local agencies and organizations involved with AIS management. Local citizen stakeholder groups—including conservation, recreation, and sporting clubs—have much to offer federal, state, and regional governments organizations and institutions, many of which are already resource-depleted. Often, the roles of agencies and local citizen groups can be supporting and complementary, provided these groups are engaged early in the process. Listed in Actions IB1-IB3 are strategic ways that local citizen stakeholder groups in the Lower Wisconsin River basin can be engaged on AIS issues.

Action IB1: Educate Lower Wisconsin River basin users about AIS threats, laws, and best practices through a multi-faceted public information campaign

A strategic, multi-faceted AIS public information campaign in the Lower Wisconsin River basin could be an effective method of getting critical AIS information to targeted basin user groups, including recreational boaters, anglers, hunters, and outdoor enthusiasts. Additionally, local municipalities or tourism boards with a stake in the health of Lower Wisconsin River basin waterbodies should be engaged as they may be key partners in such an effort, particularly for staff and/or funding purposes. The campaign could consist of outreach efforts through various media: billboard installations at the western and eastern ends of the Highway 14 corridor, ads in local newspapers and publications, public service announcements via local media outlets, flyers and signage at high-traffic venues such as bait and sporting goods shops and restaurants, announcements on internet sites, and booths or information tables at popular events in the basin, such as the Sauk County Earth Day celebration, the Coulee Region Trout Unlimited chapter's "Troutfest," the Ferry Bluff Eagle Council's "Eagle Days," and other events.

Action IB2: Ensure current and consistent AIS signage at Lower Wisconsin River basin waterbody landings

As of fall 2011, all public Lower Wisconsin River landings exhibit current and consistent WDNR AIS signage ("Prevent the Spread of Invasive Species—It's the Law"). The River Alliance of Wisconsin will continue to partner with Trout Unlimited chapters, WDNR property managers, counties, and other local stakeholder groups to post "Prevent the Spread of Invasive Species—It's the Law" sign on warmwater river or lake accesses, and "Protect Wisconsin's Streams—Stop Invasive Hitchhikers" signs on coldwater stream accesses. Owners of privately-owned municipal landings will be approached as part of this effort, as well.

WDNR AIS sign

Action IB3: Continue Clean Boats, Clean Waters courtesy watercraft inspections on high-traffic Lower Wisconsin River basin waterbodies

Volunteer Clean Boats, Clean Waters (CBCW) courtesy watercraft inspectors should continue to work high-traffic boat landings on the Lower Wisconsin River, area sloughs and lakes, and highly visited tributaries like the Kickapoo River throughout the summer and fall recreation season. These volunteers play a valuable role in not only gathering AIS data, but also educating waterbody users about AIS via a non-regulatory, non-threatening, citizen-to-citizen approach. Volunteers—from local stakeholder groups—are ideal for CBCW inspector positions, as paying for these positions can be cost-prohibitive. The following landings are highly used, and should be priority CBCW locations: Veterans Memorial Park in Prairie du Sac, Highway 14 at Spring Green, Arena, Boscobel, and Muscoda on the Lower Wisconsin River; Cox Hollow and Twin Valley landings at Governor Dodge State Park; Blackhawk Lake; and the Kickapoo River. CBCW inspectors could also play a critical role at high-use waterfowl hunting landings on floodplain lakes and sloughs in the fall, but recruitment of volunteers may be difficult due to the colder and potentially inclement weather of hunting season.

Action IB4: Hold "AIS Legislator Forum" in southwestern Wisconsin to ensure policy-makers are aware of AIS issues

To increase the awareness of state and local lawmakers of AIS threats and concerns, an "AIS Legislator Forum" should be held in the Lower Wisconsin River basin. Many lawmakers are likely familiar on some level with the threats posed by high-profile AIS such as Asian carp, but not with more immediate, pressing local threats, such as the faucet snail and didymo. Local stakeholder groups such as Friends of the Lower Wisconsin Riverway, Sauk Prairie River P.A.L., Valley Stewardship Network, Wisconsin Waterfowl Association, U.S. Coast Guard Auxiliary Flotilla 45-8, Smallmouth Bass Alliance, Wisconsin River Sportsmens' Club, Wisconsin Bowfishing Association, Trout Unlimited Driftless Area Restoration Effort, and local chapters of Trout Unlimited, Ducks Unlimited, and Izaak Walton League, could host this event, and personally invite their respective legislators. Additionally, business owners who rely on a healthy Lower Wisconsin River—or tributary—should also be invited to discuss the importance of maintaining a healthy river system. This event may not result in specific pieces of AIS legislation, but may raise the profile of the issue in the eyes of policy-makers.

Strategy IC: Increase enforcement of AIS regulations by state, county, municipal, and WDNR law enforcement agencies

The state of Wisconsin regulates invasive plant, animal, invertebrate, and pathogen species via administrative rules NR 40 and parts of NR 19 and 20. Put simply, these rules make it illegal to transport, possess, transfer, and introduce prohibited species in Wisconsin. Though these laws have been on the books for more than two years, they are not yet enforced, with the exception of episodic enforcement by WDNR conservation wardens and water guards. Law enforcement agencies should educate officials on the enforcement of AIS laws, as well as on the overall identification and best practices of AIS management as it pertains to Wisconsin's laws. The transition from the "education phase" to the "enforcement phase" should have already occurred.

Action IC1: Engage Lower Wisconsin River basin law enforcement entities as partners in the outreach and enforcement of Wisconsin's AIS laws

As mentioned above, law enforcement agencies play a critical in disseminating AIS information, as well as enforcing AIS regulations. Lower Wisconsin River basin law enforcement officials, including state, county, and municipal police, but especially WDNR conservation wardens and water guards, are invaluable partners in the fight against AIS. Agencies and organizations working on AIS issues in the region should work with these entities, if necessary, providing educational AIS resources and advocating for enforcement of AIS laws. A highly-visible and cost-effective method of raising the profile of AIS enforcement on the river would be to work with DNR water guards, wardens, and local law enforcement to hold a Lower Wisconsin River "group check." Group checks, customarily held on high-traffic weekends, station wardens and water guards at landings in a concentrated geographic area, enforcing AIS laws. This should be done on the Lower Wisconsin River, focused on the area from Prairie du Sac downstream to Mazomanie or Arena. Roadside AIS checkpoints could also be established on major roadways as part of this effort. Additionally, law enforcement officials should continue to have a (multi-lingual) presence at high priority landings on the Lower Wisconsin River, especially between the Prairie du Sac Veterans Memorial Park landing and the Prairie du Sac Dam, an area characterized by high angler foot traffic.

Goal II – Containment

Develop management strategies to limit the spread of established populations of aquatic invasive species to and from Lower Wisconsin River basin waterbodies.

Strategy IIA: Establish clearly defined roles and responsibilities, and coordinate between the various government agencies, non-governmental organizations, and citizen groups working on AIS issues in the Lower Wisconsin River basin

Numerous entities and groups in the Lower Wisconsin River basin are AIS stakeholders—from local citizens to federal agencies— yet they often aren't apprised of the AIS-related activities of other groups. For that reason, one of the most valuable and effective approaches to combating the introduction and spread of AIS is establishing coordination and open communication between these groups.


River Alliance of Wisconsin AIS presentation in Spring Green

Action IIA1: Engage local stakeholders in a coordinated effort to address AIS issues by organizing a regional Lower Wisconsin River Basin AIS Working Group

The Lower Wisconsin River basin is threatened by a host of AIS, and new AIS discoveries are made with increasing frequency. The development of a Lower Wisconsin River Basin AIS Working Group will serve as a venue for engaging local stakeholders, provide an introduction to regional AIS issues, and lay the groundwork for the development of future partnerships between different stakeholder groups. Once established, the group should be prepared to respond on some level to pressing AIS discoveries, such as the finding Japanese hops in Grant County in the summer of 2011. The group should establish a memorandum of understanding, which will define roles and responsibilities and coordination. Local groups to potentially include in this working group may include (but are not limited to): county staff or members of the board of supervisors, Southwest Badger Resource Conservation and Development, Friends of the Lower Wisconsin Riverway, Sauk Prairie River P.A.L., Valley Stewardship Network, Wisconsin Waterfowl Association, U.S. Coast Guard Auxiliary Flotilla 45-8, Smallmouth Bass Alliance, Wisconsin River Sportsmens' Club, Wisconsin Bowfishing Association, Trout Unlimited Driftless Area Restoration Effort and local chapters of Trout Unlimited, Ducks Unlimited, and the Izaak Walton League.

Action IIA2: Incorporate robust consideration of aquatic resource issues into all aspects of Lower Wisconsin State Riverway plans and management objectives

The current revision of the Lower Wisconsin State Riverway Master Plan is being spearheaded by the WDNR Bureau of Facilities and Lands, incorporating Riverway considerations related to property management, wildlife, terrestrial ecology, etc. At the heart of the Riverway, though, is the river itself, and the waters that form it. Protection of these waters—including the diverse native plant and animal species they support—should be paramount. A healthy river system should be the goal of all management and funding priorities for the Riverway, which will build resiliency to threats from polluted runoff, groundwater withdrawals and contamination, and AIS introductions. This integration of aquatic issues into Riverway management priorities could be rolled out in conjunction with the celebration of the 25th anniversary of the Riverway in 2014.

Action IIA3: Establish and maintain regional aquatic invasive species coordinator positions in the Lower Wisconsin River basin

AIS coordinator positions at the county and/or regional levels should be established/maintained to continue to prevent, control, and abate AIS infestations and coordinate between other (state and federal) agencies and citizen stakeholder groups working on AIS in the Lower Wisconsin River basin. To date, regional AIS Coordinators have provided focused attention to local AIS concerns. Additional coordinators at county and multi-county regions could provide even more attention to AIS issues. Grant funding for such positions may be available through WDNR.

Action IIA4: Host a scenario-based AIS planning and response session with stakeholders

In order to gauge and build the preparedness of federal, state, and local stakeholders to responding to new AIS infestations, a scenario-based planning session should be held, replicating an actual AIS infestation. This exercise could highlight strengths, weaknesses, opportunities, and threats. The workshop should be jointly hosted with local stakeholder groups, and the Lower Wisconsin River Basin AIS Working Group, once organized.

Strategy IIB: Encourage AIS and economic impact research in Lower Wisconsin River basin

Myriad opportunities exist to partner with area universities, technical schools, and research divisions of state and federal agencies near the Lower Wisconsin River basin on the topic of AIS. As detailed elsewhere in this plan, numerous AIS are "knocking on the door" of the basin. Despite a growing body of research and literature, there is still uncertainty in the scientific and natural resource management communities as to what the impacts—ecological, economic, and cultural—of the arrival of certain AIS will be. As such, the need for this research should be promoted widely, and funded accordingly.

2011 River Alliance/WDNR statewide biologists AIS training

Action IIB1: Perform economic analysis of ecologically healthy Lower Wisconsin River basin

In 2008, Trout Unlimited and NorthStar Economics determined that the annual economic impact of recreational trout angling in the Driftless Area of Wisconsin, Minnesota, Illinois, and Iowa is approximately $1.1 billion. These findings have been helpful in leveraging funds to implement conservation efforts to protect coldwater fisheries in the region and beyond. A study that identifies the similar economic impact of recreation on the Lower Wisconsin River and its tributaries to surrounding communities and businesses may help leverage funding to conduct prevent, contain, and control the further spread of AIS.

Action IIB2: Encourage further research of AIS of concern to the Lower Wisconsin River basin

Further research is required on the ability of certain AIS of concern to establish and reproduce in waterbodies of the Lower Wisconsin River basin. An example is Asian carp—though specimens have been captured in the Lower Wisconsin, it is not clear whether sufficient spawning habitat exists for these species to be reproductively successful. Regional institutions of higher education are obvious partners for these efforts, as are research arms of state and federal agencies. The need for this research should be promoted widely, and supported through funding programs.

Goal III - Control

Abate, and where possible, eliminate harmful ecological, economic, social and public health impacts resulting from the infestation of aquatic invasive species in Lower Wisconsin River basin waterbodies.

Strategy IIIA: Develop statewide and regional AIS rapid response plans

While WDNR is currently developing a statewide AIS rapid response plan, it is not clear when it will be completed and available to the public. Such a plan will provide a framework from which regional rapid response plans can be developed. WDNR should prioritize the development of the plan in a timely fashion. A potential component of the plan should be the development of regional AIS response teams (including one for the Lower Wisconsin River basin), where the appropriate natural resource managers and decision-makers in a geographic region are at the ready to organize and coordinate response efforts to new AIS infestations.

Action IIIA1: Develop a regional Lower Wisconsin River basin AIS control plan modeled after the statewide plan

After WDNR's publication of a statewide AIS rapid response plan, WDNR should assist AIS stakeholders, potentially including the Lower Wisconsin River Basin AIS Working Group (once organized), in Lower Wisconsin River basin in the development of their own regional AIS rapid response plan. The plan should include a decision-making process to prioritize the control of existing AIS populations and organize the response to new AIS infestations based upon the local ecology, institutional frameworks, and available resources.

Strategy IIIB: Strengthen existing statewide AIS policies, or establish new statewide AIS policies, to more strongly protect against invasions of AIS

The control of AIS often requires regulation, from either federal or state governments. As detailed elsewhere in these recommendations, Wisconsin regulates AIS, but loopholes in these regulations exist. These regulations should be reviewed and strengthened to address the issues listed below.

Action IIIB1: Prevent the importation and distribution of AIS in Wisconsin by retail or commercial vendors

Bait shipments from out-of-state wholesalers are vectors of introducing AIS fish species into Wisconsin, particularly mosquitofish (Gambusia) and Asian carp species. Retailers are subject to scrutiny, but wholesalers responsible for bringing bait shipments in-state are an issue that NR 40 does not adequately address. The WDNR Fisheries Management Bureau has developed best management practices for this industry: http://dnr.wi.gov/invasives/pdfs/invasivefish_bmp.pdf. The state's regulation of this and other industries, including mail-order pond aquaculture and aquarium fish and plants, fish imported by grocery stores (sometimes purchased as bait by anglers), and plant nursery stock, needs to be more stringent to prevent the introduction of AIS into Wisconsin waters.

Factors to consider in assessing whether to attempt to eradicate an invasive species.

What is the cost of action?
What is the expected cost (time and money) of eradication?
What is the probability of having to repeat the eradication attempt, due either to failure or reinvasion?-What is the expected cost of collateral damage (ecosystems or humans)?
What is the cost of any additional ecological restoration?

What is the likelihood of eradication success?
Biological factors:
Is the invader detected early in invasion sequence?
What is the status of the invader (density, area infested, rate of range expansion)?
Is the species/habitat amenable to eradication?
What is the likelihood of reinvasion?
Social and institutional factors:
Are there sufficient resources to carry the project to completion?
Are institutions capable of carrying out an eradication (leadership, funding, well-defined lines authority, ability to harness efforts of other institutions)?
Is there public support and participation?
Are there other legal or institutional barriers that would limit or delay eradication?

What is the cost of inaction?
What are the anticipated economic and ecological costs/impacts of the invader?
What is the probability of the invader causing negative impacts?

Figure 43: Rapid response planning questions (Vander Zanden et al., 2010)

Action IIIB2: Establish a phased-in statewide ban on felt-soled wading boots and equipment

WDNR should establish a statewide ban on felt-soled wading boots or similar equipment. This equipment has been shown to be the primary vector of the spread of New Zealand mudsnails and didymo algae—AIS with the capacity to decimate coldwater systems like trout streams. The ban should be phased-in over the period of three years, over which time vigorous outreach and education regarding the ban should take place, aided by stakeholder groups such as Trout Unlimited, Badger Fly Fishers, and the Wisconsin Smallmouth Bass Alliance.

Strategy IIIC: Encourage the development of new AIS control strategies and technologies to abate the negative effects of established AIS populations on native species.

Control of AIS also entails physical, chemical, or biological measures. An example of chemical control is listed below, but new technologies and research on all methods of AIS control should be explored and encouraged, provided impacts to ecological and human health are adequately addressed.

Action IIIC1: Using Lower Wisconsin River as a reference, evaluate applicability of zebra mussel biocontrol research to a large river ecosystem

Zebra mussel biocontrol techniques are currently being developed by the U.S. Geological Survey's Upper Midwest Environmental Sciences Center in La Crosse, Wisconsin, and field-tested in a separate project in lakes in Douglas County, MN. The Lower Wisconsin River is a good candidate for testing the efficacy of this research in a large river system, as zebra mussels exist on the Prairie du Sac Dam, as well as in isolated downstream mussel beds.

WISCONSIN AIS CASE STUDIES & LESSONS LEARNED

The discovery of a new infestation of AIS requires careful and often rapid response. There are many factors to consider in determining whether or not rapid response actions are required, but foremost should be considerations about the type of AIS, and the location of the infestation. Particular importance should be placed on responding to AIS that are new to the state, or to a defined geographic region, such as a watershed. Also important are species with specific AIS designation, such as prohibited and restricted species in the state of Wisconsin. The "perfect storm" scenario, or one that requires the utmost attention, is the first statewide or regional discovery of a prohibited species.

Upon an AIS discovery, a set of general questions should be considered to help determine whether or not action should be taken. The questions below, adapted from Vander Zanden, Hansen, Higgins, & Kornis (2010) (Figure 43), are broken into three question categories: the cost of action, the likelihood of eradication success, and the cost of inaction. Prior to undertaking eradication efforts, it is essential to estimate project costs, including staff requirements.

The immediate priority following a discovery of AIS should be to contain the population quickly, to slow any further spread while making decisions regarding future actions. Once the population is contained, more information can be collected about the species, both on-site and in literature, to help make an informed decision about action (Naylor, 2000). That said, it is noteworthy that there have been many successful eradication projects with little to no knowledge of population biology; however, these were largely done early in the invasion process (Simberloff, 2003).

Additional questions should be answered to determine the course of action. Such as,

- Who owns the property where the AIS infestation was discovered?
- Who will be the leader/point person of the project?
- What background biological information can be collected about the species (i.e. transportation, reproduction, etc.)?
- What stakeholders should be included in the planning (good to include the public and contractors from the outset)? Who will potentially be impacted by the infestation and resulting control actions?
- Who will provide the physical labor necessary to undertake the project? Can volunteers from an organization be used? Should short-term help (possibly college students, etc.) be hired?

- How can community support for containment, eradication and the prevention of future introductions be built?
- Are there physical or legal limitations to the removal effort?

Eradication is not always a viable goal; however, this shouldn't justify inaction. In fact, it is important to consider other population control outcomes other than complete eradication. With a smaller population and/or lower population density, some of the negative impacts of specific AIS may be avoided or reduced, particularly, a decreased likelihood that the species will spread into new areas, and potential increased opportunities for future eradication or containment. Decreased AIS populations may also provide an opportunity for re-establishment of native species.

Since the initial planning stages of the Lower Wisconsin River Basin AIS Strategic Plan in November of 2009, there have been a number of infestations of prohibited AIS discovered throughout Wisconsin which lend insights into rapid response planning. In the case of the red swamp crayfish and water celery, it was the first infestation of its kind in the state. Each of the following responses to the new discoveries occurred, or is currently ongoing, through a combination of the above described steps. Listed below are case study summaries of several rapid response actions that have been taken in the state in the last two years. The intention of highlighting these case studies is that lessons may be gleaned from them and applied to future AIS discoveries and/or rapid reponse efforts.

Case study: Water hyacinth and water lettuce at Orchid Heights in Middleton, WI

Background:

Water hyacinth (Eichhornia crassipes) and water lettuce (Pistia stratiotes) were discovered in two connected ponds near the Pheasant Branch Conservancy in the City of Middleton by botanist and member of the Friends of Pheasant Branch, Guerdon Coombs, in 2006. Coombs submitted reports to the University of Wisconsin Herbarium in 2008 and 2009 and reported his findings to Susan Graham, WDNR. The origin of the infestation could not be determined. The populations existed at low densities in 2008 and 2009, but over the summer of 2010 the population erupted. The water hyacinth was found only in one pond, but the water lettuce had invaded both ponds and a connected marsh. The two ponds and marsh are connected to Pheasant Branch Creek which drains to Lake Mendota and the Madison chain of lakes, so the threat of the AIS spreading to new locations downstream was very high. The plants are not believed to be able to survive the winter in Wisconsin, but it is yet to be determined if their seeds are capable of remaining viable to germinate the next growing season. For this reason, flowering plants were considered a priority for this removal effort and were quickly removed before they could go to seed.

WI DNR

Pheasant Branch Conservancy

Project details:
A partnership was formed that included a mix of local government, non-governmental organizations, private businesses, and the public:
Thompson and Associates Wetland Services – Alice Thompson and staff
Dane County – Darren Marsh
City of Middleton Conservancy Lands Committee
Oak Hill Correctional Facility Work Crew
Wisconsin Department of Natural Resources – Susan Graham
Friends of Pheasant Branch - Guerdon Coombs and Tom Klein

Funding:
DNR Early Detection Aquatic Invasive Grant
City of Middleton – emergency funding

Labor:
Volunteers – WDNR and Friends of Pheasant Branch
Thompson and Associates

Action plan:
Immediate action was needed due to the potential threat of water hyacinth and water lettuce being transported further downstream. The removal effort was headed up by Thompson and Associates Wetland Services. No permits were necessary for this removal project. A mesh net was installed at the outlet of the ponds to further contain the population to the ponds. Manual removal of the plants occurred over five days in September of 2010 by means of a combination of netting, raking, and hand collecting. A system of corralling plants using canoes/kayaks and a buoyed rope was used to gather the large infestation so it could be scooped onto an aquatic plant conveyor. The plants were then removed from the site and trucked to a county compost site. A week after the removal effort, volunteers returned and removed individuals missed in the first sweep. Monitoring took place throughout 2011 and neither plant species was found, so the eradication appears to have been successful so far. Continued monitoring is planned for 2012. The monitoring will be done by Thompson and Associates, WDNR, and the Friends of Pheasant Branch. Public education efforts were made during the project in the form of an article in the local newsletter, public meetings, and notices on the park bulletin boards.

Lessons learned:
It was important to develop removal techniques that were specific to the site. In this case canoes/kayaks were used but in other situations electric motorboats would have aided in larger waterbodies.

Additional monitoring was required after the removal to detect and collect any plants missed in the initial removal effort.

Response planning efforts should address issues such as staging prior to the action days, taking into account considerations like pond size, shore slope, access roads, areas to park vehicles, etc. It is also important to consider the timing of when labor and material should arrive at the site.

Sources:
Thompson & Nadeau, 2010; Susan Graham, personal communication

Case study: water hyacinth and water lettuce in Pool 5 of the Mississippi River, near Alma and Buffalo, WI

Background:
The interconnectedness of river systems requires an approach unique from that of lakes and ponds for AIS management. If AIS is introduced to one small upstream tributary, then the whole remaining downstream RECOMMENDED MANAGEMENT STRATEGIES AND ACTIONS SPECIFIC TO GOALS of the river system is at risk. Not only is containment more of a challenge in rivers and streams, but the use of pesticides is more problematic. Most chemical manufacturing labels or rules from EPA do not allow the chemical to go off site, which is not possible to control in a river or stream. Also, the efficacy of an herbicide usually requires a certain concentration to be reached and maintained for a specific minimum duration, which is very hard to do in a flowing system.

In the summer of 2011, an infestation of water hyacinth and water lettuce was discovered in Pool 5 of the Mississippi River between the towns of Alma and Buffalo City. A warmwater discharge from a power plant in Alma, WI could serve as a thermal refuge for over-wintering plants or seeds which are thought otherwise to be incapable of surviving Wisconsin's winter. The infestation was reported by a WDNR employee, John Sullivan, and he was subsequently appointed leader to the removal project.


biodork.wordpress.com
Mississippi River from Buena Vista Park, Alma, WI

Project details:
A partnership was formed that included a mix of local government, non-governmental organizations, and the public:
Wisconsin Department of Natural Resources – John Sullivan and Scott Provost
U.S. Fish and Wildlife Service
River Alliance of Wisconsin – provided boat landing signs for AIS awareness
Public (future involvement) – volunteering for monitoring and AIS awareness
Estimated costs to date for removal including staff hours and travel costs: $2,000 - $3,000

Action plan:
The first steps were to perform repetitive monitoring by DNR staff in the area to assess the extent of the infestation. The population covered several acres and was relatively spread out. The plants were largely found at access points which indicated that the plants may have been placed there intentionally for aesthetic reasons. In the late summer of 2011, over 1000 plants were mechanically removed by staff from the WDNR and the U.S. Fish and Wildlife Service. The removal fell under the jurisdiction of NR 109, so no permit was needed. The best way to tackle AIS management in a flowing system is to determine the upstream extent of the infestation, and work downstream starting from that point—which is what the removal team did in this scenario. Despite doubts about both plants' ability to overwinter in Wisconsin, follow-up monitoring will be conducted in Pool 5 to confirm their viability. The monitoring will be done by WDNR regional staff and potentially citizen volunteers. In 2012, the WDNR plans to engage the community in discussion concerning this infestation through community meetings and plan collaborative monitoring efforts into the future.

Lessons learned:
For rivers and streams, AIS prevention is really the key. Due to the interconnected nature of

flowing systems AIS can quickly spread downstream and throughout an extensive area.

It is very important to collaborate with the exotics industries that trade in pond organisms and aquarium species to educate both the sellers and the buyers on the dangers of AIS.

The commitment of local residents to protecting their resources is an opportunity for partnership. Residents along the Mississippi River near Alma and Buffalo feel very passionate about the river and protecting it. This passion should be harnessed to both monitor the river for AIS and to help disseminate knowledge about the pathways of spread and the negative impacts of AIS.

Source:
Scott Provost, personal communication

Case study: water celery (or "Java waterdropwort") near Brodhead, WI

Background:
An infestation of water celery (Oenanthe javanica), also known as Java waterdropwort, in a ditch near Brodhead, WI was reported to the WDNR in the summer of 2011. It was planted in a private pond and then likely escaped over the banks into the ditch during a flood in 2008. Citizens raised the alarm early in the summer of 2011, when they realized how quickly the plant was spreading and the potential impacts it could have on the Sugar River, which was connected to the infested ditch.

Wisconsin State Journal

Spraying for water celery Sugar River, WI

Project details:
A partnership was formed that included a mix of local government, non-governmental organizations, private businesses, and the public:
Applied Ecological Services, Inc. – Susan Lehnhardt and staff (volunteer basis)
Wisconsin Department of Natural Resources – Susan Graham
Interested citizen volunteers
Lower Sugar River Watershed Association

Action plan:
The response action was to walk the perimeter of the infestation, to determine a number of different factors, including:

The geographical extent of the infestation

It is important to survey a good distance downstream if the organism can be transported by water.

Any diagnostic physical and/or biological habitats where the species is located.

In this case, the plants appeared to only be growing on black organic muck. Upstream and downstream had a sandy bottom which was devoid of water celery.

Response efforts to plant infestations should include an experienced biologist or technician that can identify plant species with certainty. In this case, that person was Susan Lehnhardt.

The water celery stand appeared to be isolated to a manageable area in the ditch, so responders undertook eradication actions. Susan Lehnhardt was the leader of the removal project, as she was best positioned, both with technical resources and physical location, to apply and follow up on control efforts. A few off site experiments were started by Lehnhardt to learn more about the life history of water celery of this specific population. Rapid growth and reproduction from plant fragments was observed. Tests were run on the ability of the water celery seeds to germinate, which turned out negative. WDNR authored a management plan of the infestation that outlined a treatment with aquatic herbicide. The treatment required an NR 107 permit, which was easy to obtain and relatively inexpensive due to the small size of the infestation. The plants were treated by volunteers from Applied Ecological Services, and there were follow-up visits to ensure that no individuals had been missed. As of the fall of 2011, the initial treatment with herbicides appears to have been successful. During the treatment, there was one article concerning the water celery infestation in the local newspaper. For future action, the Applied Ecological Services staff will continue monitoring for water celery in the area for the next two years as part of their existing organizational work plan.

Lessons learned:
Rapid response efforts should incorporate as many stakeholders as the situation accommodates. It is important to include all the experts in the field as well as the interested public in the rapid response process from the beginning. Throughout the process, the neighboring citizens routinely walked the ditch checking for water celery after the treatment.

Prior to undertaking eradication efforts, reconnaissance surveying should occur in the area for other populations of the AIS at the beginning of the project, as well as downstream (especially in lotic systems).

Sources:
Seely, 2011; Susan Graham, personal communication

Case study: red swamp crayfish in Germantown, WI

Background:
In August of 2009, the first population of red swamp crayfish in Wisconsin was reported to WDNR by a relative of a resident near the infestation. The population was found in a small urban pond, Esquire Estates Pond, in Germantown, located in Washington County. Shortly thereafter two more isolated populations were discovered; one located less than one mile from the Esquire Estates Pond, the Police Department Pond, and another in Kenosha County, Sam Poerio Park Pond. All three infestations appeared to be isolated to theses small urban ponds. Since these were the first known populations of red swamp crayfish in Wisconsin, the extent of the impacts on the native Wisconsin ecosystem were unknown. However, red swamp crayfish are known to be very aggressive invaders in other areas to which they have been introduced and many negative impacts to the native ecosystems have been observed (see the red swamp crayfish profile in “Appendix D - Full species profiles, AIS of concern to the Lower Wisconsin River basin” for more details). The three separate populations seemed contained to their respective ponds,


esquireestates.org
Esquire Estates

and WDNR undertook rapid action to contain, and ideally eradicate, the red swamp crayfish infestations.

*Project details***:**
A variety of different partnerships were formed throughout the process, incorporating a mix of local government and municipalities, non-governmental organizations, private businesses, academic institutions, and the public:
Wisconsin Department of Natural Resources – Heidi Bunk, Susan Beyler, Randy Schumacher, and many more.
University of Wisconsin-Madison – Jake Vander Zanden Lab
University of Wisconsin-Parkside - Greg Mayer Lab
Wisconsin Lutheran College - Robert Anderson Lab
Village of Germantown
City of Kenosha
City of West Bend
Esquire Estates Park Association – provided volunteers to construct Nicotarp barriers.
Private contractors – donated fill for Police Department Pond
Funding:
AIS Control Grant from WDNR applied for by the Village of Germantown
Great Lakes Restoration Initiative Grant applied for by WDNR

*Action plan***:**
WDNR staff members, Heidi Bunk and Randy Schumacher, were the on-site leaders for the containment and eradication efforts of the red swamp crayfish populations.

Some immediate actions were taken to contain the spread of the red swamp crayfish:

Nicotarp barriers were constructed around each pond and any outlets were capped with netting to prevent migration offsite.

Intensive trapping was undertaken to decrease the population density and to collect information on the population dynamics.

Monitoring was done in nearby waterbodies to assess the extent of the red swamp crayfish distribution.

WDNR obtained permits for chemical treatment as quickly as possible from the Wisconsin Department of Agriculture, Trade and Consumer Protection (WDATCP).

In November 2009 and April 2010, the ponds were treated with sodium hypochlorite (12.5%). This proved to be ineffectual for complete eradication of the red swamp crayfish population.

The water levels in the Police Department Pond and Poerio Pond were reduced over the winter of 2010-11 in the hopes to freeze any red swamp crayfish in burrows remaining.

The pesticide Pyronyl 303 was applied to the shoreline, burrows and standing water of the Poerio Park Pond. 100% mortality was seen in the standing water; however, crayfish in the burrows survived the treatment.

Future actions:
Due to the continued survival of red swamp crayfish in the three ponds, the WDNR will be filling in the two smaller ponds (the Police Department Pond and the Poerio Pond) during the fall of 2011.

For the larger pond, the Esquire Estates Pond, a containment plan protocol will be followed for the immediate future. Trapping will continue for monitoring purposes and as a mechanical removal effort, to keep the population density at a minimum. Stocking of predatory fish (i.e. bass and pike species) will continue as a biological control measure.

Monitoring near the filled ponds and in nearby waterbodies will be continued in 2012 and 2013 to ensure that containment has been successful.

Lessons learned:

It is necessary to develop an adaptable AIS response plan. As seen in this example, the first eradication method attempted might not be sufficient or well suited for the situation. Even after extensive research on treatment options, unforeseen obstacles during the treatment process are likely to occur.

It is important to make sure that all surrounding citizens are aware of the AIS management plan. This might best be accomplished by sending a letter to all the neighbors explaining the treatment plan and supplying them with contact information if they have any concerns. This will hopefully ferret out any objections to a project early in the process, and build stakeholder support.

Sources:

WDNR, 2010; Heidi Bunk, personal communication; Jake Vander Zanden, personal communication

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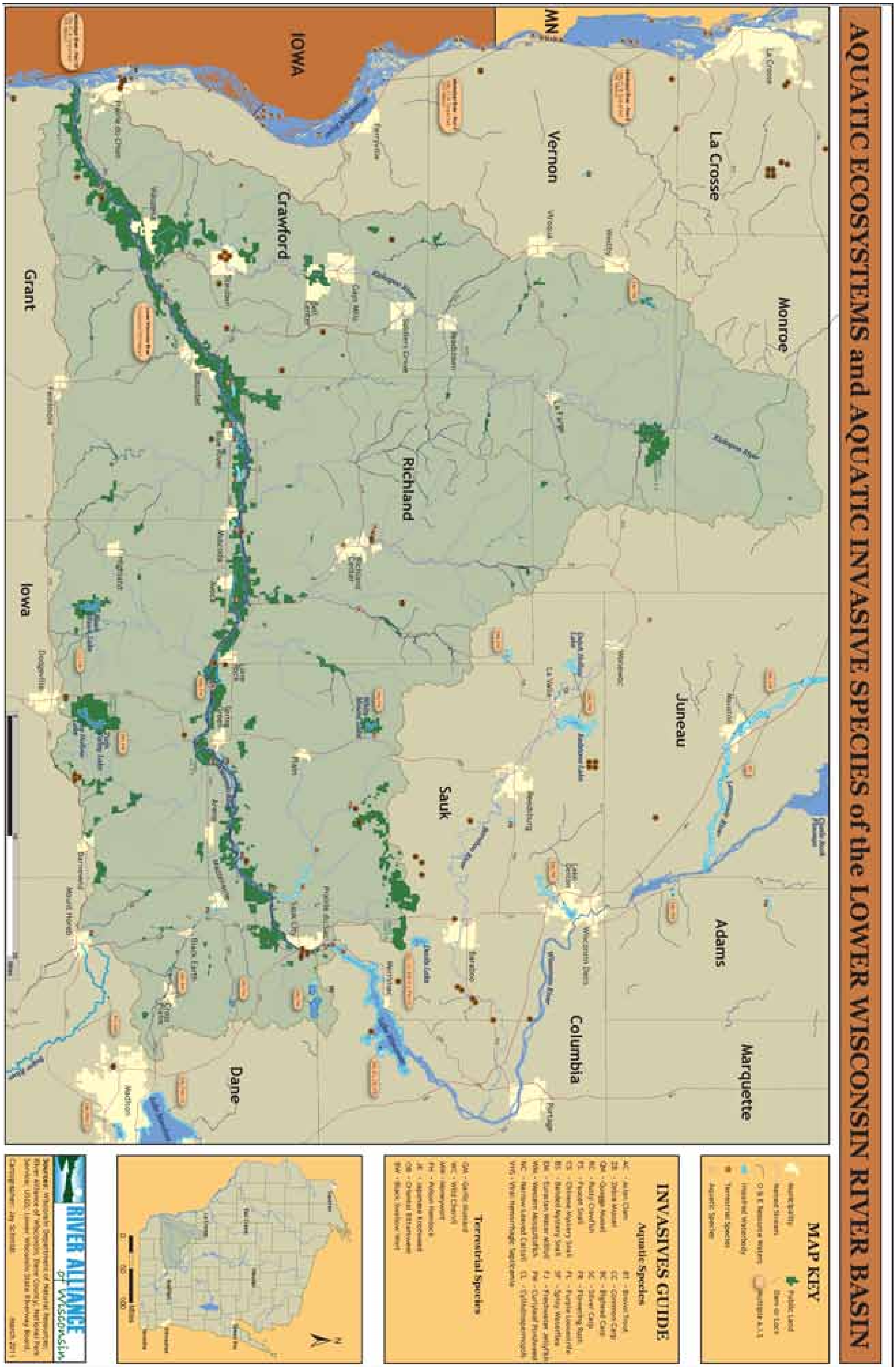
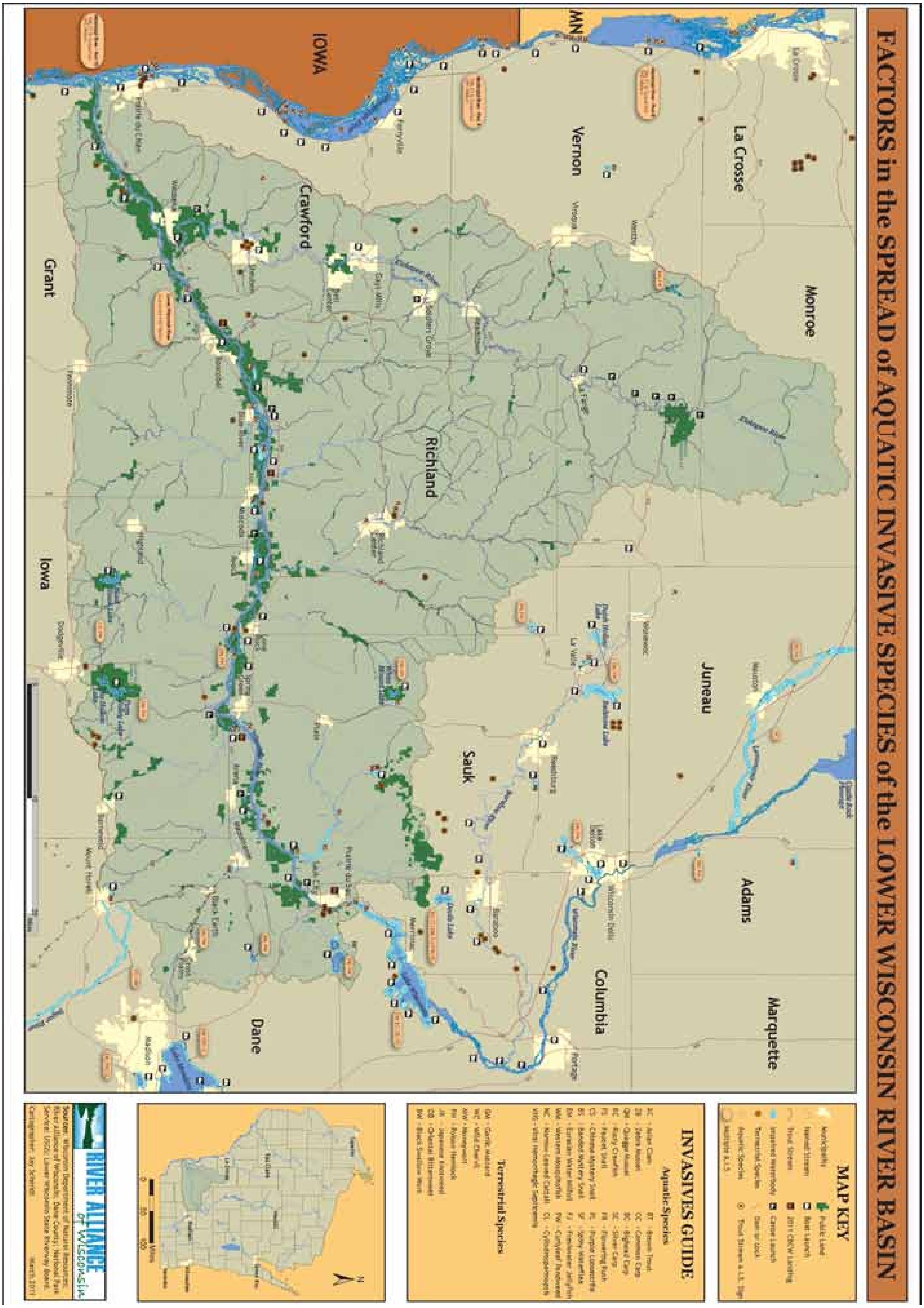
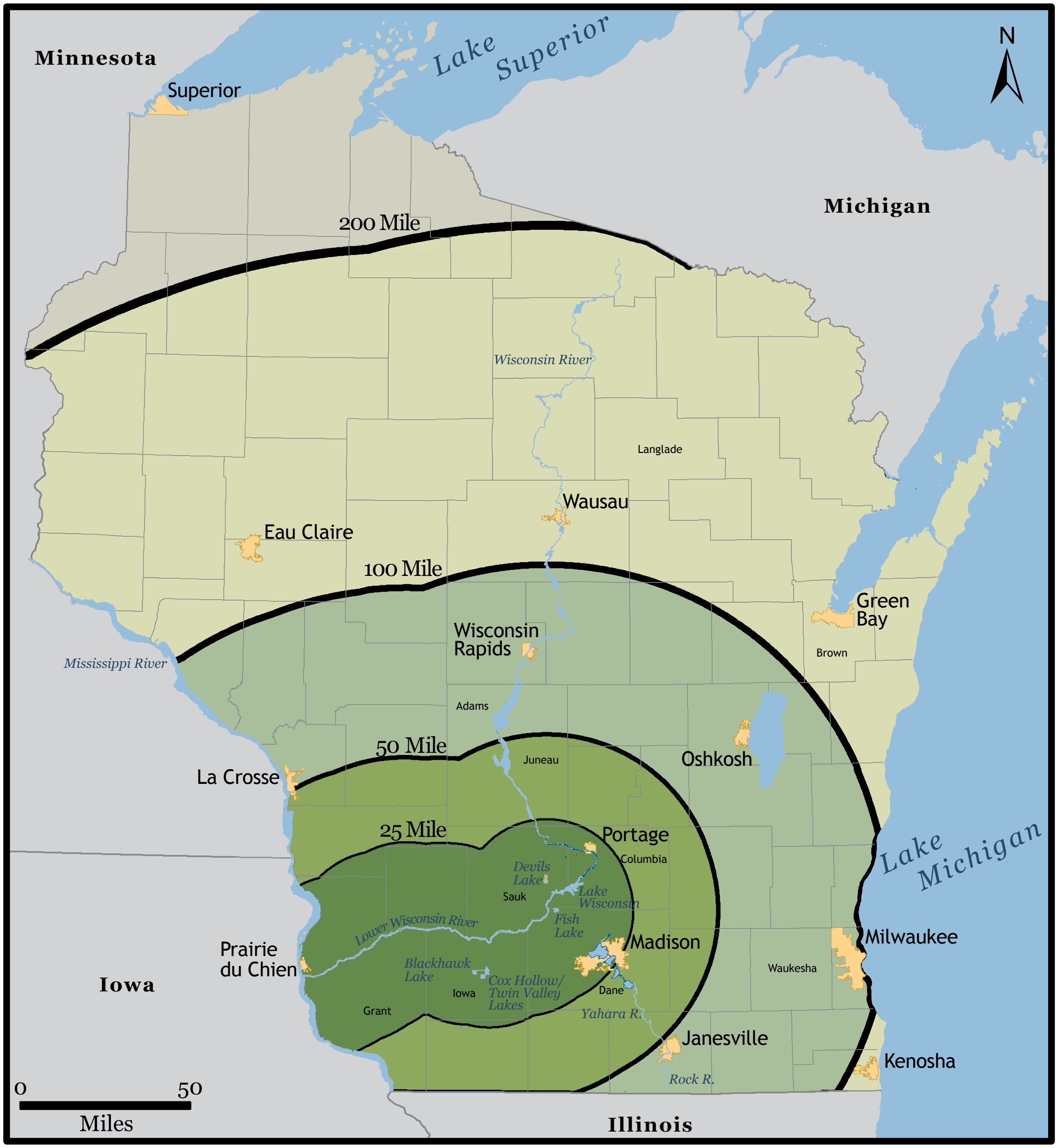


Contact the River Alliance of Wisconsin (608) 257-2424 or info@wisconsinrivers.org to request a full resolution version of this map.



Contact the River Alliance of Wisconsin (608) 257-2424 or info@wisconsinrivers.org to request a full resolution version of this map.

Illustration of Boater Movement from the Lower Wisconsin River



Legend

Geographic Area Frequented by Lower Wisconsin River Users

- 78.3%
- 6.2%
- 3.8%
- 9.8%
- 1.3%
- 0.6%

470 Total Responses

Waterbodies and Counties Frequented by Lower Wisconsin Users

By Waterbody

Lower Wisconsin River	124
Madison Lakes/Yahara R.	92
Mississippi River (WI/IA)	62
Cox Hollow/Twin Valley Lakes	38
Green Bay/Lake Michigan	26
Blackhawk Lake	23
Lake Wisconsin	18
Devils Lake	10
Fish Lake	9
Mississippi River (IA/IL)	9

By County

Dane	102
Grant	62
Iowa	61
Brown	25
Columbia	18
Out of State	13
Sauk	12
Waukesha	12
Langlade	5
Adams/Juneau	5

(TEXT = Waterbody with an aquatic species not presently found in the Lower Wisconsin River.)

In 2010 and 2011, Clean Boats, Clean Waters watercraft inspectors surveyed 470 boaters at boat landings along the Lower Wisconsin River _______.

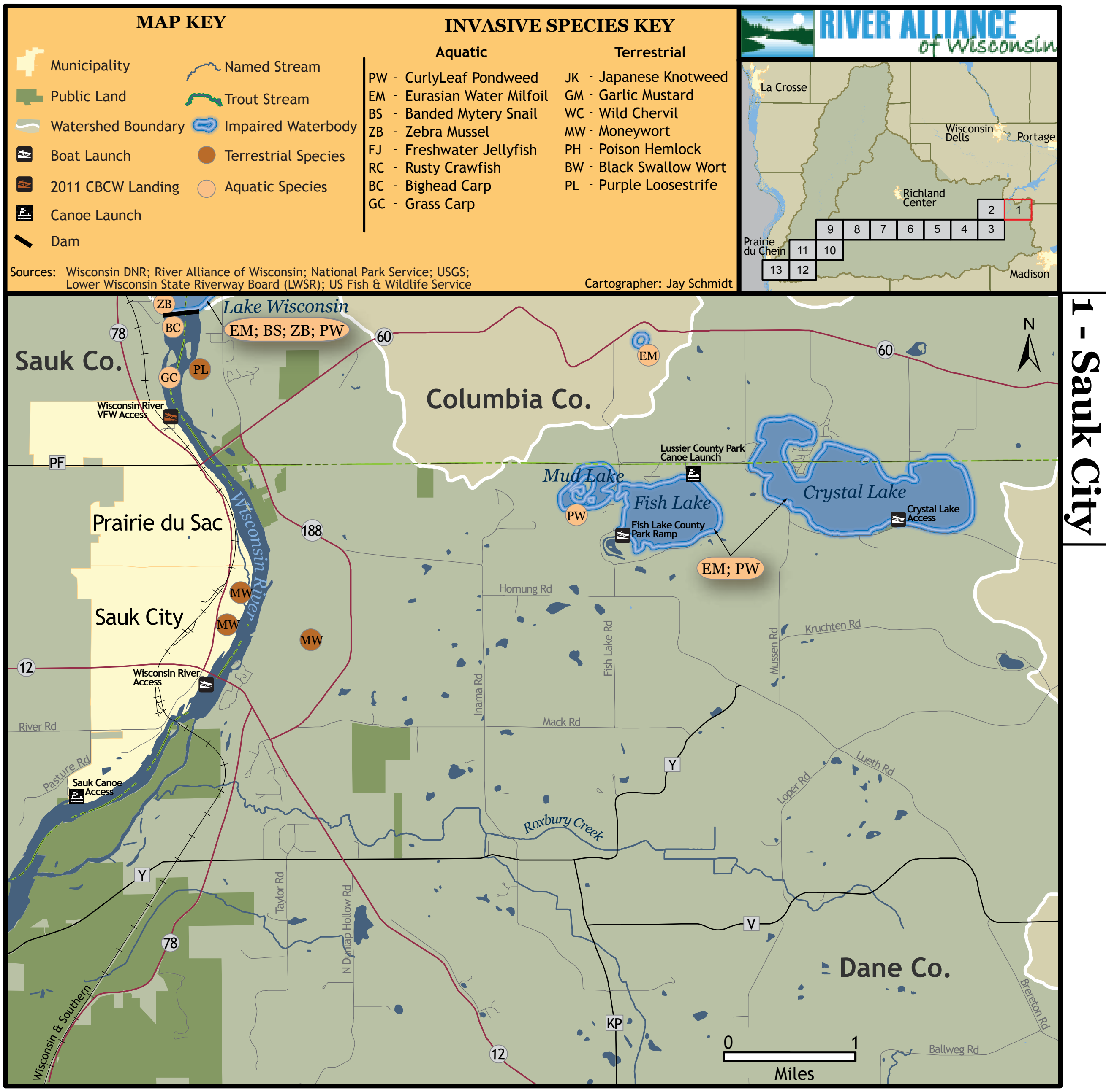
Source: River Alliance of Wisconsin

Cartographer: Jay Schmidt

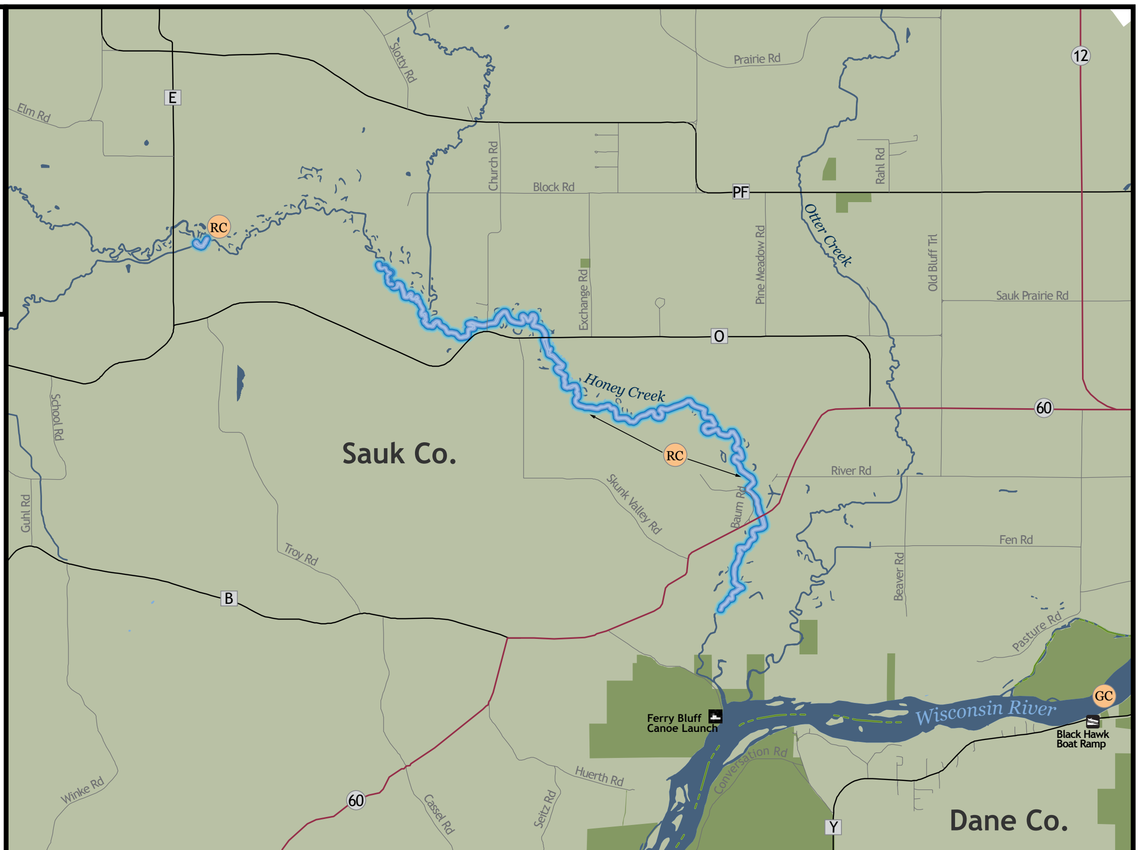
DETAILED MAPS OF THE LOWER WISCONSIN RIVERWAY

The following maps provide greater detail regarding the locations of known invasive species within the Lower Wisconsin River corridor, access points on the river, and the names and locations of the sloughs. The Lower Wisconsin River and its sloughs are a focal point for this project due to its popularity with multiple user groups, including recreational boaters, hunters, anglers, campers, and others.

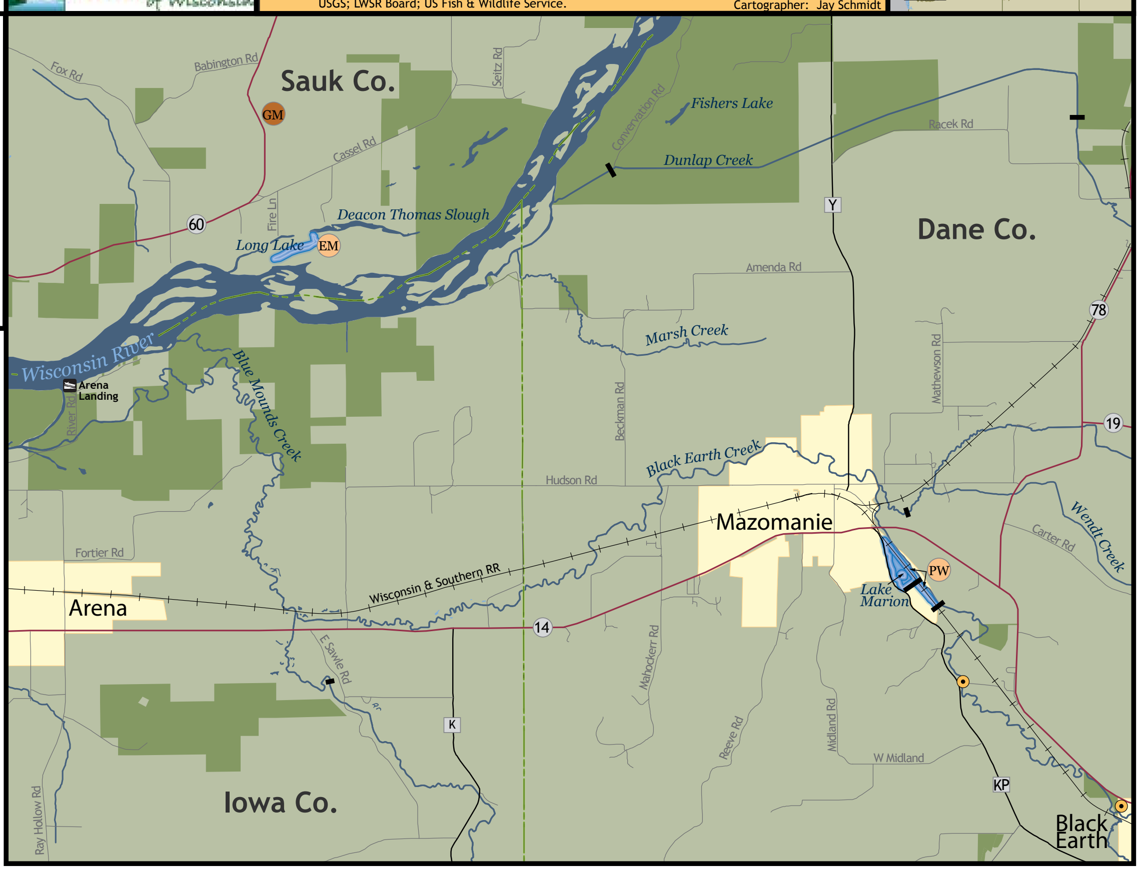
All tributaries of the Mississippi River up to the first fish barrier, including the Lower Wisconsin River, are suspected to be infected with VHS waters due to their connectivity with the Great Lakes via the Illinois River. Other aquatic or wetland invasive species that have been confirmed in the Lower Wisconsin River include grass carp, bighead carp, zebra mussels, Eurasian watermilfoil, curlyleaf pondweed, purple loosestrife, and Japanese knotweed.

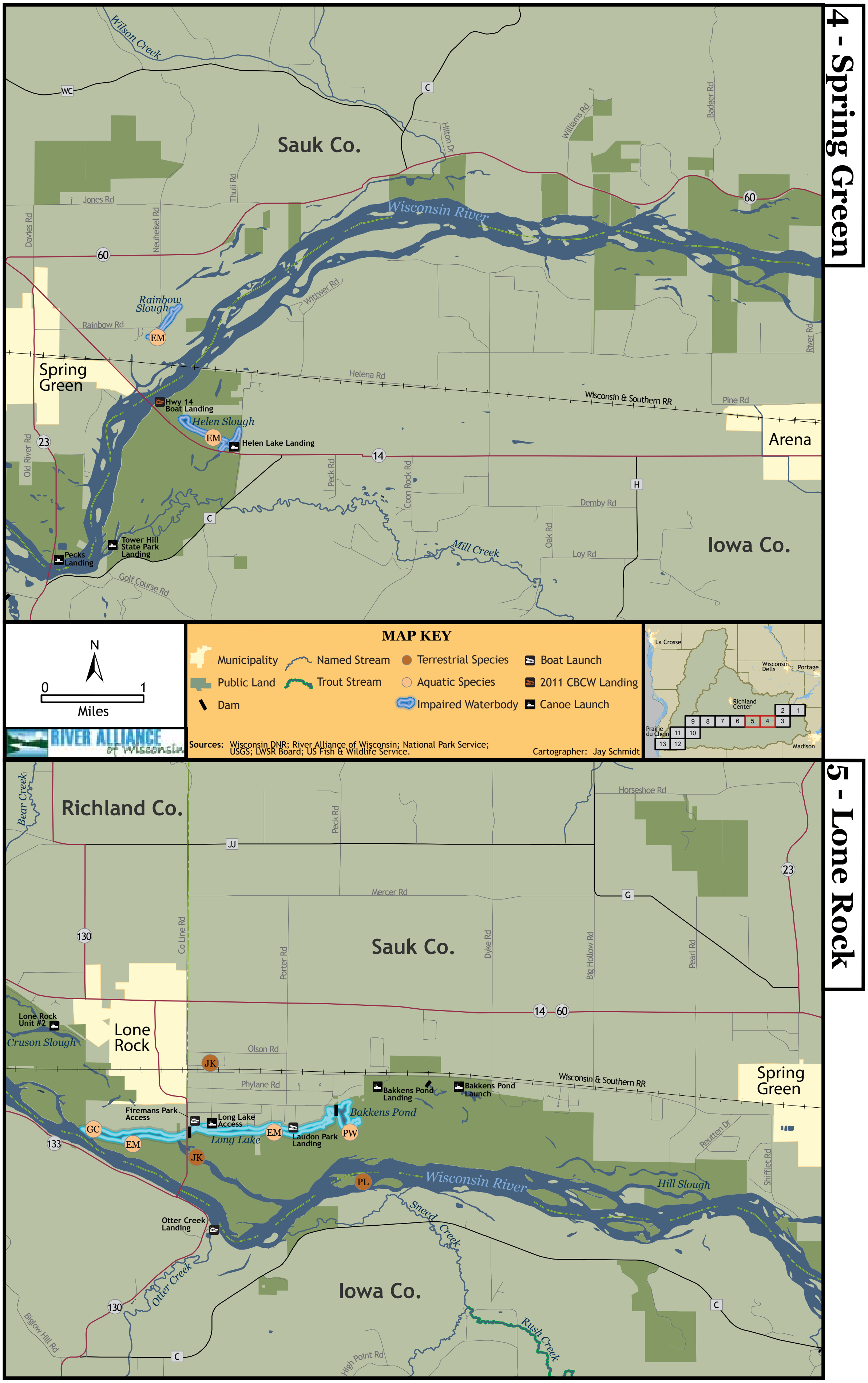


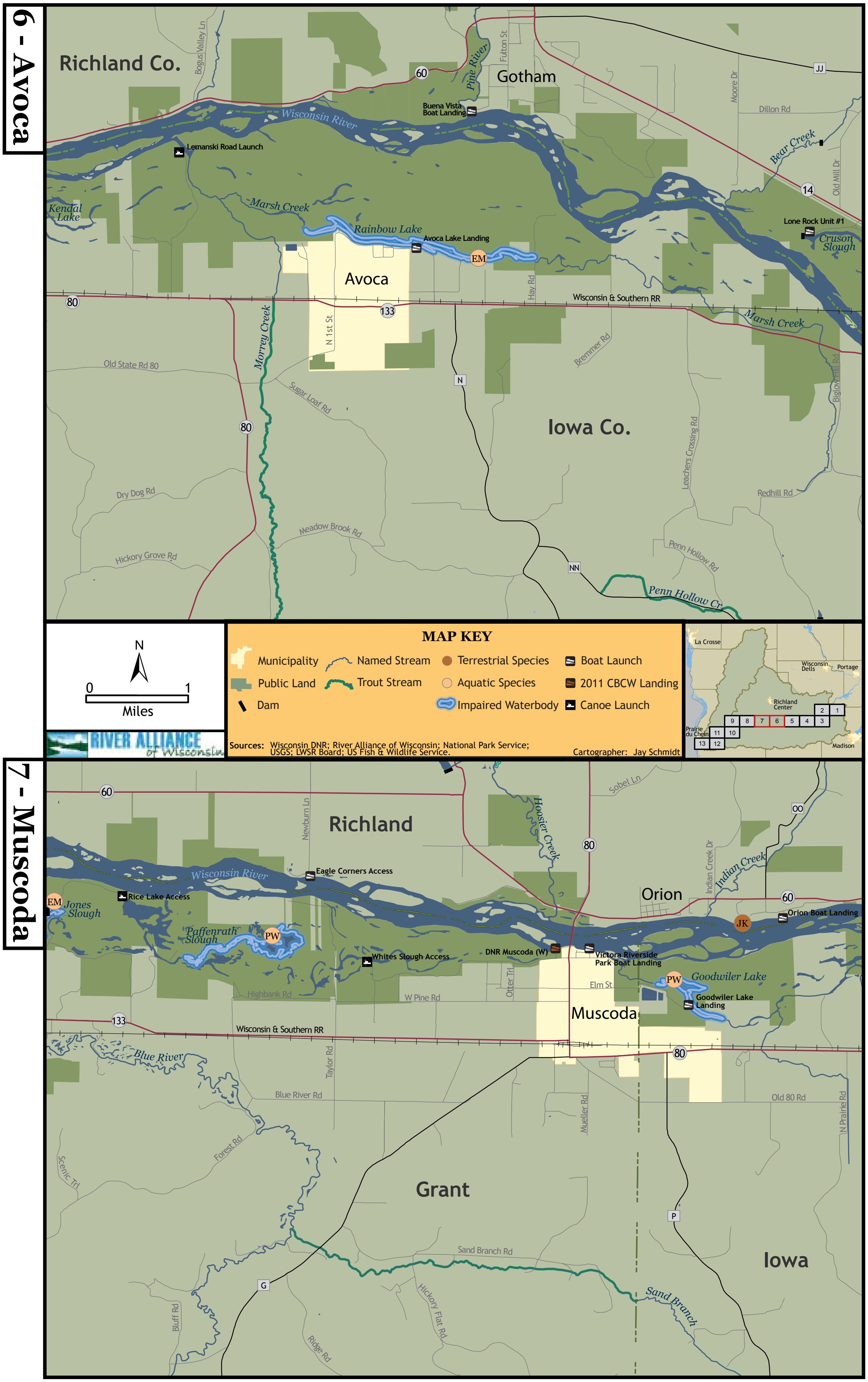
2 - Ferry Bluff



3 - Mazomanie

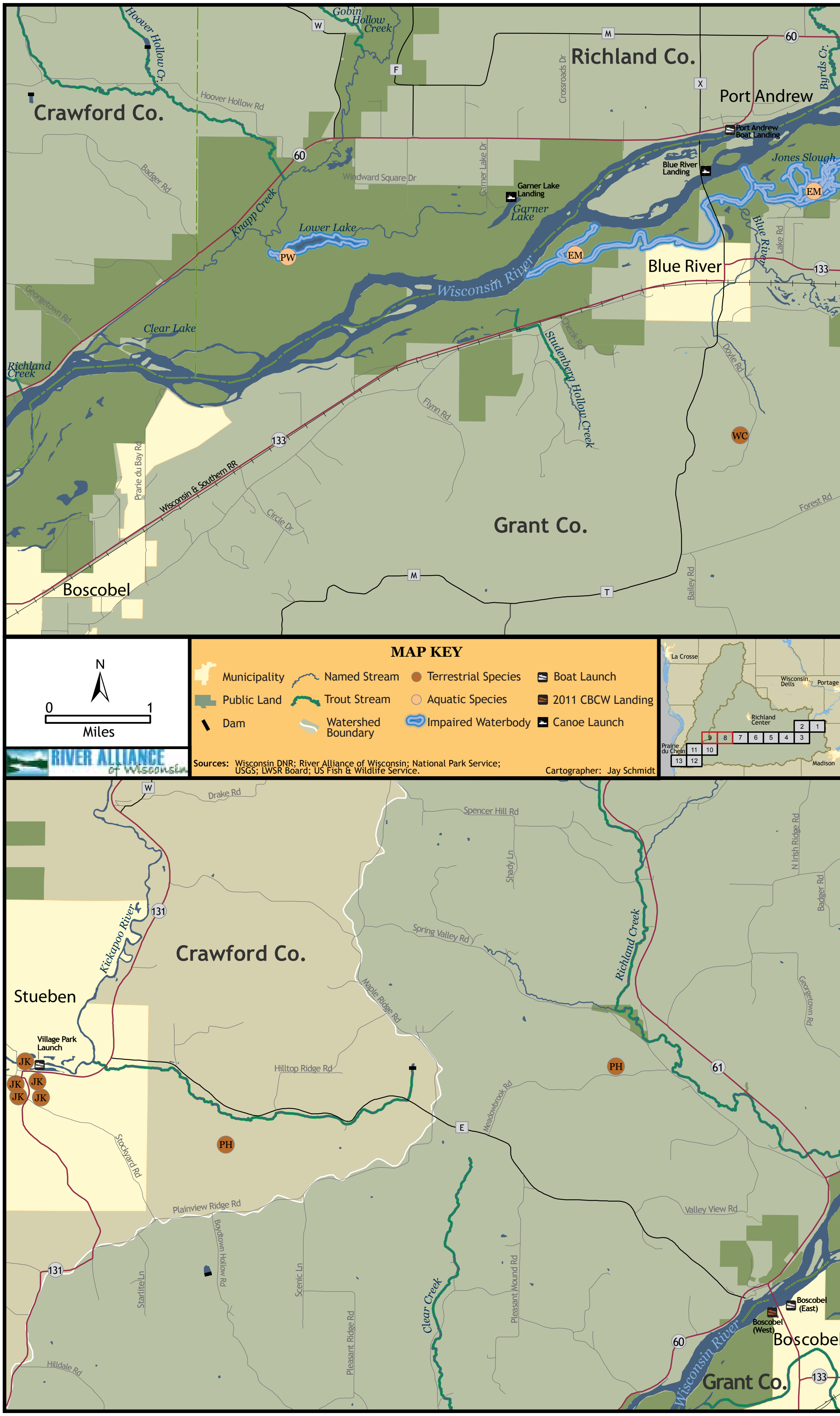



4 - Spring Green
Sauk Co.
Iowa Co.
Wisconsin River
Spring Green
Arena
Wilson Creek
Jones Rd
Davies Rd
Neuhesel Rd
Thuli Rd
Hilton Dr
Williams Rd
Badger Rd
Wittwer Rd
Rainbow Rd
Rainbow Slough
Helena Rd
Wisconsin & Southern RR
Pine Rd
River Rd
Hwy 14 Boat Landing
Helen Slough
Helen Lake Landing
Old River Rd
Peck Rd
Coon Rock Rd
Demby Rd
Oak Rd
Loy Rd
Mill Creek
Tower Hill State Park Landing
Pecks Landing
Golf Course Rd
MAP KEY
Municipality
Public Land
Dam
Named Stream
Trout Stream
Terrestrial Species
Aquatic Species
Impaired Waterbody
Boat Launch
2011 CBCW Landing
Canoe Launch
N
0
1
Miles
RIVER ALLIANCE of Wisconsin
Sources: Wisconsin DNR; River Alliance of Wisconsin; National Park Service; USGS; LWSR Board; US Fish & Wildlife Service.
Cartographer: Jay Schmidt
La Crosse
Wisconsin Dells
Portage
Richland Center
Prairie du Chien
Madison
5 - Lone Rock
Richland Co.
Sauk Co.
Iowa Co.
Bear Creek
Horseshoe Rd
Mercer Rd
Co Line Rd
Porter Rd
Dyke Rd
Big Hollow Rd
Pearl Rd
Lone Rock Unit #2
Cruson Slough
Lone Rock
Olson Rd
Phylane Rd
Wisconsin & Southern RR
Spring Green
Bakkens Pond Landing
Bakkens Pond Launch
Bakkens Pond
Firemans Park Access
Long Lake Access
Long Lake
Laudon Park Landing
Reutten Dr
Shifflet Rd
Wisconsin River
Hill Slough
Sneed Creek
Otter Creek Landing
Otter Creek
Rush Creek
Biglow Hill Rd
High Point Rd



6 - Avoca
Richland Co.
Gotham
Wisconsin River
Pine River
Fulton St
Bogus Valley Ln
Buena Vista Boat Landing
Lemanski Road Launch
Marsh Creek
Kendal Lake
Rainbow Lake
Avoca Lake Landing
EM
Avoca
Dillon Rd
Moore Dr
Bear Creek
Old Mill Dr
Lone Rock Unit #1
Cruson Slough
Wisconsin & Southern RR
Hay Rd
N 1st St
Morrey Creek
Old State Rd 80
Sugar Loaf Rd
Bremmer Rd
Iowa Co.
Leachers Crossing Rd
Biglow Hill Rd
Redhill Rd
Dry Dog Rd
Meadow Brook Rd
Hickory Grove Rd
Penn Hollow Rd
Penn Hollow Cr
MAP KEY
Municipality
Named Stream
Terrestrial Species
Boat Launch
Public Land
Trout Stream
Aquatic Species
2011 CBCW Landing
Dam
Impaired Waterbody
Canoe Launch
N
0
1
Miles
RIVER ALLIANCE of Wisconsin
Sources: Wisconsin DNR; River Alliance of Wisconsin; National Park Service; USGS; LWSR Board; US Fish & Wildlife Service.
Cartographer: Jay Schmidt
La Crosse
Wisconsin Dells
Portage
Richland Center
Prairie du Chein
Madison
7 - Muscoda
Richland
Newburn Ln
Hoosier Creek
Sobel Ln
Indian Creek Dr
Indian Creek
Orion
Orion Boat Landing
JK
Wisconsin River
Eagle Corners Access
Rice Lake Access
Jones Slough
Paffenrath Slough
PW
Whites Slough Access
DNR Muscoda (W)
Victoria Riverside Park Boat Landing
Goodwiler Lake
Goodwiler Lake Landing
Elm St
Muscoda
Highbank Rd
W Pine Rd
Otter Trl
Wisconsin & Southern RR
Blue River
Blue River Rd
Taylor Rd
Old 80 Rd
N Prairie Rd
Mueller Rd
Forest Rd
Scenic Trl
Grant
Sand Branch Rd
Sand Branch
Iowa
Hickory Flat Rd
Bluff Rd
Ridge Rd

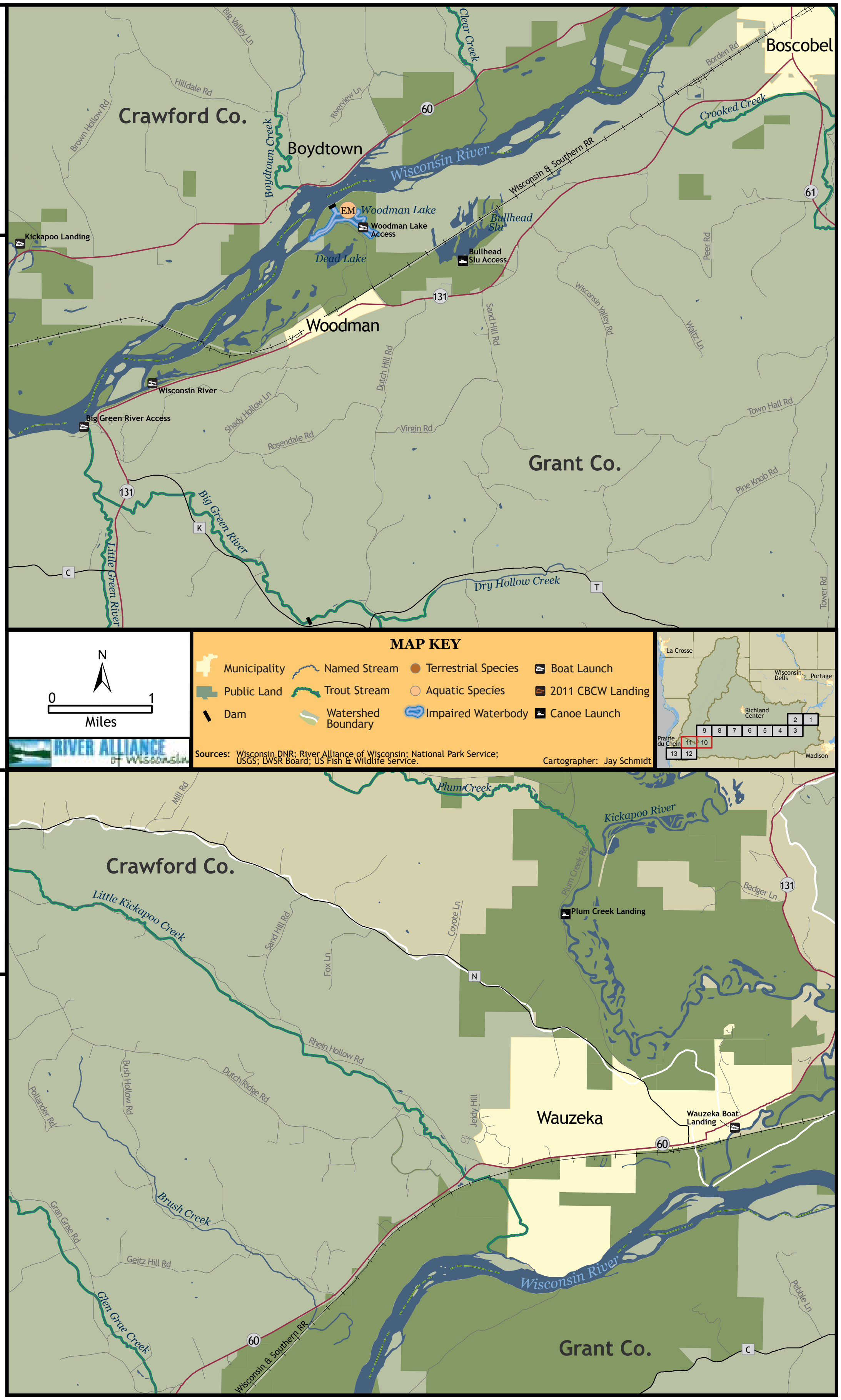
8- Blue River

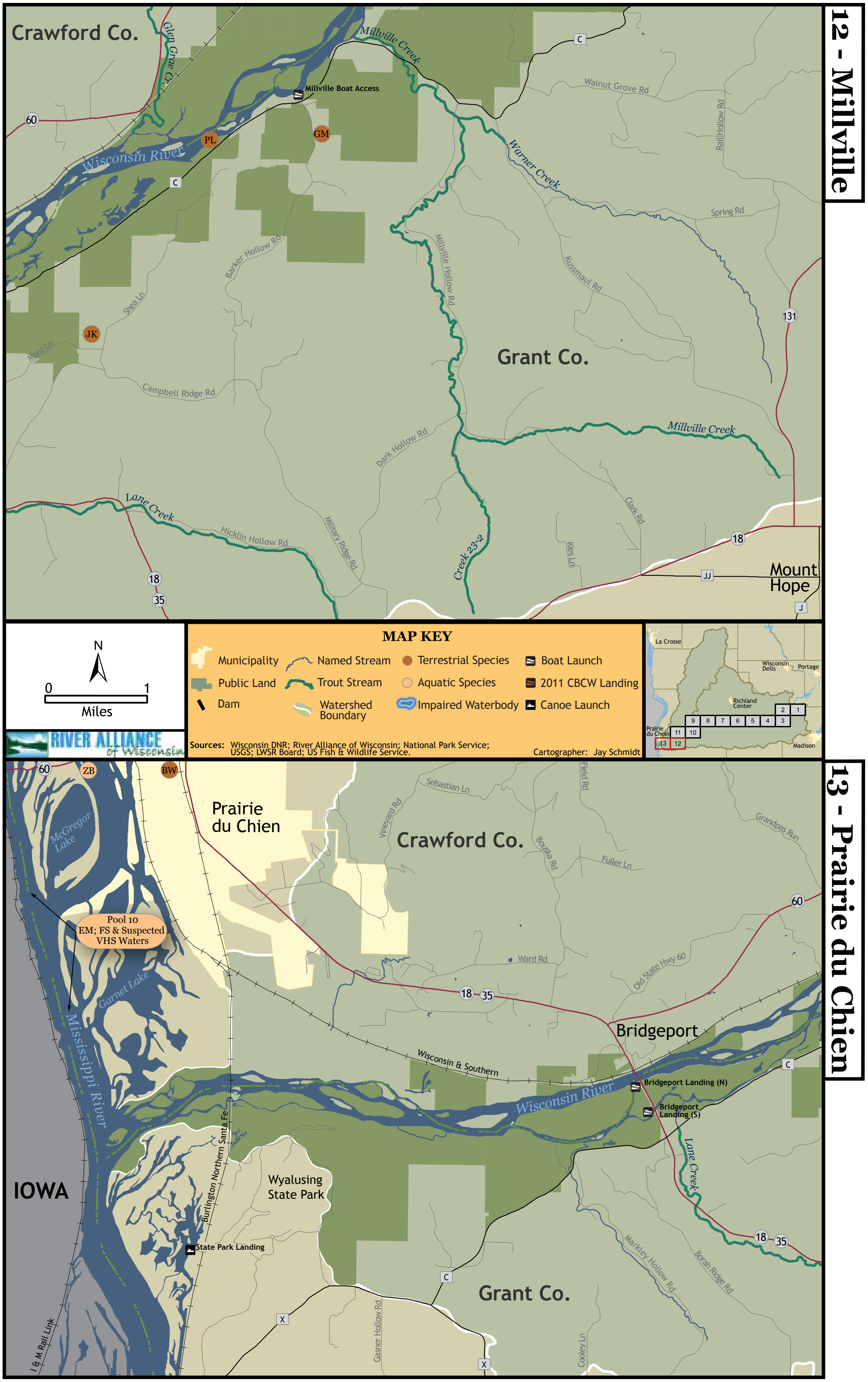


9 - Boscobel

10 - Woodman

11 - Wauzeka




12 - Millville
Crawford Co.
Glen Grae Cr.
Millville Creek
Millville Boat Access
Wisconsin River
PL
GM
JK
60
C
Walnut Grove Rd
Rail Hollow Rd
Warner Creek
Spring Rd
Barker Hollow Rd
Millville Hollow Rd
Kussmaul Rd
Shea Ln
Munz Ln
Campbell Ridge Rd
131
Grant Co.
Millville Creek
Dark Hollow Rd
Lane Creek
Hicklin Hollow Rd
Military Ridge Rd
Creek 23-2
Clark Rd
Kies Ln
18
35
JJ
J
Mount Hope
N
0
1
Miles
MAP KEY
Municipality
Named Stream
Terrestrial Species
Boat Launch
Public Land
Trout Stream
Aquatic Species
2011 CBCW Landing
Dam
Watershed Boundary
Impaired Waterbody
Canoe Launch
Sources: Wisconsin DNR; River Alliance of Wisconsin; National Park Service; USGS; LWSR Board; US Fish & Wildlife Service.
Cartographer: Jay Schmidt
RIVER ALLIANCE of Wisconsin
La Crosse
Wisconsin Dells
Portage
Richland Center
Prairie du Chien
Madison
13 - Prairie du Chien
ZB
BW
McGregor Lake
Prairie du Chien
Sebastian Ln
Vineyard Rd
Field Rd
Crawford Co.
Bouska Rd
Fuller Ln
Grandpas Run
Pool 10
EM; FS & Suspected VHS Waters
Ward Rd
Old State Hwy 60
Garnet Lake
Mississippi River
Bridgeport
Wisconsin & Southern
Bridgeport Landing (N)
Bridgeport Landing (S)
Wisconsin River
Lane Creek
Burlington Northern Santa Fe
Wyalusing State Park
IOWA
State Park Landing
Markley Hollow Rd
Borah Ridge Rd
Grant Co.
Gasner Hollow Rd
Cooley Ln
X
I & M Rail Link

FULL SPECIES PROFILES, AIS OF CONCERN TO THE LOWER WISCONSIN RIVER BASIN

Plants

Invertebrates

Fish and Crayfish

Pathogens

Butomus umbellatus (flowering rush)

LOCAL DISTRIBUTION

Butomus umbellatus is native to Eurasia and was first found in the United States in the St. Lawrence River in 1905 (Cao, 2008; Johnson, Rice, Dupuis, & Ball, 2009). It has spread into many temperate regions of the world and is currently established in both the northern region of the Mississippi River basin and the throughout the Great Lakes region. *B. umbellatus* is documented in Minnesota, Iowa, Wisconsin, Michigan, northern Illinois, Indiana, Ohio and southern Ontario (Midwest Invasive Plant Network [MIPN], n.d.). Just upstream of the Lower Wisconsin River basin, populations of *B. umbellatus* exist in Lake Wisconsin (S. Graham, personal communication, August 2011).

TRANSPORT

B. umbellatus was intentionally brought to North America from Eurasia as an ornamental plant (Cao, 2008; Kearns, 2004). Once established it can spread locally via unintentional propagule movements by muskrats, waterfowl or boater movements, and also through the movement of water and ice (Cao, 2008; Kearns, 2004).

HABITAT & KNOWN LIMITING PARAMETERS

B. umbellatus grows in shallow, slow moving waters such as marshes, lakes, ponds, backwaters and slow-moving rivers (Invasive Species Specialist Group [ISSG], 2005; Kearns, 2004). It can grow in water up to about two yards deep, which is usually deeper than the native emergent marsh species (ISSG, 2005). It cannot tolerate salt or brackish water and prefers water with a pH within the range of 5-7.5 (ISSG, 2005; Kearns, 2004). It is not suited to deep-water habitats and areas with steep, shaded banks (Roberts, 1972). Based on these parameters, *B. umbellatus* would find suitable habitat in the backwaters and sloughs of the main channel of the Lower Wisconsin River and in the reservoirs and wetlands in the watershed.

BIOLOGICAL TRAITS

B. umbellatus has a variety of reproductive strategies. Populations can reproduce by seeds, by bulblets from the rhizomes or from the inflorescence, or from rhizome fragments (Johnson et al., 2009). *B. umbellatus* can quickly colonize a disturbed area following a drop in water levels and once established it can persist indefinitely (ISSG, 2005; Kearns, 2004).

Ducks and muskrats are both natural predators of *B. umbellatus* (WDNR, n.d.), however, they can also assist in spreading it by moving around plant fragments and seeds (Johnson et al., 2009).

IMPACT POTENTIAL

There is a limited amount of research on the negative impacts of *B. umbellatus* on the native ecosystems. However, evidence exists that it can displace native aquatic plants and riparian vegetation, such as the economically valuable wild rice (Cao, 2008). In high densities, *B. umbellatus* also competes with the native species of willow and cattail (Wisconsin Department of Natural Resources, n.d.). Additionally, *B. umbellatus* tends to form monotypic stands which can impede boat traffic and recreational activities (Johnson et al., 2009), both significant concerns for recreational traffic on the Lower Wisconsin River.

PREVENTION & CONTROL

In Wisconsin, *B. umbellatus* is listed as a restricted species under NR 40. It is difficult to distinguish from native emergent marsh species if it is not in flower, which makes early detection challenging (MIPN, n.d.). Chemical treatment of *B. umbellatus* is difficult because the herbicides wash away easily from the plants' narrow leaves (Cao, 2008). Currently researchers in the Detroit Lakes area in Minnesota are studying the effectiveness of multiple herbicides on *B. umbellatus* control, and thus far, Diquat and Aquathol K appear promising (Gerdes, 2011).

The most prevalent method of controlling *B. umbellatus* is to manually cut the plant below the water surface; however, multiple cuttings a year are usually required since the plants grow back from their root system (Cao, 2008). Hand digging for eradication is only recommended for very small infestations of *B. umbellatus*. Extreme care must be taken to remove the entire root, since disturbance of the root system causes reproductive bulblets to break off which can then establish elsewhere (MIPN, n.d.).

USEFUL WEBSITES
HTTP://MSUEXTENSION.ORG/PUBLICATIONS/AGANDNATURALRESOURCES/EB0201.PDF
HTTP://NAS.ER.USGS.GOV/QUERIES/FACTSHEET.ASPX?SPECIESID=1100
HTTP://DNR.WI.GOV/INVASIVES/FACT/RUSH_FLOWERING.HTM
HTTP://WWW.ISSG.ORG/DATABASE/SPECIES/ECOLOGY.ASP?FR=1&SI=610

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Didymosphenia geminata (didymo)

DISTRIBUTION

The geographical range of *Didymosphenia geminata* has expanded rapidly across North America over the past several years, in nuisance concentrations in many areas. In the Great Lakes basin, it is well established in Lake Superior near the mouth of the Knife River north of Duluth, MN. In the Mississippi River Basin, nuisance blooms are found in Rapid Creek, S. Dakota present over a 5-10 kilometer, at 30 to 100 percent coverage, for over four months of the year, and are recurring (Spaulding & Elwell, 2007). Several factors pit the streams of the Lower Wisconsin River basin and the Driftless Area (southwestern Wisconsin, northwestern Illinois, northeastern Iowa, southeastern Minnesota) at risk to invasion by *D. geminata,* as described below.

TRANSPORT

Cells are able to survive and remain viable in cool, damp, dark conditions for at least 40 days (Kilroy et al., 2005). Fishing equipment, boot tops, neoprene waders, and felt-soled wading boots in particular, all provide a site where cells remain viable, at least during short-term studies. At the same time, prime destinations for fly fishing are becoming more popular with anglers. Rather than frequent a favorite local fishing site, it is now common that anglers travel to multiple or distant destinations for fly fishing vacations. Moreover, they may be casting flies in a river less than 24 hours after leaving their local rivers, unknowingly spreading *D. geminata.*

For aquatic organisms, the correlation between the spread of invasive species to recreational traffic is well established (for example, Eurasian watermilfoil (*Myriophyllum spicatum L.*) and zebra mussels (*Dreissena polymorpha*) in lakes with high boater traffic). Gear and equipment used in aquatic recreation may play a role in spreading *D. geminata*, but it is possible that humans transport *D. geminata* in other ways (for example, boats and jet skis, water transport for fire fighting, irrigation, water diversions, waterfowl hunting, and float airplanes).

HABITAT & KNOWN LIMITING PARAMETERS

In a broad sense, nuisance algal blooms are typically related to anthropogenic increases in nutrient input to surface waters—increased concentrations of nitrogen and phosphorus result in increased algae production, often with nuisance effects. In contrast, blooms of *D. geminata* are unlike other algal blooms, because they are associated with nutrient-poor waters. Many *D. geminata* blooms have occurred in stream habitats generally considered pristine or with limited ecological disturbance (Spaulding & Elwell, 2007).

Temperature and pH

Preliminary data from a random survey of streams in the western United States show that *D. geminata* is present in a wide range of freshwater conditions. Rather than being restricted to cold temperatures, *D. geminata* is present in waters from 4-27°C, and shows a temperature range greater than what was previously observed. The relation of *D. geminata* presence to pH is narrower, with *D. geminata* found in waters at or above a pH of 7 (Spaulding & Elwell, 2007).

Spring-fed Driftless Area streams have a baseflow temperature of 10°C. Coldwater streams in Wisconsin are defined as having a maximum summer water temperatures that are typically below 22°C (Hastings & Hewitt, 2008). In 2010, the temperature of the Lower Wisconsin River at Muscoda has ranged from 0-31°C.

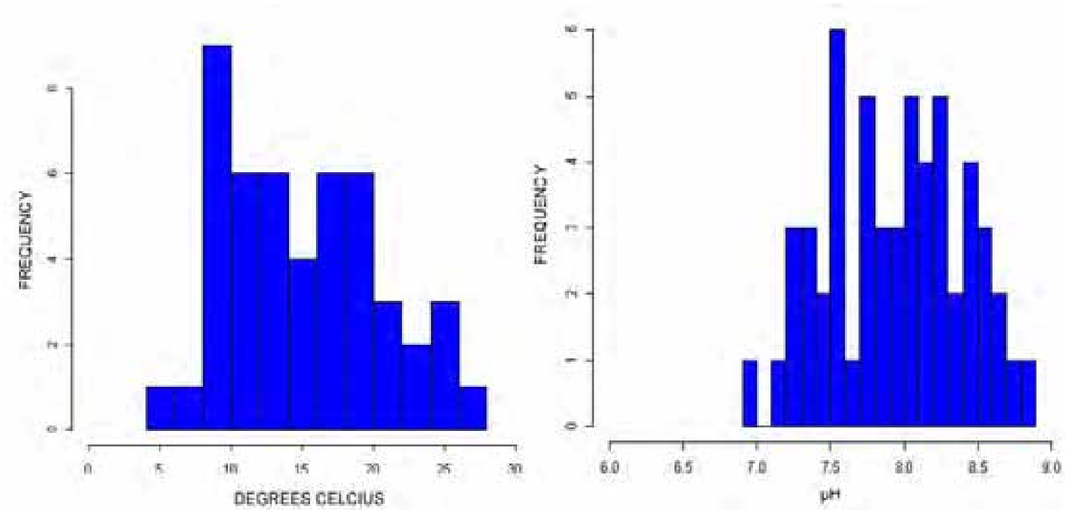

Figure 1: Water temperature versus frequency of sites with *D. geminata* present in western streams of the United States (left); pH versus frequency of sites with *D. geminata* present (right) (Spaulding et al., 2007).

Nutrients

Although *D. geminata* occurs most frequently in waters with low total phosphorus (<2 µg/l) and low nitrate (<1 mg/L), it can also be found where both of these nutrients are present at very high concentrations. These values show where *D. geminata* is present, but give no indication of the biomass or growth rate associated with nutrient concentration. Furthermore, it is unknown whether *D. geminata* is limited by either of these nutrients in any North American waters. In New Zealand, nutrient enrichment experiments indicate that growth of *D. geminata* is limited by nitrogen, phosphorus, or both nutrients within most of its current range. In other words, with greater concentrations of either nutrient, growth would be stimulated. Increased loading of nutrients to affected rivers by watershed sources is expected to result in increased growth of *D. geminata* (Spaulding & Elwell, 2007).

Flow

D. geminata thrives in a wide range of hydraulic conditions (Kilroy et al., 2005). The hydraulic range is striking, because dense mats of the algae are able to grow in slow-moving, shallow waters as well as in waters with greater depth and velocity than could be safely measured by technicians. In the Mararoa and Waiau Rivers, masses of *D. geminata* were greatest at water velocities of approximately 0.5 m/s. With stable flow, biomass of *D. geminata* tends to increase. In fact, the best hydrological predictor *of D. geminata* biomass is number of days since the occurrence of a flood greater than 75 to 100 m3/s. In other words, large floods scour the river bed and return biomass to a low level. However, in order to reduce cell biomass, floods must be high enough to cause the rocks on the river bed to mobilize, scouring the cells from rock surfaces (Spaulding & Elwell, 2007).

In North America and Europe, high-density *D. geminata* blooms frequently occur in rivers directly below impoundments. A monthly survey of rivers in Alberta, Canada, suggests that *D. geminata* occurs with higher frequency in locations where flow and temperature is regulated by dams compared with nonregulated rivers. In these river reaches, stable flows and fairly constant temperatures favor development of large masses of *D. geminata*. Restoration of historic, or pre-impoundment, natural flows in rivers may mitigate nuisance blooms, as well as restore river condition.

The Driftless Area of southwestern Wisconsin may be susceptible to invasion by *D. geminata*. The area is characterized by numerous small dams that control flooding. Also, streamflow trends in the region imply that baseflow (stream flow during dry periods) has increased and peak flood flows have decreased over the last century, due to better land management (Wisconsin Department of Natural Resources [WDNR], 2011). Both of these may prevent the peak scouring events that limit *D. geminata* establishment.

BIOLOGICAL TRAITS

D. geminata is a diatom, a type of single-celled alga with a polysaccharide stalk. "The stalk may attach to rocks, plants, or any other submerged substrate. When the diatom cell divides (that is, through vegetative reproduction), the stalk also divides, eventually forming a dense mass of branching stalks. It is not the diatom cell itself that is responsible for the negative impacts of *D. geminata*, but the massive production of extracellular stalk (Spaulding & Elwell, 2007).

IMPACT POTENTIAL

Ecosystem Alterations

This diatom is capable of producing such great amounts of stalk that the mats covering the stream bed result in changes in ecological properties of the stream (for example, species diversity, population sizes, nutrient pools). Algal, invertebrate, and fish species diversity and population sizes may be altered. In addition, high growth rates and extensive mats of *D. geminata* may impact ecological processes such as ecosystem metabolism and nutrient cycling. Stalk and algal biomass, formation of nuisance blooms, legacy of stalks, interactions with invertebrates, interactions with fish, control by water chemistry and hydrology, impact on dissolved oxygen, and seasonal cycles are all part of how this organism exerts its influence on its stream and how it is also controlled by environmental features (Spaulding & Elwell, 2007).

Impacts to Fish

Fish that inhabit benthic habitats, consume benthic prey, and nest beneath or between cobbles are expected to be the most impacted because they utilize the same habitat as *D. geminata*. Nuisance growths of *D. geminata* have the potential to impact fisheries through food web interactions with aquatic macroinvertebrates (Spaulding & Elwell, 2007).

Economics

The more than 600 spring-fed coldwater creeks of the Driftless Area, and the world-class fishery they support, is a large economic engine for southwest Wisconsin. Anglers (from all corners of the United States) generate approximately $1.1 billion each year in the Driftless Area, strongly benefiting the local economy (NorthStar Economics Inc., 2008). The introduction of *D. geminata* may impair the economic boon of angling in the region.

PREVENTION & CONTROL

Watercraft, float tubes, waders, and angling gear are the most likely vectors for the spread of *D. geminata*. Cleaning gear before traveling between bodies of water, whether between nearby streams or to international destinations, is crucial. Decontamination of gear—via drying completely for several days, or freezing—is the best way to prevent the spread and subsequent introduction of *D. geminata* into new watersheds. If these measures aren't possible, gear should be disinfected by washing with a 2% bleach solution (one cup of bleach per three gallons of water) for at least a minute. See the comparison of the effectiveness of methods and products tested on *D. geminata* and their rank, according to operational suitability for compliance with Biosecurity New Zealand's "Check Clean Dry" public awareness campaign to reduce the spread of the algae at http://www.biosecurity.govt.nz/files/pests/didymo/didymo-survival-results-table-may-07.pdf (Kilroy, Lagerstedt, Davey, & Robinson, 2006).

An aggressive education and outreach program could be implemented to change water resource user behavior in order to minimize the spread of *D. geminata*. A public awareness campaign, directed at freshwater anglers, boaters, professional guides, and other recreationalists could be integrated with existing invasive species programs. Freshwater resource users, including ecologists, water managers, fisheries biologists, and other scientists, need to be aware of the threat posed by *D. geminata*, and practice decontamination procedures to prevent the spread (Spaulding & Elwell, 2007).

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Egeria densa (Brazilian waterweed)

DISTRIBUTION

The aquatic macrophyte *Egeria densa* is native to South America—Brazil, Uruguay, and Argentina (Morgan, 2009). It has been established in most southern, east coast, and west coast states in the U.S.

Local Distribution

A population of *E. densa* was reported by WDNR staff in 2009 in a small Portage County fish pond (Wisconsin Department of Natural Resources [WDNR], 2010). In the Mississippi River basin, a population of *E. densa* was reported in Powderhorn Lake, in Minneapolis, MN (United States Geological Survey [USGS], 2011).

HABITAT & KNOWN LIMITING PARAMETERS

E. densa is generally found rooted on the bottom in depths of up to six meters or drifting (Washington Department of Ecology [WDE], 2011). It is found in both still and flowing waters, in lakes, ponds, pools, ditches, and quiet streams. Its preferred habitat is mildly-acidic, nutrient-rich lakes. During winter, it survives along the bottom and resumes growing when waters reach 10°C (WDNR, 2011). It tends to form dense monospecific stands that can cover hundreds of acres and can persist until senescence in the fall. High water temperatures (greater than 30°C) and high light intensities can cause senescence (WDE, 2011).

E. densa has the capacity to grow under low light availability when compared with some other submerged species under similar temperatures (Rodrigues & Thomaz, 2010).

PHYSICAL & BIOLOGICAL TRAITS

*E. densa l*eaves and stems are generally bright green and the short internodes length result in a very leafy appearance. The leaves of *E. densa* are minutely serrated (requiring magnification to see) and linear, are 10-30 mm long, up to 5 mm wide, and found in whorls of four to eight. The lowest leaves may be opposite or in whorls of three; middle and upper leaves are in whorls of four to eight. The stems are erect, cylindrical, simple, or branched, and grow until they reach the surface of the water where they form dense mats. Flowers have three petals which are white (18-25 mm) and float on or rise just above the water's surface on slender peduncle. Slender roots are unbranched and typically a white to pale color. Adventitious roots are freely produced from double nodes on the stem (WDE, 2011).

Seeds and/or female flowers have never been reported from the *E. densa* populations that have established in the United States. The absence of sexual reproduction in introduced populations of *E. densa* emphasizes the importance of the vegetative growth phase of the plant. Specialized nodal regions described as double nodes occur at intervals of six to twelve nodes along a shoot. A double node consists of two single nodes separated by a greatly shortened internode. Double nodes produce lateral buds, branches, and adventitious roots. Only shoot fragments of *E. densa* which contain double node regions can develop into new plants. The plant fragments readily and each fragment containing a double node has the potential to develop into a new plant. Plant root crowns also develop from double nodes along an old shoot. When a shoot sinks to the bottom during fall and winter senescence, a new root crown may develop at one or several double nodes along the new shoot. *E. densa* lacks specialized storage organs such as rhizomes or tubers and stores carbohydrates in stem tissues (WDE, 2011).

Look-a-likes

E. densa may be mistaken for several other plants, including hydrilla (*Hydrilla verticillata*), another invasive plant, as well as the native American waterweed (*Elodea canadensis*) and common waterweed (*Elodea nuttallii*) (WDNR, 2011).

IMPACT POTENTIAL

Ecosystem impacts

Dense stands of *E. densa* may impact the hydrology and biology of an ecosystem. It may restrict water movement, trap sediment, and cause fluctuations in water quality (Morgan, 2009). *E. densa* affects aquatic plant community structure and composition by facilitating persistence of some species and reducing the likelihood of establishment of other species. Successful management of this species may therefore facilitate shifts in existing non-native or native plant species (Santos, Anderson, & Ustin, 2011).

Economic Impacts

Severe infestations may impair recreational uses of a waterbody including navigation, fishing, swimming, and water skiing. In Brazil, *E. densa* (as well as *E. najas*, *Ceratophyllum demersum*, and *Eichhornia crassipes*) have severely infested hydropower reservoirs. It was estimated that 48,000 cubic meters of aquatic weeds were removed from water intake structures in Jupia Reservoir (Morgan, 2009).

TRANSPORT

The primary vector of spread for *E. densa* is the world-wide aquarium trade, where it is sold widely as good "oxygenator" plant, and subsequently released from domestic to natural environments. A secondary vector for dispersal occurs via boat trailers, and can subsequently spread downstream via vegetative dispersal (Morgan, 2009).

PREVENTION & CONTROL

Preventing future introductions of *E. densa* by regulating the aquarium and water garden trades is an important management step. Local potential vendors should be educated about the threat of such invasive macrophytes and the existing NR 40 regulations that apply.

Large infestations of *E. densa* can be controlled with herbicides. Fluridone is most effective but diquat complexed copper mixtures, endothall complexed copper mixtures, and endothall dipotassium salt are also effective. In small areas like docks and swimming areas, an opaque fabric can be laid over the substrate to prevent the growth of all rooted aquatic vegetation. *E. densa* can be mechanically removed but this should only be used when all other available approaches are exhausted, as it spreads via fragments (WDNR, 2011).

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Humulus japonicus (Japanese hops)

DISTRIBUTION

Humulus japonicas has been observed in Missouri, Illinois, Michigan, southern Indiana, Ohio, and Wisconsin, southeastern Minnesota, and into southern Canada (Midwest Invasive Plant Network [MIPN], n.d.).

Local Distribution

H. japonicus is widespread in the watersheds of the Grant and Platte rivers in Grant County, Wisconsin. Both rivers are tributaries to the Upper Mississippi River. It was not believed to be present in large quantities in the Lower Wisconsin River watershed prior to a discovery of a large infestation on Pleasant Valley Creek, a tributary of the Fennimore Fork of the Blue River in 2011 (also in Grant County). It has also been found in several other small tributaries to the Upper Mississippi River including Copper Creek, Crawford County, as well as along a roadside drainage ditch on County Highway 81 east of Cassville, WI—only a few miles from the Mississippi River.

TRANSPORT

It appears that flowing water is the primary dispersing agent for *H. japonicus* in riparian corridors. Following a large spring event in Blockhouse Creek, a tributary to the Little Platte River in Grant County, WI, *H. japonicus* quickly spread downstream. Anecdotal evidence in the Pleasant Valley Creek watershed suggests that mowing or baling equipment and bales transported for feed may be dispersing *H. japonicus* between watersheds (J. Unmuth, personal communication, November 2011).

HABITAT & KNOWN LIMITING PARAMETERS

Preferring moist soils, it can form dense stands in floodplains and along streambanks and lakeshores, but can thrive in disturbed areas such as roadsides and urban lots. It can be found in full sun or shade (Wisconsin Department of Natural Resources [WDNR], 2004). *H. japonicus* can spread rapidly into pastures and along fences, but also potentially in no-till fields (Renz, 2008). Growth is less vigorous in shade and on drier soils (Pannill, Cook, Hairston-Strang, & Swearingen, 2010).

BIOLOGICAL TRAITS

H. japonicus is an herbaceous annual, twining, shallow-rooted vine that can climb to heights of ten or more feet with the help of rough-textured stems covered with short, sharp, downward-pointing prickles that can be very irritating to the skin. Its leaves are rough-textured, paired, simple, palmate with typically five to seven lobes; leaf margins are toothed. Flowering occurs in July and August; male and female flowers are borne on separate plants. Male flowers are very small, greenish yellow and occur in branched panicles. Female flowers are pale green, plump, drooping, cone-like structures with overlapping scales that become 'hops'. Seeds are about three mm in diameter, roundish with a blunt tip, and light brown with darker specks. Seeds mature through September (National Park Service [NPS], 2010).

H. japonicus may be confused with the common hop (*Humulus lupulus*), which looks very much like *H. japonicus* (but is usually three-lobed or unlobed) or native bur cucumber (*Sicyos angulatus*), which lacks prickles, has tendrils, and displays leaves with much less-pronounced lobes. The seedbank of *H. lupulus* is typically exhausted in approximately three years (MIPN, n.d.).

IMPACT POTENTIAL

Ecological
H. japonicus In Korea, *H. japonicus* seeds germinate under Amur silvergrass (*Miscanthus saccharifloru*s) and phragmites *(Phragmites australis)* in May, but by August, hops seedlings overtop these other species in riverine wetlands. Where winds are strong, plants of *M. sacchariflorus* and *P. australis* cannot withstand the weight of *H. japonicus* overhead, so they fall and become completely covered by the latter. Growth of other plants is impossible under *H. japonicus* because of deficient light, and these floodplains soon feature a monotypic expanse of *H. japonicus*. This significantly changes the unique structure and function of those riverine wetlands, especially with respect to animal habitat and landscape (Kim & Kim, 2009). In southwestern Wisconsin, *H. japonicus* has been observed blanketing reed canary grass (*Phalaris arundinacea)* as well as native vegetation.

In the same Korean study, annual decay rates for *Humulus*-shaded *M. sacchariflorus* and *P. australis* were higher than for those respective plants that withered naturally. This demonstrates that *H. japonicus* accelerated the decomposition of both species and also activated such decay earlier in the year, i.e., in August. Nutrient cycling was elevated in the presence of *Humulus*, a result of the low C/N ratio, high moisture content, greater amounts of N and P in the decaying plants, and an improved environment for decomposition due to a lower light intensity and a higher and more stable humidity and temperature. All of these factors enabled *H. japonicus* to grow quickly, thereby accelerating nutrient cycling in these riverine wetlands (Kim & Kim, 2009).

Human Health
The pollen of *H. japonicus* has been known as one of the important causes of hay fever and allergies in Korea and China (Park, Kim, & Hong, 1999).

PREVENTION
H. japonicus has the potential to significantly change riparian ecosystem function. It does not readily germinate in grassy areas, particularly in tall, sod-forming perennial grasses such as tall fescue (*Festuca arundinacea*) or *P. arundinacea*, but is more likely to germinate and grow in an area where the soil is exposed or dominated by sparse broadleaf weed cover. However, once germinated it will overtop and kill grass, leaving a bare area for the germination of next year's hops seeds to grow (Pannill & Cook, 2007). The hydrology of streams in southwestern Wisconsin has been altered due to upland agricultural practices. Flashy spring flows are responsible for the erosion of ill-protected streambanks, leaving exposed soil and making them more susceptible to invasion by *H. japonicus*. Ensuring streambanks are properly vegetated with native vegetation may serve as a good defense.

CONTROL

Manual
H. japonicus does not develop an extensive or deep root system and as a result is fairly easy to pull or dig early in the season, especially when the soil is moist (Pannill et al. 2010). However, efforts to pull large infestations in the Platte River watershed proved to be ineffective, labor-intensive, and time consuming. Pulling is only recommended for landowners who have a small infestation (B. Trewartha, personal communication, October 2011). As much of the rootstock as possible should be removed in these instances. It is likely that resprouts could occur from both the rootstock and the bines (the leafy portion of the plant), so the pulled plants should be removed or left where they cannot reroot. (MIPN, n.d.). Due to the irritating prickles on the stems and leaves, it is important to wear gloves, long pants and long sleeves to avoid skin contact with the plant (Pannill et al., 2010).

Chemical

Effective combinations include a pre-emergent herbicide in early March, or slightly later if using a product with post-emergent properties, followed by post-emergent application in mid-summer, or two post-emergent treatments (mid and late summer) to prevent the fall seed set. The herbicide options can also be combined with efforts to pull vines or regularly mowing. It is important to follow any herbicide applications with native seed planting, as following the treatment, soil will be bare and susceptible to erosion and invasion; establishing native plants are a necessary step to preventing erosion and revegetation by invasive species. According to the Nature Conservancy, hop seeds in the soil are unlikely to last more than three years. Repeat treatments for two to three years should be expected especially in areas subject to flooding that may receive influx of seed from upstream infestations (Pannill et al., 2010).

Biological

Currently, no biological agents to control *H. japonicus* are available to the public. However, the U.S. Forest Service has been investigating natural enemies of plants of Asian origin that are invasive in the U.S., and they have identified two moths (*Epirrhoe sepergressa* and *Chytonix segregata*) and one fungus (*Pseudocercospora humuli*) as potential natural enemies of *H. japonicus* and will continue researching these species. The Japanese beetle (*Popillia japonica*) has been observed to feed on *H. japonicus* but did not cause extensive damage (Pannill et al., 2010).

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Lythrum salicaria (purple loosestrife)

DISTRIBUTION

Lythrum salicaria is a wetland plant that is native to the temperate regions of Europe and Asia (Thompson, Stuckey, & Thompson, 1987). It has spread around the world and can now be found in almost all of the lower 48 states in the U.S. and in nine Canadian provinces (Blossey, Skinner, & Taylor, 2001). In the U.S., *L. salicaria* is the most abundant in the Midwest and the Northeast regions. Minnesota has approximately 8,500 hectares infested with *L. salicaria*, Wisconsin has about 11,900 hectares, and Ohio also has around 11,900 hectares (Cao, 2009).

Local Distribution

L. salicaria is widely spread in Wisconsin with 70 of the 72 counties reporting populations (Wisconsin Department of Natural Resources [WDNR], 2011). The areas of heaviest infestation are sections of the Wisconsin River, the extreme southeastern part of the state, and the Wolf and Fox River watersheds (WDNR, 2011).

TRANSPORT

L. salicaria was likely brought to North America in the 1800s both intentionally, as an ornamental plant, and unintentionally, by ships dumping ballast water or European raw sheep wool that contained seeds (Thompson et al., 1987). Humans have continued to transport *L. salicaria* throughout the U.S. as a landscaping plant and as a food source for bees due to its nectar-producing capabilities. *L. salicaria* spreads naturally through either vegetative spread that is activated by soil disturbance or through seed dispersal. Its seeds either fall near the plant or are dispersed by water. Additionally, animals and humans can be a vector of transport when seeds stuck in mud are attached to bodies, equipment or vehicles (Skinner, Rendall, & Fuge, 1994; WDNR, 2011).

HABITAT AND KNOWN LIMITING PARAMETERS

L. salicaria can thrive in a variety of habitats: tidal and non-tidal marshes, stream and river margins, pond and lake edges, and ditches. Table 1 shows the habitat types where *L. salicaria* is found in Minnesota, and its associated density for each habitat type, which would likely be similar to population in Wisconsin. The Lower Wisconsin River watershed contains all of these listed habitats, providing favorable growing conditions for introduced *L. salicaria* populations.

Table 1. Types of Minnesota habitats where *L. salicaria* was found. Table replicated from Skinner et al. 1994.

Site Type*	Percent (%)
Lake and Pond	32
Wetland (marsh, swamp, etc.)	29
Roadside Ditch	15
River and Streams	9
Drainage Ditch	5
Garden	5
Meadow (pasture, upland site, prairie)	2
Undefined	2
Other (parking lots, etc.)	1

* As defined by the Minnesota Purple Loosestrife Program.

Once an adult plant is established, *L. salicaria* is tolerant to changes in water regimes, canopy cover (up to 50% shade), temperature (> 20°C), salinity, a wide range of soil pH, and low soil nutrients. However, for germination a seed requires sunny, moist soils (Skinner et al., 1994; Thompson et al., 1987). This typically occurs in areas of recent disturbance.

BIOLOGICAL TRAITS

L. salicaria is a pioneer species and grows quickly in disturbed systems. This gives it an advantage over native species which take longer to germinate and re-establish after a disturbance (Skinner et al., 1994). A single plant can produce more than two million seeds per year and remain viable in the soil for many years, creating an impressive seed bank for *L. salicaria* (Thompson et al., 1987; WDNR, 2011). A seed bank under an established *L. salicaria* bed can contain over 410,000 seeds per square meter of five cm deep soil (Welling & Becker, 1990 as cited in Skinner et al., 1994).

IMPACT POTENTIAL

Ecological

L. salicaria can form monotypic stands that outcompete native wetland plants and can change the soil and water chemistry of the ecosystem. Lavoie (2010) compiled studies looking at the impact of *L. salicaria* on plants, invertebrates, amphibians, birds, and the ecological processes of wetlands. The studies showed that *L. salicaria* had an especially strong negative impact on tadpoles, black tern (*Chlidonias niger*), least bittern (*Ixobrychus exilis*), pied-billed grebe (*Podilymbus podiceps*), and marsh wren (*Cistothorus palustris*) (Blossey, 2002; Lavoie, 2010). Additionally, other marsh birds that nest in native marsh grasses are negatively impacted by *L. salicaria* stands since the native grasses, sedges and flowering plants supply a higher quality of cover, food, or nesting sites (Cao, 2009). Lavoie (2010) noted that no studies on the impacts of *L. salicaria* on fish, mammals, or waterfowl had been published to date.

L. salicaria can cause changes in the wetland nutrient cycling. Native plants decompose more slowly than *L. salicaria*, the rapid decomposition of which leads to a fall nutrient release instead of the usually spring nutrient flush (Cao, 2009). This change in timing can cause alterations throughout the different communities in the wetland.

Economic
Dense *L. salicaria* stands can impede boat traffic and reduce the recreational and aesthetic value of waterways (Invasive Species Specialist Group [ISSG], 2010).

PREVENTION AND CONTROL
L. salicaria is a restricted species under NR 40 in Wisconsin. This means that it cannot be transported, transferred or introduced into ecological systems in Wisconsin; however, possession of the species is allowed. Prevention of new populations is always the number one tool against AIS. *L. salicaria* seed transport is possible by animals and human bodies, equipment, and/or vehicles, so it is important when leaving an area with *L. salicaria* to clean mud and seeds from pets, boots, clothes, equipment and vehicles.

Mechanical
Removal by cutting and pulling is recommended only for small populations of *L. salicaria*. The timing of cutting should be taken into consideration. Cutting should take place before flowering begins and seeds are developed, but cutting too early could encourage more flowering (WDNR, 2011). If manually pulling *L. salicaria*, care must be taken in removing all root fragments since these can grow into new plants. Additionally, leaving open soil encourages the germination of *L. salicaria* (and other invasive) seeds in the soil, so revegetation with native plants or seeds is a necessary measure.

Chemical
Timing is important when chemically treating *L. salicaria*; late July or August, before the plant is flowering is best (WDNR, 2011). Glyphosate herbicides (Roundup and Glyfoes) are typically used in areas where there is no open water (WDNR, 2011). Rodeo, also a glyphosate, is recommended for use over water (WDNR, 2011). The best technique is to cut the *L. salicaria* stems at knee level and then apply the herbicide directly onto the stump of the cut stem (WDNR, 2011). It is important to note that care should be taken when applying the herbicide, since it is not species-selective and will harm all plants that it comes in contact with. Another herbicide option is Triclopyr (Garlon 3A) which can be applied as a foliar spray and can be used around water (WDNR, 2011). It does not harm grass or sedge species. However, Triclopyr is not yet approved by the EPA for wetlands (WDNR, 2011).

Biological
Biocontrol of *L. salicaria* is recommended for heavy infestations. In its native range, the plant is kept in check by natural predators and disease, but in North America these checks in the system do not exist (WDNR, 2011). There are four species of insects that have been approved and have been released to control *L. salicaria* populations: two weevil species (*Hylobius transversovittatus* Goeze and *Nanophyes marmoratus*) and two beetle species (*Galerucella calmariensis* and *Galerucella pusilla*) (Cao, 2009; WDNR, 2011).

Site Characteristics	1-20 plants scattered	20-100 plants scattered/ small clumps	100-1,000 plants small clumps/ dense stands	>1,000 plants Large stands >75% coverage
Walkable or drivable	Hand remove plants and destroy all parts.	Same as left or selectively spray with Rodeo.	Spot-spray Rodeo or broadcast-spray selective herbicide.	Broadcast-spray selective herb./ Biological control when available.
Accessible by boat	Same as above or selectively spot-spray w/herbicide.	"Selectively" spotspray with Rodeo.	Spot-spray Rodeo or broadcast-spray selective herbicide.	Broadcast-spray selective herb./ Biological control when available.
Inaccessible by ground or water	"Selectively" broadcast spray w/herbicide.	"Selectively" broad-cast spray with herbicide.	Biological control when available.	Biological control when available.
Sensitive site (e.g., rare plants)	Hand Remove/ Wick application of Rodeo.	Hand Remove/Wick application of Rodeo.	Biological control when available.	Biological control when available.
Chemical use prohibited	Hand remove plants and destroy all plant parts.	Hand remove plants and destroy all plant parts.	Biological control when available.	Biological control when available.

Table 2: *L. salicaria* management guide (Skinner et al., 1994)

USEFUL WEBSITES

WDNR Controlling Purple Loosestrife - http://dnr.wi.gov/invasives/fact/loosecontrol.htm
WDNR Factsheet - http://dnr.wi.gov/invasives/fact/loosestrife.htm
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Myriophyllum spicatum (Eurasian watermilfoil)

DESCRIPTION

Myriophyllum spicatum is a submersed aquatic plant native to Europe, Asia, and northern Africa. It is the only non-native milfoil in Wisconsin. Its stems tend to be limp, and may show a pinkish-red color. The four-petaled, pink flowers of *M. spicatum* are located on a spike that rises a few inches out of the water. The leaves are typically divided into twelve or more pairs of threadlike leaflets. The most common native water milfoils tend to have whitish or brownish stems, and leaves that divide into fewer than ten pairs of leaflets (Wisconsin Department of Natural Resources [WDNR], 2011a).

DISTRIBUTION

M. spicatum is one of the most widely distributed of all nonindigenous aquatic plants; confirmed in 45 U.S. states, and in the Canadian provinces of British Columbia, Ontario and Quebec (Jacono & Richerson, 2011).

M. spicatum was first documented in the Lower Wisconsin River basin in 1965 in Avoca Lake. It has been found in 22 of the 100 floodplain lakes surveyed by Dave Marshall; however, rarely at nuisance levels (WDNR, 2011b). It is also found in several heavily visited waterbodies in and adjacent to the basin including but not limited to White Mound Lake, Cox Hollow Lake, the Yahara chain of lakes near Madison, Devil's Lake, Lake Wisconsin, and Lake Delton.

TRANSPORT

First documented in 1942 from a pond in Washington D.C., *M. spicatum* was probably intentionally introduced to the United States. After being planted in waterbodies around the continent, its spread continued naturally as vegetative propagules disseminated in flow and by motorboat traffic. Today, transport on boating equipment plays the largest role in introducing fragments to new waterbodies. It continues to spread through the aquarium and water garden trades as well (Jacono & Richerson, 2011).

HABITAT PREFERENCES

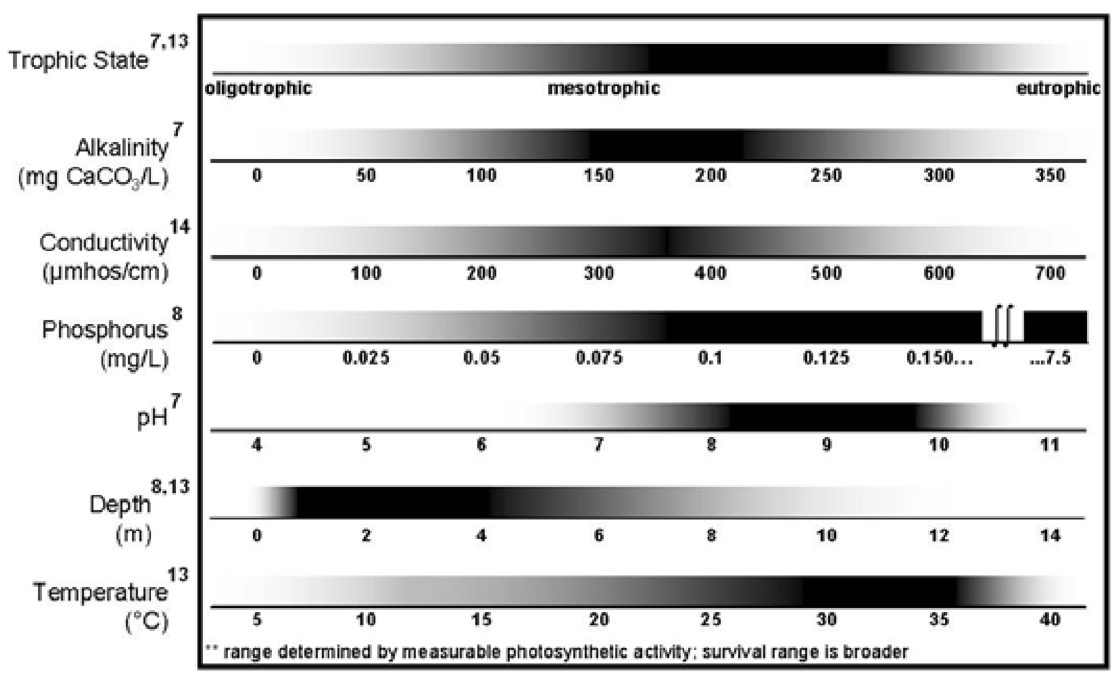

Figure 1: *M. spicatum* prefers moderate eutrophication; fine organic sediments; moderate clarity; high alkalinity; tolerates a wide range of pH and salinity (WDNR, 2011a).

BIOLOGICAL TRAITS
Tolerant of low water temperatures, *M. spicatum* quickly grows to the surface in the spring, forming dense canopies that overtop and shade the surrounding vegetation (Jacono & Richerson, 2011). It grows best in fertile, fine-textured, inorganic sediments; in less productive lakes, it is restricted to areas of nutrient-rich sediments. It has a history of becoming dominant in eutrophic, nutrient-rich lakes, although this pattern is not universal. *M. spicatum* is an opportunistic species that prefers highly-disturbed lake beds, lakes receiving nitrogen and phosphorous-laden runoff, and heavily-used lakes. Optimal growth occurs in alkaline systems with a high concentration of dissolved inorganic carbon. High water temperatures promote multiple periods of flowering and fragmentation (WDNR, 2011a).

IMPACT POTENTIAL

Flora Diversity
M. spicatum competes aggressively to displace and reduce the diversity of native aquatic plants. Canopy formation and light reduction are significant factors in the decline of native plant abundance and diversity observed when *M. spicatum* invades healthy plant communities (Jacono & Richerson, 2011).

Fauna Diversity
M. spicatum has less value as a food source for waterfowl than the native plants it replaces. And although fish may initially benefit from increased cover, the overabundant growth of *M. spicatum* may negate any short-term benefits it may provide fish in healthy waters. At high densities, its foliage supports a lower abundance and diversity of invertebrates, organisms that serve as fish food. Dense cover allows high survival rates of young fish, however, larger predator fish lose foraging space and and are less efficient at obtaining their prey. The growth and vigor of a warm-water fishery has been found to be reduced by dense *M. spicatum* cover (Jacono & Richerson, 2011).

M. spicatum has also been responsible for the spread of invasive mussels, such as zebra and quagga mussels (*Dreissena polymorpha* and *D. rostriformis*). *D. polymorpha* has been found attached to *M. spicatum* being transported on the trailers of recreational boaters from one waterbody to another. (Johnson & Padilla, 1996)

Water Quality
The growth and senescence of the thick vegetation of *M. spicatum* degrades water quality and depletes dissolved oxygen levels (Jacono & Richerson, 2011).

Recreation
Typically dense *M. spicatum* beds restrict swimming, fishing and boating, clog water intakes, and result in decaying mats that foul lakeside beaches (Jacono & Richerson, 2011).

Lower Wisconsin River
More negative impacts can be expected in eutrophic than mesotrophic systems (WDNR, n.d.). Therefore, the impact potential of *M. spicatum* on the floodplain lakes of the Lower Wisconsin River and other area lakes will depend heavily upon the overall resiliency of the lake which is in turn dependent upon whether or not it is receiving excess nutrients from surrounding land uses or if the hydrology of the lake has been altered due to impounding or otherwise (Marshall,

2010).

PREVENTION & CONTROL

Eradication of established populations of *M. spicatum* is most likely impossible (WDNR, n.d.). Currently, herbicides or mechanical harvesting are most often used to control watermilfoil infestations. These methods can provide relief from the nuisances caused by milfoil. As is the case with terrestrial weeds, control often must be done annually and sometimes more than once per season. The cost of control can be expensive, from $150 to $2000 per acre annually in Minnesota (Newman, 2008).

In riverine and lacustrine ecosystems, such as the St. Croix River, managers have hand-pulled small *M. spicatum* infestations. Drawdown may be another feasible option on impounded bodies of water. Biocontrol is not currently an option in flowing systems.

The best defense against *M. spicatum* is ensuring that waterbodies are healthy and not heavily impacted by nutrient loading, preventing the removal of native macrophyte population by invasive omnivores such as the grass carp (*Ctenopharyngodon idella*), and preventing hydrologic disturbances.

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Nymphoides peltata (yellow floating heart)

DISTRIBUTION

Nymphoides peltata is native to temperate and tropical Eurasia and the Mediterranean Sea region. It was first noted in the United States in 1882 in Winchester, MA (Les & Mehrhoff, 1999). Evidence exists that *N. peltata* was marketed as an ornamental plant in the United States as early as 1891 (Countryman, 1970).

Local Distribution

Established populations of *N. peltata* have been found in many locations near and connected to waters of Wisconsin. It has been reported in the Lower Mississippi River valley and the Ohio River valley (Wisconsin Department of Natural Resources [WDNR], 2008). It has also been found within Indiana, Illinois and Ohio (Howard, 2007).

There are five known occurrences of *N. peltata* in Wisconsin, all of which have been in ponds. One pond in Walworth County (found in 2008), two ponds in Marinette County (found in 2010), a pond in Waukesha County (found in 2010), and one pond in Dane County (found in 2006) contained established populations of *N. peltata* (WDNR, 2008).

TRANSPORT

The primary vector of the spread of *N. peltata* is humans. It is commonly cultivated as a water garden plant, and has been sold as an ornamental pond species since 1891 (Howard, 2007). After establishing in water gardens and ornamental ponds, it can then spread during flood events, natural dispersal by seed and rhizome fragmentation, and hitchhiking on watercrafts, waterfowl, and mammals to new locations (Darbyshire & Francis, 2008; Howard, 2007).

HABITAT & KNOWN LIMITING PARAMETERS

N. peltata grows in still or slow-moving waters in rivers, lakes, reservoirs, ditches, canals, and swamps and typically grows at depths of 0.5-4 meters (Darbyshire & Francis, 2008; Howard, 2007; WDNR, 2008). Although not a usual occurrence, *N. peltata* can also grow on damp mud (Invasive Species Specialist Group [ISSG], 2006).

N. peltata prefer substrates such as clay, organic mud, or a combination of the two (Van der Velde, Giesen, & Van Der Heijden, 1979). It is usually found in eutrophic waterbodies that are well-buffered (alkalinity range of 150-250 mg $CaCO_3$/L and pH range of 7-11) (Darbyshire & Francis, 2008). *N. peltata* needs dissolved calcium for leaf development, which explains its alkalinity limitations (Darbyshire & Francis, 2008).

In the Lower Wisconsin River basin, *N. peltata* would likely favor quiet, shallow backchannels, sloughs, and reservoirs. Based on a preliminary review of water quality data—particularly alkalinity—for Lower Wisconsin River basin waterways (available on the WDNR SWIMS database), reservoirs such as Twin Valley and Blackhawk lakes may provide favorable habitats for *N. peltata*.

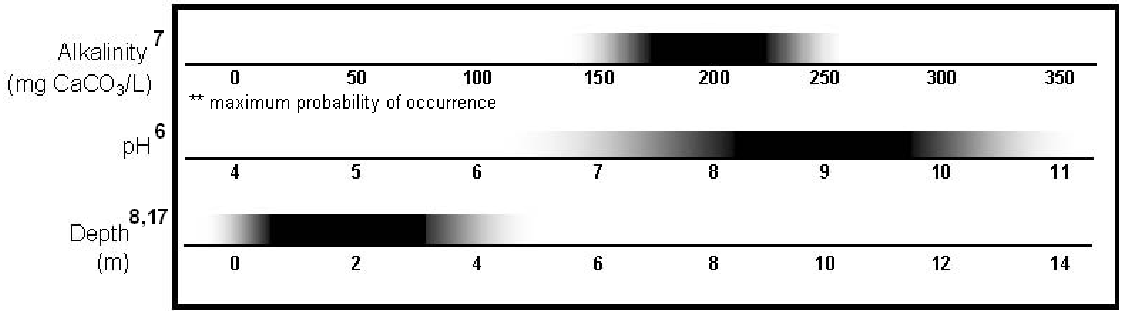

Figure 1: Dark shading indicates optimal *N. peltata* growing conditions (WDNR)

BIOLOGICAL TRAITS

N. peltata possesses many characteristics of a typical pioneer species. It can reproduce either sexually by producing seeds, or asexually from fragments of rhizomes, stolons, or separated leaves (WDNR, 2010). Ideally, for seed establishment, there should be a minimal inundation and plenty of light (ISSG, 2006). *N. peltata* produces a persistent seed bank, and is therefore hard to eliminate once a population establishes (Smits, Avesaath, & Velde, 1990). Due to its intense stolon production, a single *N. peltata* plant can colonize a large area in just a few years (Darbyshire & Francis, 2008).

There are a variety of consumers of *N. peltata,* ranging from insects to mammals. The aquatic sowbug (*Asellus aquaticus*), the great pond snail (*Lymnaea stagnalis*), a moth larvae (*Nausinoe nymphaeata*), a midge species (*Cricotopus trifasciatus*), and a slug species (*Deroceras leave*) have all been found feeding on it (WDNR, 2010). American coots (*Fulica atra*) eat both the floating leaves and the seeds of *N. peltata* (Darbyshire & Francis, 2008). In the Netherlands, the North American muskrat (*Ondatra zibethicus*) has been observed eating all parts of the *N. peltata* plant (Lammens & van der Velde, 1978). Domestic cattle (*Bos Taurus* L.) have also been shown to consume the entire *N. peltata* plant along the littoral zone of an old river branch in the Netherlands (Darbyshire & Francis, 2008).

IMPACT POTENTIAL

N. peltata plants grow at such great densities that they can create extensive mats. The mats can shade out native plants and in some cases create a stagnant area with low oxygen levels that can be harmful to aquatic wildlife (Howard, 2007; WDNR, 2008). Additionally, *N.* peltata can actually alter the chemical composition of the water, when growing in large densities, by increasing the organic content and nutrient levels from the sediment during their life cycle. The mats can also cause problems for recreational activities such as fishing, boating, and swimming (Darbyshire & Francis, 2008; WDNR, 2008).

N. peltata is an aggressive competitor for light and outcompetes many native aquatic plants such as floating pondweed (*Potamogeton natans*), water smartweed (*Polygonum amphibium*), and wild rice (*Zizania latifolia*) (Darbyshire & Francis, 2008; WDNR, 2010). Larson (2007) found *N. peltata* had a negative impact on the growth rates of three submerged aquatic plant species: coontail (*Ceratophyllum demersum),* elodea *(Elodea Canadensis),* and crowfoot *(Ranunculus circinatus*).

Another issue with *N. peltata* is that "hitchhiker" plants, such as hydrilla (*Hydrilla verticillata*), can be introduced unintentionally when *N. peltata* is ordered through the mail (ISSG, 2006).

PREVENTION & CONTROL

Mechanical

N. peltata is easily cut by hand; however, it will quickly recover (Centre for Ecology and Hydrology [CEH], 2004). If the sediment is soft and the infestation covers a small area, raking out the rhizomes may be a viable option (Darbyshire & Francis, 2008). Weed bottom barriers are also an option, but this has negative effects on non-target species and does not work in areas with water flow (WDNR, 2010). Darbyshire & Francis (2008) recommend completely drying out infested waters for one year as an eradication method. This should kill both the rhizomes and the seed bank in the sediment.

Chemical

Aquatic glyphosate (Rodeo®) and dichlobenil may be an effective treatment for *N. peltata*, but permits and special licenses are required (CEH, 2004; WDNR, 2008). At least for the dichlobenil, the manufactures recommend that no more than 20% of the waterbody can be treated at a time and used in water with flows less than 90 m/hour. Spring application is recommended (CEH, 2004). Glyphosate is thought to be less effective than dichlobenil; control was estimated around 40-50% and only lasted for one season (CEH, 2004). The chemicals are not species-specific, so non-target species will be harmed.

USEFUL WEBSITES

HTTP://WWW.CEH.AC.UK/SCI_PROGRAMMES/DOCUMENTS/FRINGEDWATERLILY.PDF
HTTP://DNR.WI.GOV/INVASIVES/FACT/YELLOW_FLOATING_HEART.HTM
HTTP://NAS.ER.USGS.GOV/QUERIES/FACTSHEET.ASPX?SPECIESID=243
HTTP://WWW.ISSG.ORG/DATABASE/SPECIES/ECOLOGY.ASP?SI=225&FR=1&STS=SSS&LANG=EN

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Bithynia tentaculata (Faucet snail or mud bithynia)

DISTRIBUTION

Bithynia tentaculata is native to Europe, ranging from Scandinavia to Greece (Kipp & Benson, 2010).

Local Distribution

Regionally, the snail is present and established in both the Great Lakes and Mississippi River basins. Kipp & Benson (2010) report the first occurrence of *B. tentaculata* in the Great Lakes basin was in Lake Michigan in 1871. It spread to Lake Ontario by 1879, the Hudson River by 1892, and other tributaries and waterbodies in the Finger Lakes region of New York during the 20th century (Jokinen, 1992; Mills, Leach, Carlton, & Secor, 1993). In Wisconsin, *B. tentaculata* was found in Shawano Lake (headwaters of the Wolf River system) in 1997 and 1998 (Carver, 2008). It has also been established in Lake Michigan near Milwaukee since 1974 and collected in the Duluth Harbor of Lake Superior in 2006 (Kipp & Benson, 2010).

In the Mississippi River basin, the presence of *B. tentaculata* has largely been indicated by waterbird die-off events. These events have been observed in Lake Onalaska (Pool 7 of the Mississippi River) every year since 2002 (Sauer, Cole, & Nissen, 2007). The snail has also been found in several other Mississippi River pools: Pool 4, Pool 5, Pool 6, Pool 8, and Pool 9 (Sauer et al., 2007). More recently it has also been found in Pools 10 and 11 of Mississippi River (Lower Wisconsin River Basin Aquatic Invasive Species Technical Advisory Committee, personal communication, 2010).

In the Great Lakes basin of Wisconsin, mortality events due to *B. tentaculata* have been recorded in Shawano Lake, in Shawano County, Wisconsin. In 1997, a significant mortality event measuring an estimated 11,000 American coot (*Fulica americana*) and 800 lesser scaup (*Aythya affinis*) occurred on Shawano Lake (Boere, Galbraith, and Stroud, 2006), which drains to the Wolf River system, and eventually Lake Winnebago.

B. tentaculata is also established in multiple locations in Minnesota on or near the Mississippi River, most notably Lake Winnibigoshish downstream to White Oak Lake via the Mississippi River (detected in 2007), the Crow Wing River from First Crow Wing Lake downstream to Mississippi River (detected in 2009), and Upper and Lower Twin Lakes and the downstream stretch of the Shell River (detected in 2009) (Hoverson, 2010).

HABITAT & KNOWN LIMITING PARAMETERS

The habitat parameters of *B. tentaculata* have been well documented by (Kipp & Benson, 2010):

> "Commonly found in freshwater ponds, shallow lakes, and canals. This species is found on the substrate in fall and winter (including gravel, sand, clay, mud or undersides of rocks) and on aquatic macrophytes (including milfoil, *Myriophyllum spicatum* and muskgrass, *Chara spp*.) in warmer months (Jokinen 1992; Pennak 1989; Vincent et al. 1981). It lives mostly in shoals, but is found at depths up to 5 m (Jokinen 1992). *B. tentaculata* can inhabit intertidal zones in the Hudson River (Jokinen 1992). In general, the snail inhabits waters with pH of 6.6–8.4, conductivity of 87–2320 µmhos/cm, Ca++ of 5–89 ppm, and Na+ of 4–291 ppm (Jokinen 1992). It can potentially survive well in water bodies with high concentrations of K+ and low concentrations of NO3- (Jokinen 1992). In the St. Lawrence River, it tends to occur in relatively unpolluted, nearshore areas (Vaillancourt and Laferriere 1983) and amongst dreissenid mussel beds (Ricciardi et al. 1997)."

Local observations of *B. tentaculata* habitat in Lake Onalaska (Pool 7 of the Mississippi River) revealed high numbers of snails on submersed rock surrounding islands, as well as in sediment and on aquatic vegetation (Sauer et al., 2007). It may also be "found on rocky shorelines, river and lake bottoms, aquatic plants, docks, and other objects placed in the water" (Minnesota Department of Natural Resources [MDNR], 2010). Based on preliminary research (Walker, 2011), high flow conditions and sand substrates may be a limiting factor for *B. tentaculata,* as seen in Lake Onalaska. The snail's ability to thrive in water deeper than three meters is relatively unknown (Walker, 2011).

Adult specimens of *B. tentaculata* in the Mississippi River have displayed an ability to endure hydrologic fluctuations—particularly prolonged periods of dessication, ranging from hours to months (Wood, Haro, Haro, & Sandland, 2011). Rapidly fluctuating water levels are characteristic of river systems that feature locks and dams, such as the Mississippi, and the Wisconsin. The flow regime of the Lower Wisconsin River, though undammed from Prairie du Sac to its confluence with the Mississippi, is affected by dozens of upstream dams and reservoirs, and may change rapidly due to upstream alterations to flow. These rapid hydrological fluctuations may afford *B. tentaculata* a competitive advantage over native snails, such as the pond snail *Physa gyrina* (Wood et al., 2011), and may potentially spread waterfowl infections.

Lower Wisconsin River basin
The Lower Wisconsin River basin is potentially at risk of colonization by *B. tentaculata* due to nearby source populations in the Mississippi River, suitable habitat in the Lower Wisconsin River basin, and the existence of potential transport vectors. Nearby Mississippi River populations of *B. tentaculata* may potentially spread to the Lower Wisconsin River basin by infected waterfowl on migration routes, and/or by the movement of waterfowl hunters, known to travel between the numerous backwater lakes and sloughs of both the Wisconsin and Mississippi rivers. Based upon *B. tentaculata's* habitat preferences listed above (pH, conductivity, substrates), the backwater sloughs and shallower channels of the mainstem Lower Wisconsin River, as well as some of its impoundments, are possible sites of colonization. It is unclear whether the snail would have reproductive success on the sandy substrates of the main channels of the Lower Wisconsin River.

TRANSPORT
The original introduction of *B. tentaculata* to the midwestern United States is thought to have occurred via ballast water (Jokinen, 1992), but since, it has successfully spread by a number of means, including "by attaching to aquatic plants, boats, anchors, decoy anchors, other recreational gear and equipment placed in the water. Some movement by waterbirds may also spread this invasive to new waters, as it is possible for birds to ingest sublethal doses of parasite eggs and transport them to a new waterbody prior to eggs hatching" (MDNR, 2010).

Additionally, populations of *B. tentaculata* are strongly correlated with the presence of submergent macrophytes. A likely vector for the snail's downstream spread in lotic systems occurs when submergent macrophytes release from benthic substrates in the fall of the season, distributing plants and attached snails downstream via the current (Walker, 2011).

Lower Wisconsin River Basin
Waterfowl hunters travelling between the Upper Mississippi River and the Lower Wisconsin River may present a potential vector for the spread of *B. tentaculata,* as the snails are already established from Pool 4 near Pepin, WI downstream to Pool 11 near Cassville, WI. Equipment used by waterfowl hunters, including boats, blinds, decoys, waders, dogs, and trailers could provide provide refuge fto the snail as gear is transported from one waterbody to another.

PHYSICAL & BIOLOGICAL TRAITS

Identification

"Faucet snails are difficult for non-specialists to conclusively identify. Native snail species and young nonnative mystery snails could look similar to faucet snails. Adult faucet snails can grow up to 13mm in length, but are generally smaller. They are light brown to black, with 4 to 5 whorls and a cover on the shell opening . The shell opening is on the right when the shell pointed up" (MDNR, 2010). The operculum of adult specimens is concentric (Hoverson, 2010), but can be spirally marked in juveniles (Jokinen, 1992).

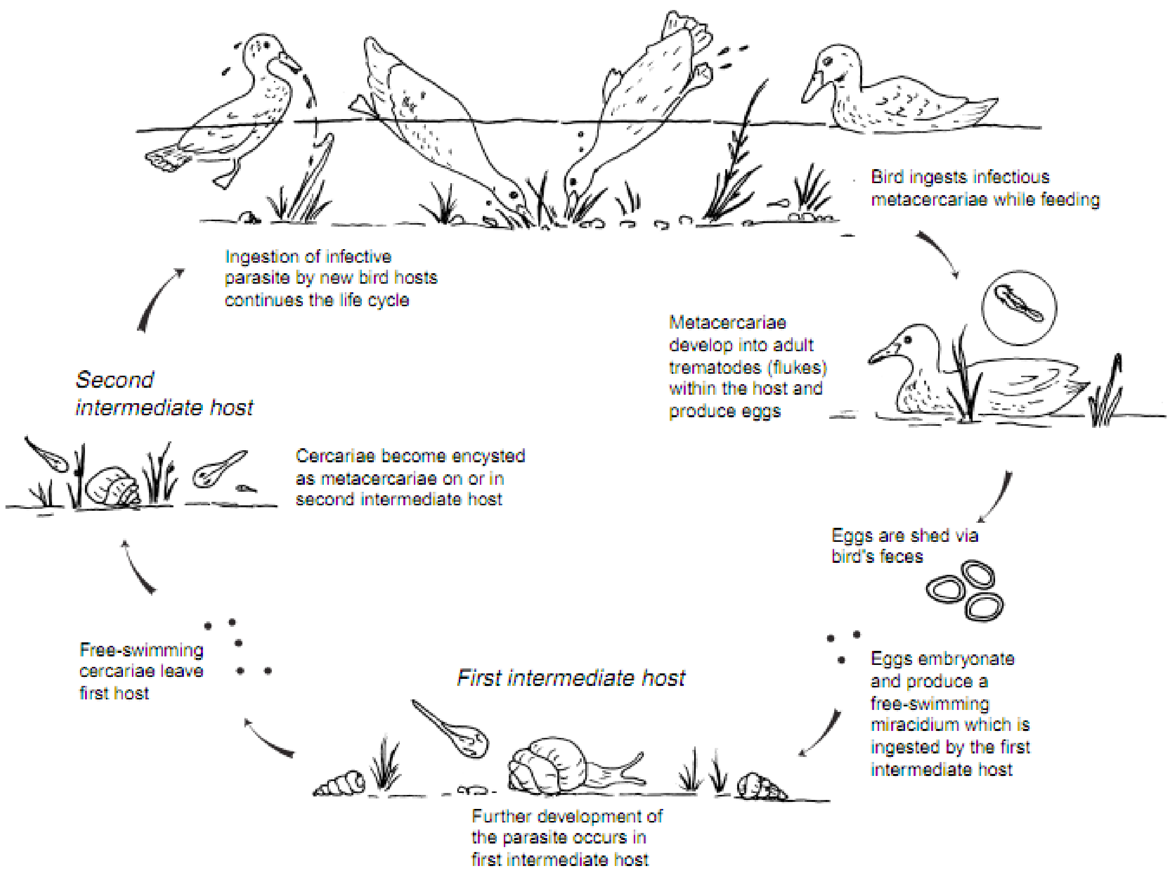

Figure 1 - General trematode life cycle (Cole & Friend, 1999)

Trematodes

B. tentaculata is the intermediate host to three species of parasitic trematodes known to cause waterfowl mortality—*Sphaeridiotrema globulus, Cyathocotyle bushiensis, and Leyogonimus polyoon* (Friend & Franson, 1999). (The trematodes actually cause waterfowl mortality, not the faucet snail, though the faucet snail is a host species of the snail, hence the emphasis on it.) Of the three trematodes*, S. globulus* and *C. bushiensis are* thought to have the greatest impact on waterfowl in the Midwest in recent years (Herrmann & Sorensen, 2011). *S. globulus* is less than 1mm long and is known to infect swans and multiple species of diving ducks, including *Fulica americana* and *Aythya affinis. C. bushiensis* is slightly larger, about 1.8mm long, and known to infect black duck (*Anas rubripes*)*,* blue-winged teal (*Anas discors*)*,* green-winged teal (*Anas crecca*)*,* and *Fulica americana*. *L. polyoon* measures 0.75-1mm long and is only known to infect *Fulica americana* in the United States, though has infected the common moorhen (*Gallinula chloropus*) in Europe (Friend & Franson, 1999).

IMPACT POTENTIAL

The ecosystem impacts of *B. tentaculata* are significant. The snail is the first and second intermediate host to parasitic trematodes or fluke worms that are not known to be a health risk to humans (MDNR, 2010), but have significant deleterious impacts on avian populations, as evidenced in large-scale spring and fall mortality events on the Upper Mississippi Wildlife Refuge (UMWR) and in the Lake Winnibigoshish area of Minnesota. The snail has also been shown to outcompete native snails, likely causing a decrease in the numbers of native species.

Native snail impacts

B. tentaculata possesses a competitive advantage over most native snails, in that it has the ability to alternate between two types of feeding—grazing, and suspended filter feeding in the water column, though it prefers suspension feeding (Brendelberger & Jurgens, 1993). *B. tentaculata* "coexists with indigenous pleurocerids in habitats where grazing is the only feeding mode, but outcompetes native pleurocerids whenever suspended food is available" (Brendelberger & Jurgens, 1993).

Additionally, the altered flow regimes of lock-and-dam river systems—such as the Mississippi—"may afford B. tentaculata a competitive advantage over native snails, such as Physa gyrina" (Wood et al., 2011). Furthermore, drawdowns of water levels to manage invasive zebra mussel populations "may inadvertently enhance the success of B. tentaculata and its parasites in the region" by killing native snails and giving drought-tolerant B. tentaculata an advantage (Wood et al., 2011).

Bird species impacts

The Mississippi River Flyway is a critical migratory corridor for waterfowl. The UMWR region is of particular importance, as migratory birds utilize the abundant wetland habitat of the region as a final stopover prior to continuing north on migration routes. *B. tentaculata* thrives in the shallow water habitats of the UMWR, however, and has impacted thousands of migrating waterfowl in the past ten years. From 2002 to 2006, an estimated 22,000-26,000 waterfowl deaths in the UMWR were linked to *B. tentaculata* (Sauer et al., 2007). From fall 2006 to fall 2010, an additional estimated 38,000-50,000 waterfowl deaths were recorded exclusively in Pools 7 and 8 of the UMWR (Stemper, 2011). Waterfowl mortality due to infected snails can occur quickly, according to Sauer et al. (2007), with death occurring as quickly as within 24 hours, up to three to eight days.

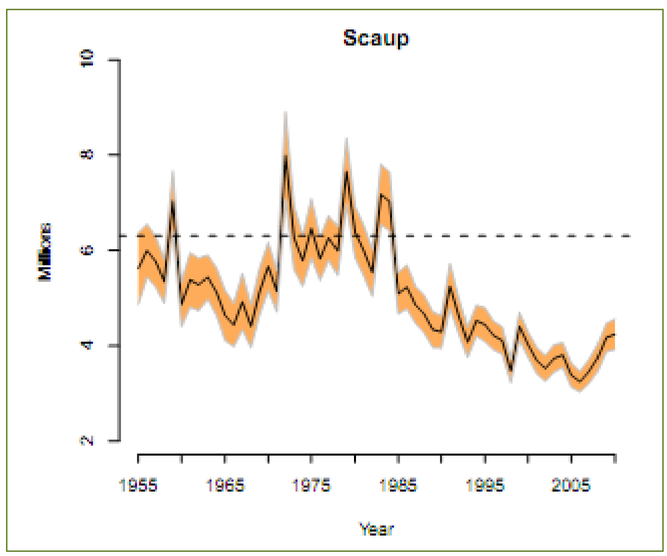

Figure 2: Nationwide scaup populations, 1955-2010 (USFWS, 2010)

Though many avian species are susceptible to infection via the snail, *Fulica americana* and *Aythya affinis* are particularly susceptible, with the two species comprising only 20-25% of migrating bird species, but consisting of 95% of die-offs in the UMWR refuge (Herrmann & Sorenson, 2011). As of 2006, scaup populations (greater and lesser) were down 37% below their long-term average, according to the Waterfowl Breeding Population and Habitat Survey and were 16% below their long-term average in 2010 (United States Fish & Wildlife Service, 2010).

Other species that have shown susceptibility to the snail include: northern pintail (*Anas acuta*), American wigeon (*Anas americana*), northern shoveler (*Anas clypeata*), blue-winged teal*(Anas discors)*, mallard (*Anas platyrhynchos*), American black duck*(Anas rubripes)*, gadwall (*Anas strepera*), redhead (*Aythya americana*), ring-necked duck (*Aythya collaris*), bufflehead (*Bucephala albeola*), tundra swan (*Cygnus columbianus*), herring gull (*Larus argentatus*), and ruddy duck (*Oxyura jamaicensis*) (Sauer et al., 2007).

In the Lake Winnibigoshish region of north central Minnesota, *B. tentaculata* has also significantly impacted waterfowl populations, with an estimated 8,000 coot, scaup, and other water birds dying off between 2007 and 2008 (Hoverson, 2010). Beyond the environmental impact of these events, the Winnibigoshish region (as well as the UMWR region) is a significant destination for waterfowl hunting.

Economic Impacts
In 2006, the state of Wisconsin featured 66,000 waterfowl hunters aged 16 years old or older that spent a sum total of 1,001,000 days hunting waterfowl (Carver, 2008). These hunters spent an estimated $19 million on trip expenditures and equipment, and contributed to a total output of approximately $26 million associated with waterfowl hunting, including 444 jobs (Carver, 2008).

PREVENTION & CONTROL
Chemical control of *B. tentaculata* has proven difficult, largely due to the ability of the snail to close its operculum, protecting the inside of the shell from outside elements, including chemicals and dessication. The snail shows "avoidance behavior by closing operculum when exposed to a l-Cyhalothrin pyrethroid insecticide" (Schroer, 2004). One day later, when placed in fresh water, snails opened the operculum and showed no adverse affects to the insecticide. The snail is also "highly resistant to a number of other attempted treatments, including ethanol, NaCl, formalin, Lysol, potassium permanganate, copper sulfate, Bacquacil, Virkon, household bleach, and to waters adjusted to pH values as low as 1 and as high as 13" (Mitchell & Cole, 2008). A chemical treatment recommended by Mitchell & Cole for successful elimination of *B. tentaculata* is Hydrothol 191 at 20mg/L or higher for a period of 24 hours.

B. tentaculata proved susceptible to extreme physical temperatures of 50°C, also shown by Mitchell & Cole (2008). Snails were exposed for one a minute, and all test snails were eliminated. Though the snail has many natural predators (waterfowl, crayfish, fish), biological controls thus far haven't proven successful at limiting *B. tentaculata.*

Disinfectant recommendations
Recommended treatment for gear or equipment utilized in waters infected with *B. tentaculata* is listed above. At this point, exposure of gear for at least one minute at a temperature of at least 50°C is recommended. However, Mitchell & Cole (2008) recommend "an extra measure of caution," suggesting that due to the possibility of equipment absorbing some of the water's heat, exposure time should be increased to 5 minutes, or the heat should be increased above 50°C.

In the absence of hot water treatment, drying is the next-best option. Allowing infected equipment and gear to completely dry over a period of three weeks should eliminate any snail specimens on gear or equipment (Mitchell & Cole, 2008).

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Cercopagis pengoi (fishhook waterflea) and *Bythotrephes longimanus* (spiny waterflea)

DISTRIBUTION
Both *Cercopagis pengoi* (fishhook waterflea) and *Bythotrephes longimanus* (spiny waterflea) entered the Great Lakes in ship ballast water from Europe – *B. longimanus* arrived in the 1980s, followed in the 1990s by the *C. pengoi* (Wisconsin Department of Natural Resources [WDNR], 2011).

B. longimanus was first detected in Lake Michigan in September 1986 and Lake Superior in August 1987 (Liebig & Benson, 2007). It has been found in Wisconsin in the Gile Flowage (Iron County) in 2003, Stormy Lake (Vilas County) in 2007, and in the Yahara chain of lakes in Madison, WI, in 2009 (WDNR 2011; United States Geological Survey [USGS], 2011).

C. pengoi was first detected in Lake Michigan in 1999. A single specimen was collected from Lake Superior in 2003, but the species is not believed to be established there (Benson, Maynard, & Raikow, 2009). *C. pengoi* has not been found in inland Wisconsin waters (USGS, 2011).

TRANSPORT
B. longimanus was probably introduced to the region from ships ballast water. Both species are likely to be spread secondarily to inland waters by recreational boaters (Benson et al., 2009; Liebig & Benson, 2007).

HABITAT & KNOWN LIMITING PARAMETERS
B. longimanus prefer large, deep, clear lakes with relatively low summer bottom temperatures. It typically is not present in shallow eutrophic lakes was due to a need for deep, oxygenated water to escape from fish predation (Invasive Species Specialist Group [ISSG], 2005). Both in the Caspian Sea and Lake Ontario, *Cercopagis* abundance increases with distance from shore, suggesting that this is a typical pelagic species, which live in the open sea, away from the littoral zone (ISSG, 2010).

Temperature
C. pengoi has a wide tolerance to temperatures occurring in water 3-38°C. However, highest population densities are found at summer temperatures 16-26°C. Although some specimens may be found at temperatures of 10°C, it generally requires temperatures of 15°C or higher to establish a significant population. It also resides above the thermocline in stratified waters in warmer, more active waters (ISSG, 2010).

BIOLOGICAL TRAITS
B. longimanus is a large cladoceran distinguished by a long straight tail spine that is twice as long as its body and has one to three pairs of barbs. *B. longimanus* appearance is similar to *C. pengoi*, except *B. longimanus* is larger with a more robust spine that lacks a hook at the end (Liebig & Benson, 2007).

B. longimanus can reproduce both by parthenogenetic (cloning) and gamogenetic (sexual) reproduction. Parthenogenetic reproduction occurs throughout the whole life cycle, while gamogenesis occurs at the end of a growing season and results in the formation of resting eggs capable of surviving unfavorable conditions (ISSG, 2005).

Like *B. longimanus*, *C. pengoi* is a cyclic parthenogen. It reproduces parthenogenically during the summer and gametogenically later in the year. In late summer and autumn, parthenogenic females produce eggs that develop into males and gametogenic females, which copulate. Gametogenic reproduction results in resting eggs, which are released when the brood pouch ruptures, and overwinter in the sediment. After a refractory period, development proceeds and neonates hatch in spring-summer, depending on local temperatures, to reestablish the population. Sexual females produce one to four resting eggs every two weeks, while parthenogenic females produce between 1 and 24 embryos (ISSG, 2010).

IMPACT POTENTIAL

Ecological
B. longimanus has caused major changes in the zooplankton community structure; invasion history; reproduce rapidly; competes directly with small fish and can have impact on zooplankton community.

B. longimanus and *C. pengoi* consume small zooplankton such as small cladocerans, copepods, and rotifers, competing directly with planktivorous larval fish for food. They have been implicated as a factor in the decline of alewife (*Alosa pseudoharengus*) in lakes Ontario, Erie, Huron, and Michigan (Liebig & Benson, 2007). *C. pengoi* long spine makes it less palatable to planktivorous fish. For these reasons *C. pengoi* could have a serious effect on the food supply of planktivores. For example, yearling alewives compete directly with *C. pengoi* because they are planktivorous, and cannot consume *C. pengoi* due to the caudal appendage. Once alewives reach their first year they are large enough to handle the caudal appendage. The establishment of *C. pengoi* in Lake Ontario in 1998 corresponded with the lowest alewife population in twenty years (Benson et al., 2009).

B. longimanus also compete with, and possibly prey on, *Leptodora kindtii* and may be a causal factor in the decline of *Leptodora*. There is speculation that *B. longimanus* may control the abundance of *C. pengoi* through competition and predation. *B. longimanus* are a food source for the following fish species: yellow perch (*Perca flavescens*), white perch (*Morone americana*), walleye (*Sander vitreus*), white bass (*Morone chrysops*), alewife (*Alosa pseudoharengus*), bloater chub (*Coregonus hoyi*), chinook salmon (*Oncorhynchus tshawytscha*), emerald shiner (*Notropis atherinoides*), spottail shiner (*Notropis hudsonius*), rainbow smelt (*Osmerus mordax*), lake herring (*Coregonus artedi*), lake whitefish (*Coregonus clupeaformis*), and deepwater sculpin (*Myoxocephalus thompsonii*) (Liebig & Benson, 2007).

Recreation
The tail spines of *B. longimanus* and *C. pengoi* hook on fishing lines, fouling fishing gear (Benson et al., 2009; Liebig & Benson, 2007).

Lower Wisconsin River Basin
The ecological impact on the lakes and impoundments of the Lower Wisconsin River basin (as well as Wisconsin as a whole) is not yet well understood. Researchers at the University of Wisconsin-Madison Center for Limnology are currently monitoring Stormy Lake and the Yahara system of lakes in Madison to understand the effect of *B. longimanus* on water quality, fish populations, and lake ecosystems as a whole (Uni versity of Wisconsin-Madison Center for Limnology, n.d.).

PREVENTION AND CONTROL
There is currently no known method of eradication or control for *C. pengoi*. Prevention of

establishment and spread are the only means of management. Strengthening and improving existing ballast water regulations and promoting awareness of *C. pengoi* would help in preventing the spread.

A few measures are recommended to prevent further local spread of *C. pengoi* and *B. longimanus*. Bait and bait water should not be released into waterbody or transport from one waterbody to another. Good containment measures should be followed to control both the spread of adults and resting eggs, which are capable of surviving desiccation and freezing for periods of several years. Rinsing boat and equipment with water at least 40°C, high-pressure water spray, or drying boat and equipment for at least 5 days before re-entering waterbody will help to control the spread of adults. Thoroughly draining and cleaning motor; bilge, transom and live wells; bait buckets; and fishing apparatus and gear will help to control the spread of adult and resting eggs (ISSG,2005; ISSG, 2010).

USFUL WEBSITES

Spiny waterflea
USGS NAS Factsheet – http://nas.er.usgs.gov/queries/factsheet.aspx?SpeciesID=162
USGS Point Map - http://nas2.er.usgs.gov/viewer/omap.aspx?SpeciesID=162

Fishhook waterflea
USGS NAS Factsheet - http://nas.er.usgs.gov/queries/factsheet.aspx?SpeciesID=163
USGS Point Map - http://nas2.er.usgs.gov/viewer/omap.aspx?SpeciesID=163

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Corbicula fluminea (Asian clam)

DISTRIBUTION

Corbicula fluminea is native to the temperate and tropical regions of southeastern China, Korea, and southeastern Russia (Invasive Species Specialist Group [ISSG], 2005). From its native range, is has spread around the world. *C. fluminea* was first reported in the St. Croix River in 1977 and in the Mississippi River in 1981 (Wisconsin Department of Natural Resources [WDNR], n.d.). Populations have been found in the Mississippi River near Prairie du Chien and La Crosse (Foster, Fuller, Benson, Constant, & Raikow, 2010).

Established populations of *C. fluminea* have been found in three of the Great Lakes—Michigan, Superior and Erie (Foster et al., 2010). *C. fluminea* is widespread and common throughout Illinois (Illinois Natural History Survey, 1996).

TRANSPORT

The main vector for transport of *C. fluminea* is human movement and activities. It is believed that they first were brought to North America for food, and have since been introduced to new areas through bait bucket releases, ballast water transport, aquarium/water garden releases, as hitch-hikers with imported aquaculture species, and intentional introductions for food (Foster et al., 2010; Indiana Department of Natural Resources [IDNR], 2009; WDNR, n.d.). Additionally, the pediveligers and juveniles of the *C. fluminea* can make small geographical hops naturally by fluvial currents and attached to waterfowl (Sousa, Antunes, & Guilhermino, 2008).

HABITAT & KNOWN LIMITING PARAMETERS

C. fluminea establishment is largely limited by temperature. They flourish in 2-30°C water and generally spawn when the water temperature is above 16°C (IDNR, 2009; WDNR, n.d.). Mueller & Baur (2011) found that Asian clam survival decreased from 100% to 17.5% when exposed to 0°C water over a two to three month period.

C. fluminea is usually found in flowing water since it prefers waters with a higher concentration of dissolved oxygen (>3.0 mg/L) (WDNR, n.d.). It is sometimes found in lentic habitats, but when in lakes it is usually found in sunny near-shore water with well oxygenated habitats (Hornbach, 1992). *C. fluminea* can tolerate slightly brackish water, but do not do well in polluted water (ISSG, 2005). It prefers sandy substrates, but has been found on almost all substrate types (WDNR, n.d.).

BIOLOGICAL TRAITS

C. fluminea can produce up to 70,000 offspring a year and the veligers are brooded on the parent's gills (WDNR, n.d.). The clam is hermaphroditic and can self-fertilize, which aids in rapid colonization. They can also quickly reach considerable densities of 10,000 to 20,000 clams per square meter (IDNR, 2009).

C. fluminea is a very efficient filter feeder and consumes phytoplankton and bacteria, and when food is scarce it can also feed from the sediments (Strayer, 1999; Wittmann et al., 2008). Predators of *C. fluminea* include common carp (*Cyprinis carpio*), channel catfish (*Ictalurus punctatus*), yellow bullhead (*Ameiurus natalis*), largemouth bass (*Micropterus salmoides*), multiple bird species, raccoons, crayfish and flatworms (Foster et al., 2010). However, none of these predators consume enough *C. fluminea* to have a significant impact on the population (Massachusetts Department of Conservation & Recreation [MDCR], 2004).

IMPACT POTENTIAL

Due to its voracious filter feeding, *C. fluminea* tends to out-compete both native mussels and juvenile fish for food. Food competition coupled with competition for space has lead to decreased abundances and diversity of native bivalves in systems where *C. fluminea* has been introduced (Sousa et al., 2008; Strayer, 1999). Since it removes large quantities of phytoplankton from the system, *C. fluminea* can have cascading effects up the trophic levels (Sousa et al., 2008). It can alter benthic habitats and can facilitate establishment of other invasive bivalves such as zebra and quagga mussels (Wittmann et al., 2008).

C. fluminea can have large economic impacts on industrial and power plants that intake water from rivers and lakes. Alive and dead clams clog the intake pipes and it is costly to remove them; an estimated one billion U.S. dollars each year goes into removing clams from plant pipes (Foster et al., 2010).

PREVENTION & CONTROL

C. fluminea is listed as a prohibited species under NR 40 in Wisconsin. There are many different techniques to exterminate it. Filter screens, hot water, chemicals (chlorine and bromine), high salinity or extended periods of drying out are all methods that have been used by factories (MDCR, 2004). However, these methods are not very suitable for natural areas. A labor intensive approach for removing isolated populations is removing the clams from the substrate, but this does not remove the floating veligers which will quickly re-colonize. Researchers in Lake Tahoe are currently trying an eradication effort by using large rubber tarps laid over the clam beds to suffocate the clams (Wittmann et al., 2008). Results from this method have yet to be reported. Prevention of new introductions is really the key in limiting the spread of the Asian clam. Since humans are the primary vector of *C. fluminea*, public education on not transporting adult specimens, the necessity of emptying live wells and drying out boats and equipment is essential.

USEFUL WEBSITES

HTTP://DNR.WI.GOV/INVASIVES/CLASSIFICATION/PDFS/LR_CORBICULA_FLUMINEA.PDF
HTTP://NAS.ER.USGS.GOV/QUERIES/FACTSHEET.ASPX?SPECIESID=92
HTTP://WWW.ISSG.ORG/DATABASE/SPECIES/ECOLOGY.ASP?SI=537&FR=1&STS=SSS

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Dreissena polymorpha (zebra mussel)

DISTRIBUTION

Dreissena polymorpha is native to the Black, Caspian, and Azov seas of Europe. In 1769, Pallas first described populations of this species from the Caspian Sea and Ural River (Benson & Raikow, 2010). It is established in all the Great Lakes, all of the large navigable rivers in the eastern United States, and in many small lakes in the Great Lakes region. It has been reported in 139 lakes and rivers in Wisconsin, and is found from Nepco Lake to Castle Rock Lake on the Upper Wisconsin River and upstream of the Prairie du Sac Dam (Lake Wisconsin), on the dam itself, and downstream.

HABITAT & KNOWN LIMITING PARAMETERS

The optimal temperature range for adults extends to 20-25°C, but *D. polymorpha* can persist in temperatures up to 30°C. Short-term tolerance of temperatures up to 35°C is possible if the mussels were previously acclimated to high temperatures (Benson & Raikow 2010).

Oxygen demands of *D. polymorpha* are similar to those of other freshwater bivalves including unionids. Tolerance of "anaerobic" conditions has been reported for short time periods under certain temperatures and sizes, but *D. polymorpha* cannot persist in hypoxic conditions. The lower limit of O_2 tolerance is 32-40 Torr at 25°C. *D. polymorpha* has been found in the hypolimnetic zone of lakes with oxygen levels of 0.1-11.2 mg/l, and in the epilimnetic zone with oxygen levels of 4.2-13.3 mg/l. Zebra mussels are described as poor O_2 regulators, possibly explaining their low success rate in colonizing eutrophic lakes and the hypolimnion. *D. polymorpha* can tolerate only slight salinity (Benson & Raikow 2010).

Larval development is inhibited at pH of 7.4. Higher rates of adult survival occur at a pH of 7.0-7.5, but populations have been found in the hypolimnetic zone of lakes with a pH of 6.6-8.0, and in the epilimnetic zone with a pH of 7.7-8.5. Optimal larval survival occurs at a pH of 8.4, and optimal adult growth occurs at pH 7.4-8.0.

Water calcium concentrations (mg/l) heavily influence *D. polymorpha* development and growth. A lower threshold has been estimated at 10 mg/l (mean mg/l Ca – 95% CI) and an upper threshold of 21 mg/l (mean mg/l Ca + 95% CI). These thresholds delimited three classes of lakes: not suitable to *D. polymorpha* invasion (mg/l Ca < 10), borderline suitable (10<mg/l Ca < 21) and suitable (mg/l Ca > 21) (Vander Zanden, 2009).

Lower Wisconsin River basin

In 2009, the University of Wisconsin-Madison Center for Limnology estimated *D. polymorpha* suitability for approximately 13,000 Wisconsin lakes, based upon the above calcium thresholds. Lakes were classified as suitable, borderline, or unsuitable based on measured or estimated dissolved calcium concentrations (Vander Zanden, 2009).

The Lower Wisconsin River sloughs in which data was available fell into the suitable or borderline suitable classifications. Sloughs that have boat landings and are classified as suitable include but are not limited to Woodman Lake, Garner Lake, Lower Lake, Clear Lake, Goodwiler Lake, Puffenrath Slough, Rice Lake, Hill Slough, Bakkens Pond, and Cruson Slough (Vander Zanden, 2009).

Other lakes in the basin commonly frequented by boaters such as Twin Valley and Cox Hollow in Governor Dodge State Park, Devil's Lake, and the Yahara chain of lakes near Madison are thought to be susceptible as well. The complete results of the suitability model may be found at http://www.aissmartprevention.wisc.edu.

TRANSPORT

A release of larval mussels during the ballast exchange of a single commercial cargo ship traveling from the north shore of the Black Sea to the Great Lakes has been deduced as the likely vector of introduction of *D. polymorpha* to North America. Its rapid dispersal throughout the Great Lakes and major river systems was due to the passive drifting of the larval stage (the free-floating or "pelagic" veliger), and its ability to attach to boats navigating these lakes and rivers. Its rapid range expansion into connected waterways was probably due to barge traffic where it is theorized that attached mussels were scraped or fell off during routine navigation.

Overland dispersal is also a possibility for aiding *D. polymorpha* range expansion. Many small inland lakes near the Great Lakes unconnected by waterways but accessed by individuals trailering their boats from infested waters, have populations of the mussels living in them. Under cool, humid conditions, *D. polymorpha* can stay alive for several days out of water (Benson & Raikow, 2010).

Lower Wisconsin River Basin

Boaters likely introduced *D. polymorpha* into the Wisconsin River which have become established at impoundments upstream from the Lower Wisconsin River. Mussels have since been found downstream of the Prairie du Sac Dam likely due to passive drifting of veligers.

PHYSICAL & BIOLOGICAL TRAITS

Identification

D. polymorpha are small shellfish named for the striped pattern of their shells. Color patterns can vary to the point of having only dark or light colored shells and no stripes. They are typically found attached to objects, surfaces, or each other by threads underneath the shells. Although similar in appearance to the quagga mussel (*Dreissena bugensis*), the two species can be easily distinguished. When placed on a surface, *D. polymorpha* are stable on their flattened underside while quagga mussels, lacking a flat underside, will fall over. See Mackie & Schlosser (1996) for a key to adult *Dreissenid*s (Benson & Raikow, 2010).

IMPACT POTENTIAL

Environmental Impacts

D. polymorpha is a prodigious filter feeder, capable of removing phytoplankton and particulates from the water, disrupting the base of the food web and resulting in the potential to destabilization of entire ecosystem (Wisconsin Department of Natural Resources [WDNR], 2009). It can threaten native mussel populations by outcompeting them for food supply and fouling them by colonizing on the mussels themselves. A small percentage of the native mussels collected from the Lower Wisconsin River in August 2011 by River Alliance and WDNR staff had *D. polymorpha* specimens attached to them.

Prairie du Chien, Wisconsin, (East and West channels of the Mississippi River) was valuable and well known to biologists and commercial mussel fishermen. In particular, this area was considered to be the most valuable Essential Habitat Area for the federally-endangered Higgins eye pearlymussel. In the late 1990s, the native mussel community at Prairie du Chien was devastated by *D. polymorpha*. *D. polymorpha* densities in the East Channel rose dramatically from 2 per square meter in 1993 to 56,507 per square meter in 1999. Consequently, density of native mussels in the East Channel fell from 59.2 per square meter in 1996 to 1.7 per square meter in 1999; no juvenile native mussels were found between 1999 and 2001 (U.S. Fish & Wildlife Service [USFWS], 2006).

Economic Impacts
Financial impacts have been significant to Wisconsin's water utilities and to power plants, where these animals congregate on and clog intake and distribution pipes. In 2001, for example, Wisconsin Electric Power Company reported that they were spending $1.2 million per year in the control of *D. polymorpha* on their Lake Michigan power plants. Lock and dam operators on the Mississippi River and raw water users have also incurred costs. The estimated annual cost of controlling *D. polymorpha* in the Great Lakes now range from $100 to $400 million, according to NOAA Great Lakes Environmental Research Laboratory Director Dr. Stephen Brandt (WDNR, 2009).

PREVENTION & CONTROL
Zequanox, a biopesticide that can be used by power plants and raw water treatment facilities as an alternative to chemical treatments, such as chlorine, or as a complement to chemical products to kill *D. polymorpha* and the quagga mussel, was approved the EPA in September 2011. Currently, the inventor, Dr. Dan Molloy, is conducting controlled experiments in Douglas County, Minnesota to determine its applicability in lakes and rivers. Field trials will continue through next year pending sufficient funding (Douglas County Citizens' Committee on Zebra Mussels, 2011).

In the meantime, the favored approach is containment through education and proper equipment disinfection. Clean Boats, Clean Waters watercraft inspections can be integral in preventing or delaying the spread until further control research can be done.

Disinfectant recommendations
As a general practice, boaters should wash and scrub their boats and equipment, allowing it to completely dry, before moving to a new waterbody. Tiny mussels attached to a watercraft may not be visible to the naked eye. Prolonged exposure to high-pressure water at a temperature above 60°C will kill *D. polymorpha* and is the best choice for washing watercraft and equipment in order to prevent spread. All water should be drained from watercraft, including bilges, live wells, bait buckets and coolers, and everything should be left to dry for several days. Water and plants should never be transported from one waterbody to another.

The VFW boat landing at Prairie du Sac on the Lower Wisconsin River might be a good location for a boat washing station considering the amount of traffic it receives and the fact that *D. polymorpha* are known to exist on the dam and below the dam.

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Dreissena bugensis (quagga mussel)

DISTRIBUTION
In 2005 the first specimen of *Dreissena bugensis* was confirmed in Lake Superior in the Duluth-Superior Harbor. A few inland occurrences have been reported in Iowa, Kentucky, Michigan, Minnesota, New York, Ohio, and Pennsylvania. The first sighting of *D. bugensis* outside the Great Lakes basin was made in the Mississippi River between St. Louis, Missouri and Alton, Illinois in 1995 (Benson, Richerson, & Maynard, 2011). The first reports of *D. bugensis* in the Mississippi River basin were in 2004. It has been found in the Mississippi River near Prairie du Chien, WI, and La Crosse, WI, and in Lake Pepin (United States Geological Survey [USGS], 2011). So far, *D. bugensis* has not been found in any inland lakes in Wisconsin (Wisconsin Department of Natural Resources [WDNR], 2004).

TRANSPORT
The introduction of *D. bugensis* into the Great Lakes appears to be the result of ballast water discharge from transoceanic ships that were carrying veligers, juveniles, or adult mussels. The genus *Dreissena* is highly polymorphic and prolific with high potential for rapid adaptation attributing to its rapid expansion and colonization. Still, there are other factors that can aid in the spread of this species across North American waters, such as, larval drift in river systems or fishing and boating activities that allow for overland transport or movement between water basins (Benson et al., 2011).

HABITAT & KNOWN LIMITING PARAMETERS
D. bugensis can inhabit rivers, ponds, and lakes. It can survive in softer substrate, such as sand and muck, in which the zebra mussel (*D. polymorpha*) cannot (Mills et al., 1993). It also has a tolerance for a large temperature range. It can survive in water from 0-30°C, but it prefers 4-20°C (Mills et al., 1996). This enables it to colonize deeper waters in the Great Lakes than *D polymorpha*.

BIOLOGICAL TRAITS
D. bugensis lacks the keeled shape that allows *D. polymorpha* to anchor tightly to hard substrata; therefore, it has retained the ability to survive in soft strata (Mills et al., 1996). Preferring silt- and sand-bottomed lakes, *D. bugensis* may be able to successfully invade inland lakes with those characteristics if introduced, including some lakes not suitable for *D. polymorpha* establishment (WDNR, 2004). This may provide the *D. bugensis* with a distinct advantage over *D. polymorpha* in lakes in the Lower Wisconsin River basin.

However, *D. polymorpha* grows byssal threads at a faster rate and hang on better in fast flowing water, giving it the edge over *D. bugensis* in rivers (Knight, 2009), suggesting that it may not be able to outcompete *D. polymorpha* in streams and rivers unless it adapts.

IMPACT POTENTIAL
D. bugensis are prodigious water filterers, removing substantial amounts of phytoplankton and suspended particulate from the water. As such, its impacts are similar to those of *D. polymorpha*. By removing the phytoplankton, *D. bugensis* in turn decreases the food source for zooplankton, therefore altering the food web (Benson et al., 2011).

Impacts associated with the filtration of water include increases in water transparency, decreases in mean chlorophyll-a concentrations, and accumulation of pseudofeces. Water clarity increases light penetration causing a proliferation of aquatic plants that can change species dominance and alter the entire ecosystem (Benson et al., 2011).

The pseudofeces that is produced from filtering the water accumulates and creates a foul environment. As the waste particles decompose, oxygen is used up, and the pH becomes very acidic and toxic byproducts are produced. In addition, *D. bugensis* accumulates organic pollutants within its tissues to levels more than 300,000 times greater than concentrations in the environment and these pollutants are found in its pseudofeces, which can be passed up the food chain, therefore increasing wildlife exposure to organic pollutants (Benson et al., 2011).

Dreissena species' ability to rapidly colonize hard surfaces causes serious economic problems. These major biofouling organisms can clog water intake structures, such as pipes and screens, therefore reducing pumping capabilities for power and water treatment plants, costing industries, companies, and communities. Recreation-based industries and activities have also been impacted; docks, breakwalls, buoys, boats, and beaches have all been heavily colonized (Benson et al., 2011).

PREVENTION AND CONTROL

Zequanox, a biopesiticide that can be used by power plants and raw water treatment facilities as an alternative to chemical treatments, such as chlorine, or as a complement to chemical products to kill both *D. bugensis* and *D. polymorpha*, was approved the EPA in September 2011. Currently, the inventor, Dr. Dan Molloy, is conducting controlled experiments in Douglas County, Minnesota to determine its applicability in lakes and rivers. Field trials will continue through next year pending sufficient funding (Douglas County Citizens' Committee on Zebra Mussels, 2011).

In the meantime, the favored approach is containment through education and proper equipment disinfection. Clean Boats, Clean Waters watercraft inspections can be integral in preventing or delaying the spread until further control research can be done.

Disinfectant recommendations

As a primary disinfection practice, boaters should wash and scrub their boats and equipment, allowing it to completely dry, before moving to a new waterbody. Tiny mussels attached to watercraft may not be visible to the naked eye. Prolonged exposure to high-pressure water at a temperature above 60°C will both *D. bugensis* and *D. polymorpha* and is the best choice for washing your boat and equipment in order to prevent spread. Boaters should be sure to drain all water from their watercraft, including bilges, live wells, bait buckets and coolers. Additionally, boaters should let all gear, equipment, and watercraft dry for several days, and should never transport water or plants from one waterbody to another.

USFUL WEBSITES

USGS NAS Factsheet – http://nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=95
USGS Point Map - http://nas2.er.usgs.gov/viewer/omap.aspx?SpeciesID=95

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Potamopyrgus antipodarum (New Zealand mudsnail)

DISTRIBUTION

Potamopyrgus antipodarum has been found in all of the Great Lakes, except Huron. In Lake Superior it is established in the St. Louis River estuary and the Duluth-Superior Harbor. In 2007, one population of the snail was discovered in a small stream in upstate New York, a tributary of Lake Ontario. This was the first time *P. antipodarum* had been found in a tributary of the Great Lakes. In the summer of 2008, Levri et al. sampled over 100 sites from the Niagara River, NY, to Oswego, NY, on Lake Ontario and over 80 sites from Buffalo, NY, to the Pennsylvania-Ohio state line on Lake Erie. *P. antipodarum* was found only at the site of original discovery in Niagara County, NY (Levri & Jacoby, 2008).

TRANSPORT

P. antipodarum was likely introduced to the Great Lakes via ballast water discharge. In the western United States where it was likely introduced through fish stocking, it has been dispersed by angling equipment and birds**.** It has also been observed to pass through the gut of fish unscathed (Haynes, Taylor, & Varley, 1985)**,** indicating that fish themselves are capable of dispersing it. In the Great Lakes, this might be a viable means of its establishment in tributaries as fish such as trout and salmon move into interior waters. Once established in a river or stream, it has been estimated that *P. antipodarum* can move upstream at a rate of 1 kilometer/ year (Aquatic Nusiance Species Task Force, 2007)

HABITAT & KNOWN LIMITING PARAMETERS

P. antipodarum tolerates physical habitat disturbance and pollution. It has been associated with agricultural land-use disturbance (livestock grazing/pasture), where streams have been degraded by bank erosion, fine sediment, and elevated levels of nutrients (Kipp & Benson, 2010)**.** This mudsnail has been found to become the dominant mollusk in environments that are rich in nutrients (http://rivrlab.msi.ucsb.edu/NZMS/habitat.php).

P. antipodarum tolerates siltation, thrives in disturbed watersheds, and benefits from high nutrient flows allowing for filamentous green algae growth. It occurs amongst macrophytes and prefers littoral zones in lakes or slow streams with silt and organic matter substrates, but tolerates high flow environments where it can burrow into the sediment (Kipp & Benson, 2010).

Conductivity

P. antipodarum survival can be correlated to conductivity. In one study, survival was rare at less than 25 µS, growth is inhibited over the range of 25 to 200 µS, and above 200-300 µS there is little or no restriction of conductivity on growth or survival (Herbst & Bogan, 2006). Based upon a preliminary review of water quality data available in the WDNR Surface Water Integrated Monitoring System (SWIMS) database, conductivity will not be limiting factor to the spread or establishment of *P. antipodarum* in the Lower Wisconsin River basin. Of the 11,071 conductivity sampling records from the SWIMS database in 2010 for the Lower Wisconsin River basin, 97% were over 200 µS at which little or no restriction of growth or survival has shown to take place.

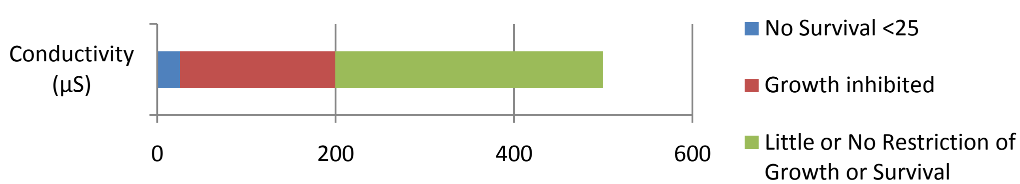

Figure 1: *P. antipodarum* conductivity parameters

Temperature
P. antipodarum are capable of tolerating a wide range of temperatures with upper thermal limits of 34°C and lower thermal limits near freezing (Kipp & Benson 2010). *P. antipodarum* "... matures earlier and produces significantly more offspring at water temperatures of 18°C than at 12°C, but the snail is unlikely to reproduce at 24°C. *P. antipodarum* reproduction is known to fail almost entirely at 24-27°C (Dybdahl & Kane, 2005)**.**

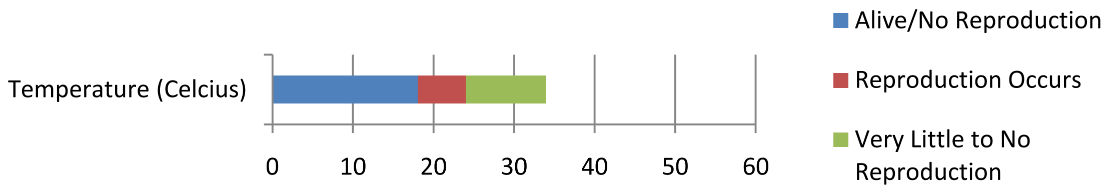

Figure 2: *P. antipodarum* temperature parameters

Freshwater systems that are supplied mostly from snowmelt runoff, or have a high water velocity usually do not have a high density population of *P. antipodarum*. Often vegetated areas with slower water velocity seem to provide refuge for *P. antipodarum* and may act as nurseries (Richards, Cazier, & Lester, 2001). Mudsnails tend to proliferate in cool springs and spring creeks, as well as in waters with moderate winter temperatures. Populations of *P. antipodarum* decrease during winter, but average water temperatures as low as 7°C has been found to not prevent survivorship, growth or reproduction of *P. antipodarum* in the greater Yellowstone area (http://rivrlab.msi.ucsb.edu/NZMS/habitat.php).

Although we were unable to access water temperature data for streams in the Lower Wisconsin River basin, we hypothesize that temperature will not be a limiting factor in many of the spring-fed streams.

In a nationwide distribution model, sites likely to be invaded by *P. antipodarum* were relatively close to population centers and blue-ribbon coldwater fisheries (Vinson, Harju, & Dinger, 2007). This is likely due to the fact that a primary factor of dispersal has been proven to be fishermen. This would indicate that popular fisheries near Madison, such as Black Earth Creek, may be at higher risk for invasion.

BIOLOGICAL TRAITS
P. antipodarum is a nocturnal grazer, feeding on plant and animal detritus, epiphytic and periphytic algae, sediments and diatoms (Kipp & Benson, 2010)**.** In its native waters the mudsnail population is primarily kept in check by trematode (small worm) parasites that sterilize the snail or change mudsnail behavior making it more likely to become eaten by natural enemies (http://rivrlab.msi.ucsb.edu/NZMS_data/mudsnail.php).

IMPACT POTENTIAL
Bioenergetic simulations suggest that diets high in *P. antipodarum* do not meet energy requirements of fish, resulting in reduced growth and weight loss (Vinson et al., 2007). *P. antipodarum* may also reduce the colonization rate of some macroinvertebrates**.** The interactions with different trophic levels coupled with the high densities observed in many systems may lead to substantial changes in trophic dynamics and nutrient cycling in aquatic ecosystems (Kipp & Benson, 2010).

These ecological impacts may result in significant economic impacts to the region. Recreational trout angling in the Driftless Area of southeastern Minnesota, southwestern Wisconsin, northeastern Iowa, and northwestern Illinois generates a $1.1 billion annual economic benefit to the local economy (NorthStar Economics Inc., 2008).

PREVENTION & CONTROL

There is no known means of eradication of *P. antipodarum* once it is introduced to a waterbody. A trematode native to New Zealand may be of assistance in the development of a biological control in the future, but further research is needed. Currently, researchers at University of California, Santa Barbara are conducting laboratory experiments that will test whether parasites could inadvertently infect non-targeted native North American mollusks. Findings will validate or invalidate the merits of using the parasite for biological control.

In the meantime, to prevent the spread, inspect and remove visible plants, animals, and mud from boats, waders, hip boots, and other gear before transporting, and drain all water from equipment. Rinse gear with hot water (113°F/45°C) or freeze gear before reuse. Fishermen are encouraged not to use felt-soled wading boots as they are more likely to harbor mudsnails and other AIS. An education campaign directed at anglers and hunters to prevent them from introducing any specimens by properly cleaning their equipment prior to moving between waterbodies is warranted.

An educational campaign directed at anglers is also a good step to prevent anglers from introducing *P. antipodarum* specimens by properly cleaning their equipment prior to moving between waterbodies. Visit UC – Santa Barbara's website (http://rivrlab.msi.ucsb.edu/NZMS/fieldsafety.php) for their suggested disinfection guidelines.

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Ctenopharyngodon idella (grass carp)

DISTRIBUTION

Ctenopharyngodon idella is native to rivers of eastern Asia, from the Amur River of far eastern Russia and China, south to the West River of southern China (Schofield et al., 2005). This species was first imported to the United States in 1963 to aquaculture facilities in Auburn, Alabama, and Stuttgart, Arkansas. The first release of *C. idella* into open waters took place at Stuttgart, Arkansas, when fish escaped the Fish Farming Experimental Station. However, many of the early stockings in Arkansas were in lakes or reservoirs open to stream systems, and by the early 1970s there were many reports of grass carp captured in the Missouri and Mississippi rivers (Nico, Fuller, & Schofield, 2011).

It is likely that breeding populations of *C. idella* exist in the Mississippi River as far upstream as Lake City, Minnesota above the Wisconsin River and Mississippi River confluence (United States Geological Survey [USGS], 2011).

Lower Wisconsin River

Three adult specimens of *C. idella* were captured from the Lower Wisconsin River in 2011. The first, a sterile triploid 1-meter-long, 18.2 kg adult, was captured in late April near the Prairie du Sac Dam. The second was shot by a bow angler in a backwater lake near Lone Rock in June. The third, a large adult (0.8 meters long and 6.2 kg) was found on September 1, 2011, near Mazomanie. There is no evidence of any reproduction or establishment of *C. idella* in the Lower Wisconsin River to this point. The captures to date in the LWR were probably a result of the high water in the spring of 2011 encouraging these adults to migrate up from the Mississippi River system (J. Lyons, personal communication, October 2011).

TRANSPORT

During the past few decades, *C. idella* has spread rapidly as a result of widely scattered research projects, stockings by federal, state, and local government agencies, legal and illegal interstate transport and release by individuals and private groups, escapes from farm ponds and aquaculture facilities; and natural dispersal from introduction sites. Stocking of *C. idella* as a biological control against nuisance aquatic plants in ponds and lakes continues (Nico et al., 2011).

HABITAT & KNOWN LIMITING PARAMETERS

Typical *C. idella* habitat includes quiet waters, such as lakes, ponds, pools, and backwaters of large rivers, and individuals generally do not travel long distances except for the annual spawning migration. Shallow water is the generally preferred habitat, although deeper waters are used when temperatures decrease (Nico et al., 2011).

A number of experimental studies have reported the environmental tolerances of *C. idella*. Fry and fingerlings have been reported to tolerate water temperatures from 0-40°C, as well as being able to survive five months under heavy ice cover. The upper lethal temperature range for *C. idella* fry is 33-41°C, and for yearlings as 35-36°C (Nico et al., 2011).

Lower Wisconsin River

At this time, it is unclear whether or not is possible for *C. idella* to successfully breed in the Lower Wisconsin River. A full risk assessment similar to Columbia River Basin Asian Carps Risk Evaluation (Aitkin, Lohr, Heimowitz, & Hill, 2008) could be conducted. A similar risk assessment is being completed for the tributaries to the Great Lakes (USGS, 2010).

BIOLOGICAL TRAITS

C. idella is a voracious herbivore that can quickly eliminate large volumes of vegetation. Adult specimens of *C. idella* prefer a diet of submerged plants with soft leaves and will consume filamentous algae and firmer macrophytes [e.g., Eurasian milfoil (*Myriophyllum spicatum*)] when preferred forage has been exhausted. In the absence of aquatic vegetation, *C. idella* has been reported to consume organic detritus, insects, small fish, earthworms, and other invertebrates. It can consume up to 40% of its body weight per day in aquatic vegetation (Conover, Simmonds, & Whalen, 2007).

C. idella females annually produce from 255,000 to 2,000,000 eggs (Schofield et al., 2005). The eggs are semi-buoyant, requiring flowing water like the silver and bighead carp. Successful reproduction requires long stretches of warm, flowing water for egg incubation and suitable backwater habitat for larval development. Floodplains associated with rising water levels provide nursery habitat areas for larvae and juvenile forms. Larval *C. idella* initially feed on rotifers and protozoans, switching to larger cladocerans and insect larvaeat 11-15 days post-hatch. Three weeks post-hatch, *C. idella* begin feeding on filamentous algae and macrophytes. By the age of one to 1.5 months, *C. idella* feed exclusively on macrophytes (Conover et al., 2007).

IMPACT POTENTIAL

C. idella, in high densities, has the potential to alter habitats significantly and affect native communities adversely through interspecific competition with invertebrates and other fishes; decrease refugia for aquatic organisms; modify preferred fish habitats; increase nutrient enrichment and eutrophication of lakes; disrupt food webs and trophic structure; and spread nonnative parasites and diseases (Conover et al., 2007).

Given favorable conditions, diploid *C. idella* specimens may reproduce and create a self-sustaining population, while the effects of triploid *C. idella* specimens are limited to the life spans of the individual fish. *C. idella* has been reported to consume all available aquatic vegetation in some lakes, and is also known to consume terrestrial vegetation by digging into banks and uprooting riparian vegetation. This method of feeding damages banks and may cause erosion (Conover et al., 2007).

C. idella has been associated with increased turbidity and alkalinity and reduced dissolved oxygen as a result of its feeding behavior and removal of macrophytes. Competition for vegetation has been documented to decrease abundances of snails and cause significant declines in crayfish populations. The removal of macrophytes can directly degrade habitat for those fishes which depend upon aquatic vegetation for all or part of their life cycle, such as northern pike (*Esox lucius*) and largemouth bass (*Micropterus salmoides*) (Conover et al., 2007).

PREVENTION AND CONTROL

At this time, chemical treatments of *C. idella* are expensive and treatment of the Mississippi River and other large rivers in the United States is not logistically or economically feasible; chemical treatments would need to be conducted regularly. Due to adverse affects on numerous rare and valuable native species, chemical treatment in the Lower Wisconsin River would likely only be possible if confined to an isolated lake or slough. The USGS is currently developing a means to deliver piscicides, such as rotenone, to target species with little or no impact to native species. This technology will not be available for use in the field for at least a few years (R. Hines, personal communication, 2011).

USFUL WEBSITES

USGS NAS Factsheet – http://nas.er.usgs.gov/queries/factsheet.aspx?SpeciesID=514

USGS Point Map - http://nas2.er.usgs.gov/viewer/omap.aspx?SpeciesID=514

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Gambusia affinis and *Gambusia holbrooki* (western & eastern mosquitofish)

Historically, western mosquitofish (*Gambusia affinis)* and eastern mosquitofish (*Gambusia holbrooki*) were considered subspecies of *G. affinis*. For this reason, the two species were not separated in historic fish records (United States Geological Survey [USGS], 2011). They are usually referred to collectively as "mosquitofish" or increasingly as plague minnows. *G. affinis* and *G. holbrooki* have the same life histories, transport vectors, impacts and management strategies, so they are addressed together in this profile sheet.

DISTRIBUTION

Mosquitofish are considered one of the most widespread freshwater fishes in the world. The native range of *G. affinis* includes the Atlantic and Gulf Slope drainages and reaches as far north as central Indiana and Illinois (USGS, 2011). The native range of *G. holbrooki* is smaller and stretches northeast from Florida to Maryland (USGS, 2011). Mosquitofish can now be found on every continent except Antarctica (Pyke, 2008; USGS, 2011).

Mississippi River Basin

Mosquitofish have been introduced to many waterbodies in the Mississippi Basin. Populations have been stocked in Minnesota, Illinois, Indiana, Iowa, Ohio, and Wisconsin (USGS, 2011). A few unsuccessful introductions of mosquitofish have occurred Wisconsin since the 1920s; their failure to establish was likely due to the harsh winter conditions (Lyons, 2009). In 2009, an established population of *G. affinis* was discovered in Pool 11 of the Mississippi River (Lyons, 2009). Specimens have been collected from the lower (southern) end of Pool 11, and extending as far north as Bertom Lake, 20 miles upstream of Lock and Dam 11 (J. Lyons, personal communication, 2011). No physical barriers prevent *G. affinis* from populating the upper (northern) extent of Pool 11 up to Lock and Dam 10. The Wisconsin River enters Pool 10 about 16 miles above Lock and Dam 10. Another localized and established population of *G. affinis* was discovered in the Sugar River in Green County, near Brodhead, WI (Lyons, 2009).

Great Lakes Basin

A population of *G. holbrooki* was recorded in the Great Lakes basin in Illinois in 1947, but the population was extirpated in that location by 1948 (USGS, 2011). Frequent stocking of mosquitofish occurred in northern Illinois in the 1920s, resulting in a few successful mosquitofish introductions to the Chicago region (Lyons, 2009).

TRANSPORT

The reputation of the *Gambusia* species as being voracious predators of mosquito larvae led to their indiscriminate movement around the world as a cheap and effective way to fight malaria (USGS, 2011). However, since the 1960s a debate has occurred about the effectiveness of mosquitofish as a biologic control for mosquito populations (Pyke, 2008). Once stocked populations establish, natural dispersal to surrounding areas usually follows (USGS, 2011). Accidental and intentional introductions by bait-bucket release, aquarium releases, and escapees from private ponds are potential vectors for mosquitofish introductions. Mosquitofish have been found mixed in with shipments of fathead minnows (*Pimephales promelas*), which were being shipped to Wisconsin for baitfish (Lyons, 2009). Exotic mosquitofish populations have also occurred when individuals escaped from private ponds (USGS, 2011).

HABITAT & KNOWN LIMITING PARAMETERS

Mosquitofish are tolerant of a wide range of environmental conditions, which is why the species has done so well around the world (Meisch, 1985). Mosquitofish are usually found in shallow water with little to no current (Casterlin & Reynolds, 1977; Lyons, 2009; Pyke, 2008). They prefer habitats with subsurface vegetation, but tend to avoid floating vegetative cover since it restricts water surface feeding (Casterlin & Reynolds, 1977).

Mosquitofish can survive and often maintain a population in a waterbodies with poor water quality. They can handle a wide range of pH levels (5-9.5) and low levels of dissolved oxygen (<0.2mg/l) (Lyons, 2009; Meisch, 1985; Zeiber, 2007). They can live in brackish water and have been found in power plant cooling ponds with salinities as high as 15 ppt (USGS, 2011). Additionally, they often inhabit turbid waters and can survive in 3 to 275 Jackson Turbidity Units (Lyons, 2009; Pyke, 2008).

The two controlling parameters for mosquitofish habitation appear to be water temperature and flow regime. Their temperature tolerance ranges from 0.5-42°C (Meisch, 1985). However mosquitofish seem to prefer temperatures around 31-35°C, and reproduction only occurs when temperatures are greater than 15.5°C (Lyons, 2009; Pyke, 2005). Historically, harsh Wisconsin winters have killed introduced *Gambusia* populations, but with increased winter temperatures, we can no longer count on this safe guard (Lyons, 2009). Areas of groundwater seepage into the waterbody are areas that could help mosquitofish overwinter in Wisconsin (Lyons, 2009). The other limiting parameter is the river or stream flow regime or wave-swept areas of lakes and rivers. *Gambusia* prefers still or slow-moving water (Lyons, 2009; Pyke, 2005, 2008).

Based on these two limitations, mosquitofish will likely not be found in headwater streams that are fast-flowing, coldwater trout streams (Lyons, 2009). Otherwise, the rest of the Lower Wisconsin River basin offers areas of favorable habitat for mosquitofish populations. Of particular concern are the backwater or slough areas on the Lower Wisconsin, which are usually warmer in temperature, can be characterized by groundwater inflow (D. Marshall, personal communication), and reduced water flows. A potential introduction of *Gambusia* into the Lower Wisconsin River could occur during a flood event on the Mississippi River, whereby *Gambusia* could advance out of Pool 11 past Lock and Dam 10, and gain unrestricted access to the Lower Wisconsin River.

BIOLOGICAL TRAITS
Mosquitofish have very high reproductive potential, producing multiple broods a year with 40-50 live young (sometimes up to several hundred young) in a brood (Knight, Walton, O'Meara, Reisen, & Wass, 2003; Lyons, 2009; Zeiber, 2007). A female can mature in 18 days and then can generate a brood every 21-28 days if the water temperature is over 15.5°C (Lyons, 2009; Pyke, 2008). In addition, a female can produce multiple broods from a single mating, so it takes only one pregnant female in a new, suitable location to invade a new area (Lyons, 2009).

The diet of the mosquitofish is quite varied, including insects, small crustaceans, zooplankton, fish eggs and larvae (Lyons, 2009).

Gambusia is prey to wading birds, kingfishers, larger fish, snakes, bats, and large crustaceans in its native range (Pyke, 2008). However, there is no evidence of mosquitofish being a large portion of a predator's diet outside of its native range (Aarn & Unmack, 2007).

IMPACT POTENTIAL
Invasive mosquitofish have been found to have negative impacts on many different native species from a range of trophic levels. Various studies have documented declines in the abundance of rotifers, crustaceans, backswimmers, water beetles and odonate larvae following the introduction of *Gambusia* (Pyke, 2008). *Gambusia*'s consumption of zooplanktivores can cause trophic cascading effects that result in algal blooms (USGS, 2011). Declines have also

been seen in the abundance and diversity of native amphibian species (Pyke, 2008).

Mosquitofish are known for their high feeding capacity. In laboratory experiments, the maximum consumption rates were 42-167% of their body weight per day, indicating that their foraging abilities assist in outcompeting native fish of similar size and with similar diets (USGS, 2011; Zeiber, 2007). In Wisconsin, the three fish species that are most threatened by mosquitofish introduction are the relatively common blackstripe topminnow (*Fundulus notatus*), the special-concern banded killifish (*Fundulus diaphanous*), and the state-endangered starhead topminnow (*Fundulus dispar*) (Lyons, 2009).

PREVENTION & CONTROL

According to Lyons (2009), "although fairly easy to capture individually, the small size, abundance, and use of difficult-to-sample habitats by mosquitofish makes their populations highly resistant to elimination by netting or electroshocking." Another physical control method that has been tried is to completely drain the waterbody (Invasive Species Specialist Group [ISSG], 2010). However, this technique is only practical in small waterbodies.

Piscicides have been used to try and eradicate mosquitofish with mixed results. The use of piscicides is most effective in small waterbodies where high chemical concentrations can be reached and the fish cannot escape. Rotenone, Antimycine A, liquid chlorine and calcium hydroxide have all been used in *Gambusia* control, but none of these poisons are species-specific (Pyke, 2008).

USEFUL WEBSITES

HTTP://WWW.ISSG.ORG/DATABASE/SPECIES/ECOLOGY.ASP?SI=126&FR=1&STS=&LANG=EN
HTTP://NAS.ER.USGS.GOV/QUERIES/FACTSHEET.ASPX?SPECIESID=846
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Hypophthalmichthys molitrix (silver carp)

DISTRIBUTION

Hypophthalmichthys molitrix are native to several major Pacific drainages in eastern Asia from the Amur River of far eastern Russia south through much of eastern half of China to the Pearl River, possibly including northern Vietnam (Nico, 2011).

H. molitrix was first imported into the United States in 1973 by a fish farmer in Arkansas. It was also stocked to control phytoplankton in eutrophic waterbodies. By 1980, the species was discovered in natural waters, probably a result of escapes from fish hatcheries and other types of aquaculture facilities (Freeze & Henderson, 1982). *H. molitrix* has been moving north at a rate of about 80 km per year and is now present in large numbers and believed to be well established below Mississippi River Lock and Dam 19 in Iowa (Wisconsin Department of Natural Resources [WDNR], 2007), near Keokuk, IA, approximately 444 river kilometers south of where the Wisconsin meets the Mississippi.

Only three specimens of *H. molitrix* have been collected in the Upper Mississippi River adjacent to Wisconsin, in Winneshiek Slough near Ferryville, WI (Crawford County) in 2011, and in the backwaters of the Mississippi River near the city of La Crosse, WI in 2008 and 2009. *H. molitrix* e-DNA was detected in the Lower St. Croix River in 2011, though no actual specimens were collected. No established population is thought to exist above Lock and Dam 19 in southern Iowa (United States Geological Survey [USGS], 2011). No *H. molitrix* specimens have been found in the Lower Wisconsin River; however, several specimens of grass carp (*C. idella*) and bighead carp (*H. nobilis*) have been found (see their species profiles for more information).

TRANSPORT

Dispersal of *H. molitrix* (and *H. nobilis*) appears to be occurring naturally, especially during high flow events which enable them to swim around and through barriers in the Mississippi River and Great Lakes regions. Their populations have been doubling annually, with the fastest expansions occurring in the Missouri and Illinois rivers (WDNR, 2004).

Other mechanisms of *H. molitrix* (and other Asian carp species) transport include the release of baitfishes caught in the wild; stocking in private or public waters for biological control; the production, live transport, and sale of live fish at seafood markets; live transport and intentional spread by commercial anglers; movement in ballast waters and live wells; and intentional releases by consumers, hobbyists, and animal rights activists (Conover, Simmonds, & Whalen, 2007).

HABITAT AND KNOWN LIMITING PARAMETERS

H. molitrix is thought to require rivers with a certain length, velocity, and turbulence to spawn (Kolar et al., 2007). The species spawns within areas of high turbulence within a river, allowing its semi-buoyant eggs and young larvae to remain adrift in the water column. If the eggs and larvae sink to the bottom and remain there, they generally do not survive. Therefore, a river must have adequate current and reach length to keep the eggs and larvae adrift to survive (USGS, 2010). *H. molitrix* spawning typically occurs in the spring when the runoff is high ensuring enough flow to suspend the eggs and larvae. Reported current velocities required for successful spawning range from 0.3 to 3.0 m/s. These velocities must be sustained for a certain distance, believed to be approximately 100 km (Kolar et al., 2005). The actual required reach length depends upon several variables, including water temperature (which controls how fast the eggs and larvae develop) and the current's velocity (USGS, 2010).

Lower Wisconsin River
At this time, it is unclear whether or not is possible for *H. molitrix* to successfully breed in the Lower Wisconsin River. A full risk assessment similar to the Columbia River Basin Asian Carps Risk Evaluation (Aitkin, Lohr, Heimowitz, & Hill, 2008) could be conducted. A similar risk assessment is being completed for the tributaries to the Great Lakes (USGS, 2010).

BIOLOGICAL TRAITS
H. molitrix migrate up streams and rivers to breed; eggs and larvae float downstream to floodplain zones. Females produce about 265,000-2,000,000 eggs annually (Schofield et al., 2005). These fish are fast growing and become very large, weighing up 45 kg and measuring up to 1.2 meters (WDNR, 2004).

H. molitrix is a filter feeder that consumes plankton and other particles. It is capable of consuming smaller particles than other filter feeders such as *H. nobilis*, due to its epibranchial organ that consolidates filtered materials by production of copious amounts of mucus. *H. molitrix* has the capability of changing the abundance and structure of phytoplankton and zooplankton communities (Kolar et al., 2005).

IMPACT POTENTIAL
Ecological

In numbers, *H. molitrix* has the potential to cause enormous damage to native species because it feeds on plankton required by larval fish and native mussels (Laird & Page, 1996). A study by Sampson, Chick, & Pegg (2008) found that *H. molitrix* and *H. nobilis* had dietary overlap with American gizzard shad (*Dorsoma cepedianum*) and bigmouth buffalo (*Ictiobus cyprinellus*). This research suggests that both carps would compete for resources with *Dorsoma cepedianum* (Sampson et al., 2008), which was the third-most-common species captured by WDNR researchers in 2011 Lower Wisconsin River fish samples. They also found *Ictiobus cyprinellus*, smallmouth buffalo (*Ictiobus bubalus*), and black buffalo (*Ictiobus niger*), a state threatened species (Lyons, 2011).

Recreation
H. molitrix pose a threat to human safety due to their jumping behavior when startled. These “flying carp” have caused numerous personal injuries to recreational boaters and anglers. In addition to personal injury, *H. molitrix* can also cause property damage. Broken Plexiglas faring, generators, radios, and depth finders have been reported. Additionally, even if an airborne *H. molitrix* specimen does not cause damage when landing inside a boat, it leaves slime, scales, and feces behind (Kolar et al., 2005).

PREVENTION AND CONTROL
At this time, chemical treatments of *H. molitrix* are expensive, and treatment of the Mississippi River and other large rivers in the United States is not logistically or economically feasible. Due to adverse affects on numerous rare and valuable native species, chemical treatment in the Lower Wisconsin River would likely only be possible if confined to an isolated lake or slough. The USGS is currently developing a means to deliver piscicides, such as rotenone, to target species with little or no impact to native species. This technology will not be available for use in the field for at least a few years (R. Hines, personal communication, 2011).

USFUL WEBSITES
USGS NAS Factsheet - http://nas.er.usgs.gov/queries/factsheet.aspx?speciesID=549
WDNR Factsheet - http://dnr.wi.gov/invasives/fact/asian_carp.htm
USGS Point Map - http://nas2.er.usgs.gov/viewer/omap.aspx?SpeciesID=549

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Hypophthalmichthys nobilis (bighead carp)

DISTRIBUTION

Hypophthalmichthys nobilis is native to eastern China, eastern Siberia, and extreme North Korea. *H. nobilis* and silver carp (*H. molitrix*) were first imported into the United States in the early 1970s. Soon after, both species escaped confinement during flood events and are now well established with reproducing populations in much of the Mississippi River basin (Kolar et al., 2007).

No evidence of breeding populations of *H. nobilis* has been found above Lake George, which is adjacent to the Mississippi River near Rock Island, Illinois; however, several individuals have been found as far north as the St. Croix River (United States Geological Survey [USGS], 2011a).

Lower Wisconsin River

Three *H. nobilis* specimens were captured from the Lower Wisconsin River in 2011. The first, a 13.6-kilogram adult, was reported by an angler in July. The second, a large 21.3-kilogram adult, was captured in October by WDNR fisheries biologist while gill netting for sturgeon at the Prairie du Sac Dam. The third, a 17.7-kilogram adult, was captured by an angler below the Prairie du Sac Dam in November.

TRANSPORT

Dispersal of *H. nobilis* (and *H. molitrix*) appears to be occurring naturally, especially during high flow events that enable them to swim around or through barriers in the Mississippi River and Great Lakes region. Their populations have been doubling annually, with the fastest expansions occurring in the Missouri and Illinois rivers (Wisconsin Department of Natural Resources [WDNR], 2004).

Other mechanisms of *H. nobilis* (and other Asian carp) transport include the release of baitfishes caught in the wild; stocking in private or public waters for biological control; the production, live transport, and live sales associated with seafood markets; live transport and intentional spread by commercial anglers; movement via ballast waters and live wells; and intentional releases of by consumers, hobbyists, and animal rights activists (Conover, Simmonds, & Whalen, 2007).

HABITAT & KNOWN LIMITING PARAMETERS

Spawning Habitat

Schrank et al. (2001) found that increased water discharge and a temperature of 22°C initiated spawning of *H. nobilis* in the Lower Missouri River. Spawning grounds are characterized by rapidly flowing (current velocity of 0.6 to 2.3 m/s) turbid water, 18-30°C, with suspended solids and a visibility of 10-15 centimeters. These sites are commonly found where there is a mixing of water, such as at a confluence of rivers, among the rocks of rapids, or behind sandbars, stonebeds, or islands (Kolar et al., 2005). Similar to *H. molitrix, H.nobilis* requires long stretches of flowing rivers in order for successful reproduction to occur.

Temperature and pH

In the laboratory the thermal maximum temperature was 39°C and the preferred temperature was 25°C. The maximum pH for culture was 9.24. Egg hatching was delayed below pH 6.5 and increased mortality and deformation of larvae occurred below pH 6.0. However, sensitivity to low pH decreased with age (Schofield, Williams, Nico, Fuller, & Thomas, 2005).

Lower Wisconsin River
At this time, it is unclear whether or not is possible for *H. nobilis* to successfully breed in the Lower Wisconsin River. A full risk assessment similar to the Columbia River Basin Asian Carps Risk Evaluation (Aitkin, Lohr, Heimowitz, & Hill, 2008) could be conducted. A similar risk assessment is being completed for the tributaries to the Great Lakes (USGS, 2010).

BIOLOGICAL TRAITS
H. nobilis are planktivorous, fast growing, and become very large, weighing up to 100 pounds and measuring up to 1.5 meters (WDNR, 2004), having the potential to deplete zooplankton populations. A decline in the availability of plankton can lead to reductions in populations of native species that rely on plankton for food, including all larval fishes, some adult fishes, and native mussels. Sampson, Chick, & Pegg (2008) found that the diets of Asian carp (*H. nobilis* and *H. molitrix*) overlapped with American gizzard shad (*Dorsoma cepedianum*) and bigmouth buffalo (*Ictiobus cyprinellus*) (Nico & Fuller, 2011).

Adult carp remain in the main river channel until the water levels rise; migrate upstream to spawn, and then move on to floodplain lakes (Kolar et al., 2005). *H. nobilis* females produce about 280,000 to 1.1 million eggs annually (Schofield et al., 2005). Eggs and larvae float downstream to floodplain zones. Juvenile *H. nobilis* prefer areas of low velocity, including floodplain lakes, wetlands, and back channels in larger river systems (Kolar et al., 2005).

IMPACT POTENTIAL

Ecological

In numbers, *H. nobilis* has the potential to cause enormous damage to native species because it feeds on plankton required by larval fish and native mussels (Laird & Page, 1996). The research of Sampson et al. (2008) suggests that both *H. molitrix* and *H. nobilis* carps would compete for resources with *D. cepedianum* (Sampson et al., 2008), which was the third-most-common species captured by WDNR researchers in 2011 Lower Wisconsin River fish samples. Researchers also found *I. cyprinellus*, smallmouth buffalo (*Ictiobus bubalus*), and black buffalo (*Ictiobus niger*), a state threatened species (Lyons, 2011).

Recreation
H. nobilis, to a lesser extent than *H. molitrix*, has the potential to thrash around the surface when spawning, and on rare occasions leap in response to boats (Lyons, 2011). They also diminish the opportunities of fisherman as native fishes decline from carp competition (WDNR, 2004).

PREVENTION AND CONTROL
At this time, chemical treatments of *H. molitrix* are expensive, and treatment of the Mississippi River and other large rivers in the United States is not logistically or economically feasible. Due to adverse affects on numerous rare and valuable native species, chemical treatment in the Lower Wisconsin River would likely only be possible if confined to an isolated lake or slough. The USGS is currently developing a means to deliver piscicides, such as rotenone, to target species with little or no impact to native species. This technology will not be available for use in the field for at least a few years (R. Hines, personal communication, 2011).

USFUL WEBSITES
USGS NAS Factsheet – http://nas.er.usgs.gov/queries/factsheet.aspx?SpeciesID=551
WDNR Factsheet - http://dnr.wi.gov/invasives/fact/asian_carp.htm

USGS Point Map - http://nas2.er.usgs.gov/viewer/omap.aspx?SpeciesID=551

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Mylopharyngodon piceus (black carp)

DISTRIBUTION
Mylopharyngodon piceus inhabits most of the major waterways of eastern Asia. Its natural range includes China, parts of far eastern Russia, and possibly northern Vietnam (United States Fish & Wildlife Service [USFWS], 2002).

M. piceus was first brought into the United States in the early 1970s as a "contaminant" in grass carp (*Ctenopharyngodon idella*) stocks imported to Arkansas. Subsequent introductions of *M. piceus* into this country occurred in the early 1980s. During this period it was imported as a food fish and as a biological control agent to combat the spread of yellow grub in aquaculture ponds. The first known record of an introduction of *M. piceus* into open waters occurred in Missouri in 1994, when thirty or more *M. piceus* specimens along with several-thousand bighead carp (*H. nobilis*) reportedly escaped into the Osage River, Missouri River drainage, when high water flooded hatchery ponds at an aquaculture facility near Lake of the Ozarks (Nico, 2009). They have been found as far up the Mississippi River as Clarksville, Missouri (United States Geological Survey [USGS], 2011).

TRANSPORT
According to a particular aquaculture farmer, hundreds of young *M. piceus* were accidentally included in shipments of live baitfish sent from Arkansas to bait dealers in Missouri as early as 1994. In addition, because of the continued widespread distribution of *C. idella* across the United States, the possibility remains that shipments may inadvertently contain *M. piceus*. Juveniles, in particular, are difficult to distinguish from *C. idella* young, increasing the risk that the species be misidentified and unintentionally introduced as "grass carp" to some areas (Nico, 2009).

HABITAT & KNOWN LIMITING PARAMETERS
The typical habitat of *M. piceus* includes reaches of large rivers that are below 200 meters above sea level, such as channels of lowland rivers and associated floodplain lakes and backwaters. The species also occurs in artificial habitats (including canals), and some populations survive in lakes and reservoirs, although reproduction and completion of their life cycle require a connection to flowing waters (Schofield, Williams, Nico, Fuller, & Thomas, 2005). The species is tolerant of temperatures from about 0-40°C, though reproduction and egg development generally occur between 18-30°C (Schofield et al., 2005).

Spawning grounds of *M. piceus* are usually located in river reaches characterized by turbulent or whirlpool-like flow, often in the vicinity of islands or stream junctions. Reported current velocities of spawning areas in China ranged from 0.33-0.90 m/s. The appropriate environment, particularly with regard to water turbulence and higher water temperatures, is considered critical because it apparently stimulates spawning and is necessary for successful early development of eggs. The eggs of *M. piceus* are semibuoyant and are carried by currents until they hatch. Nevertheless, uncertainty remains as to whether spawning occurred within a reservoir or in a connected stream. If spawning does occur in such habitats, it could have been triggered by fluctuations in water levels or wave actions that mimicked natural riverine environments (Schofield et al., 2005).

Lower Wisconsin River
At this time, it is unclear whether or not is possible for *M. piceus* to successfully breed in the Lower Wisconsin River. A full risk assessment similar to the Columbia River Basin Asian Carps

Risk Evaluation (Aitkin, Lohr, Heimowitz, & Hill, 2008) could be conducted. A similar risk assessment is being completed for the tributaries to the Great Lakes (USGS, 2010).

BIOLOGICAL TRAITS
Based on Asian records, large *M. piceus* adults may be 1.5 meters in length and 70 kilograms or more in weight; the largest specimen, unconfirmed, from the Chang (Yangtze) River basin reportedly measured over 2.2 meters (Nico, 2009). Larvae and small juveniles feed almost entirely on small invertebrates (such as zooplankton and aquatic insects). Larger juveniles and adults are bottom feeders that predominantly prey on snails and bivalve mollusks, although crayfish and other benthic invertebrates are sometimes consumed. The heavy pharyngeal arches and large molariform teeth of *M. piceus* are adapted to crush mollusk shells (Schofield et al., 2005).

IMPACT POTENTIAL
There is high potential that *M. piceus* would negatively impact native aquatic communities by feeding on, and reducing, populations of native mussels and snails, many of which are considered endangered or threatened. Mussel beds consisting of smaller individuals and juvenile recruits are probably most vulnerable to being consumed by *M. piceus*. Furthermore, based on the fact that the species can attain a large size, both juvenile and adult mussels and snails of many species would be vulnerable to predation by this fish. Because the life span of *M. piceus* is reportedly over 15 years, sterile triploid black carp in the wild would be expected to persist many years and therefore have the potential to cause harm native mollusks by way of predation (Nico, 2009).

If *M. piceus* become established in North American ecosystems, their feeding habits could drastically modify the ecological balance and forever change our native aquatic systems. These changes would affect the aesthetic, recreational, and economic values currently provided by native mollusks and healthy ecosystems (USFWS, 2002).

This species has been proposed as a biological control for the introduced zebra mussel (*Dreissena polymorpha*). Although the subject has been debated, to date, there is no experimental evidence that indicates *M. piceus* would be effective in controlling *D. polymorpha*. Because *M. piceus* do not have jaw teeth and their mouths are relatively small, it is unlikely that these fish are capable of breaking apart zebra mussel rafts (Nico, 2009).

PREVENTION AND CONTROL
At this time, chemical treatments are expensive and treatment of the Mississippi River and other large rivers in the United States is not logistically or economically feasible; chemical treatments would need to be conducted regularly. Due to adverse affects on numerous rare and valuable native species, chemical treatment in the Lower Wisconsin River would likely only be possible if confined to an isolated lake or slough. USGS is currently developing a means to deliver piscicides, such as rotenone, to target species with little or no impact to native species. This technology will not be available for use in the field for at least a few years (R. Hines, personal communication, 2011).

USFUL WEBSITES
USGS NAS Factsheet – http://nas.er.usgs.gov/queries/factsheet.aspx?SpeciesID=514
USGS Point Map - http://nas2.er.usgs.gov/viewer/omap.aspx?SpeciesID=514

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Neogobius melanostomus (round goby)

DISTRIBUTION
Neogobius melanostomus is native to Eurasia including the Caspian Sea, the Black Sea, and the Sea of Azov and its tributaries, and prefers brackish or fresh waters. It has aggressively invaded coastal Great Lakes regions and its tributaries (Kornis, 2010). The tubenose goby (*Proterorhinus marmoratus*), another gobiid, also invaded the Great Lakes in the 1990s; however, *N. melanostomus* has been more successful in its spread and proliferation (Charlebois, 2001). *N. melanostomus* has been highly successful due to its high tolerance for a wide range of environmental conditions, ability to reproduce repeatedly throughout the spring and summer, aggressive behavior, parental care of the males of the offspring, and its large size compared to other similar benthic species (Charlebois, 2001).

TRANSPORT
N. melanostomus is easily transported via ballast water. The species is beginning to enter river drainages of the Great Lakes, including the Chicago River, which could potentially lead to an invasion of the Mississippi River (Sapota, 2006).

N. melanostomus has been found in 26 of 73 streams in the Wisconsin tributaries of Lake Michigan, which is a significantly high percentage (Kornis, 2010). They are predicted to further invade about about 1,370 km of stream habitat up to the first stream barrier.

HABITAT
N. melanostomus is a bottom dweller that lives in the near-shore region of rivers and lakes. It prefers rocky habitats in addition to mussel beds, piers, and sunken objects. It can live in depths approximately varying from 0-30 meters and can survive in temperatures ranging from 0-30°C (Charlebois, 1996). It can also survive in areas with low oxygen concentrations and low water quality.

Biological Traits
N. melanostomus has a frog-like head with raised eyes, spineless dorsal fin, and is usually shorter than 18 centimeters in length. It has a distinctive black dot on its front dorsal fin. The color of its scales lightens when threatened, but is usually black and brown. It also has a distinctive fused pelvic fin that distinguishes the species from other Gobiidae fish species. *N. melanostomus* is easily confused with native black gobies in the Baltic Sea (Jude, 1995).

The lifespan of *N. melanostomus* is approximately four years. Males die after defending nests in breeding season (Pascualita, 2008). There is no significant sexual dimorphism or adult size classes, although cranial skeletal analyses suggest there might be acute sexual dimorphism (Simonovic, 2001). *N. melanostomus* has a polygynous mating system; many reproductive females lay eggs in the nests of a single male (Corkum, 2004).

N. melanostomus juveniles consume zooplankton and benthic invertebrates (such as chironomids and amphipods). Their diet shifts to dreissenid mussels (such as *Dreissena polymorpha* and *D. bugensis*) as they age and increase in size. Mussels are ingested either whole or are crushed by pharyngeal teeth (Lee, 2005).

Impact Potential
N. melanostomus feeds on the eggs, young-of-the-year, larval, and adult native fishes, thereby reducing hatching success (Charlebois, 2001). The decline of the mottled sculpin (*Cottus bairdi*) and the logperch (*Percina caprodes*) in the Great Lakes is said to have been caused by

N. melanostomus (Corkum, 2004). *N. melanostomus* is very aggressive for its size; it can attack other fish species and drive them away. Additionally, *N. melanostomus* contributes to the bioaccumulation of many contaminants that might lead to the poisoning of humans.

Prevention & Control
Electrical barriers and piscicides are being used as control measures to deter movement of *N. melanostomus*. Consistent with Wisconsin's NR 40 rule, banning the use of *N. melanostomus* as live bait may also limit spread (Crosier, 2005). A control strategy is currently being developed that uses natural pheromones to disrupt the reproductive behaviors. This method would prevent the males from attracting the females to the nests, which could eventually diminish the population (Corkum, 2004).

More generally, the best preventative measures against the spread of *N. melanostomus* is to inform the public on how to identify this species, inform them to never transport water or bait from one body of water to another, and dispose of bait in trash (Crosier, 2005).

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Procambarus clarkii (red swamp crayfish)

DISTRIBUTION

The red swamp crayfish (*Procambarus clarkii*) is native to northeastern Mexico and south-central United States (United States Geological Survey [USGS], 2011). Its native range includes the Southern Mississippi River drainage and is considered native in parts of Illinois. *P. clarkii* is one of the most widespread crayfish in the world; it has expanded to more than 15 states in the United States and 25 countries, spanning five continents (Gherardi & Daniels, 2004; Hobbs, Jass, & Huner, 1989). Within the midwestern United States, *P. clarkii* has been introduced to Indiana and Ohio (United States Geological Survey, 2011). In 2009, two isolated populations of the species were discovered in urban ponds in southeastern Wisconsin. The ponds were located in Germantown, Washington County and Kenosha, Kenosha County (Wisconsin Department of Natural Resources [WDNR], 2009a).

TRANSPORT

P. clarkii has been introduced to new areas through many vectors; natural expansion, aquaculture, commerce of live crustacean, bait-bucket releases, and pet trade (Geiger, Alcorlo, Baltanas, & Carlos Montes, 2005; Hobbs et al., 1989). Additionally, according to Huner & Barr (1991), *P. clarkii* is able to travel long distances over land (Chucholl, 2011). It has also been introduced by humans to enhance local fisheries. Another vector of concern has been release of *P. clarkii* after the completion of school science programs and escapees from golf course ponds where they are used for macrophyte control (Larson & Olden, 2008).

HABITAT AND KNOWN LIMITING PARAMETERS

Temperature

According to Huner and Barr (1991), *P. clarkii* prefers water temperatures between 21-27°C (Chucholl, 2011).

Flow Regime

Chucholl (2011) found indications that *P. clarkii* does well in stagnant or slow flowing waters. It would do well in the slow-moving sloughs of the Lower Wisconsin River. Gil-Sanchez and Alba-Tercedor (2002) found altitude, water current, and minimum winter temperature to be the best predictors of *P. clarkii* occurrence. This species prefers slow-moving waters in marshy areas due to its burrowing tendencies. *P. clarkii* is typically a warm water crayfish; however, in Europe it can inhabit colder water. It is very tolerant of poor water quality conditions (pH and salinity), which gives it an advantage due to the declining water quality worldwide (Gil-Sanchez & Alba-Tercedor, 2002; Smart et al., 2002). Experimental work by Smart et al. (2002) found that *P. clarkii* requires systems with a pH of 6.5-8.5, salinity <15%, and temperature of 22-25°C. It prefers clay/silt substrates to burrow in, which is different from most crayfish species that prefer cobble substrate (Gil-Sanchez & Alba-Tercedor, 2002).

As with many invasive species, *P. clarkii* is quite adaptable to sites that vary in size, gradient, and temperature. Populations have been found in everything from swampy lowlands and ponds to trout streams (Lieb, Bouchard, & Canine, 2011). As such, most of the Lower Wisconsin River watershed would be susceptible to *P. clarkii* invasion. In its introduced range, *P. clarkii* seems to be found more in developed areas that have enriched waters (Lieb et al., 2011).

BIOLOGICAL TRAITS

The diet of *P. clarkii* is very diverse and adaptable, depending on the availability of prey (Correia, 2002). Its diet can include aquatic plants, macroinvertebrates, detritus (animal or plant), periphyton, benthos, plankton, and agriculture byproducts. The adults tend towards herbivory, while the juvenile crayfish are carnivorous or omnivorous (Ilheu & Bernardo, 1993).

P. clarkii females produce between 100 and 500 eggs (Invasive Species Specialist Group [ISSG], 2011). A photoperiod and a hydroperiod of longer than four months are needed for larger females to reproduce. When longer floods occur, *P. clarkii* can reproduce twice a year, once in the spring and once in the fall. Additionally, it requires a temperature above 18°C and a pH within the range of 7-8 (Gutiérrez-Yurrita, Sancho, Bravo, Baltanás, & C. Montes, 1998).

IMPACT POTENTIAL

P. clarkii has the potential to negatively impact native ecosystems at multiple levels. It has been found to cause large decreases in native macrophyte populations (Feminella & Resh, 1989; Rodriguez, Becares, M. Fernandez-Alaez, & C. Fernandez-Alaez, 2005). It also has negative impacts on the biomass of macroinvertebrates (Hofkin, Koech, Ouma, & Loker, 1991; Rodriguez et al., 2005; Smart et al., 2002). It is an efficient and successful competitor to native crayfish species, as well as, a carrier of crayfish plague. *P. clarkii* also poses a serious threat to many native amphibians, mainly during their embryo and larval stages (Cruz & Rebelo, 2005; Gamradt & Kats, 1996; Renai & Gherardi, 2004; Riley et al., 2005; Rodriguez et al., 2005).

P. clarkii can also cause significant negative economic impacts. In areas where rice production is important, the species can negatively impact seed survival (Anastacio, Parente, & Correia, 2005). In areas that use gill nets to catch fish for fisheries, *P. clarkii* can damage a significant amount of the catch (Lowery & Mendes, 1977). Additionally, it creates burrows in the bank, which create bank instability (Ilheu & Bernardo, 1993).

PREVENTION AND CONTROL

There are some local laws which are in place to prevent crayfish movement into and around the state. *P. clarkii* is classified as a prohibited species in Wisconsin under Chapter NR 40, so therefore it is illegal to transport, possess, transfer or introduce it to any state waterbody. Additionally, in Wisconsin it is illegal to release crayfish into any waterbody without a permit (WDNR, 2009a). It is also illegal to simultaneously possess live crayfish and angling equipment on any inland waterbody.

No eradication methods are known for *P. clarkii*, however, there are several methods of control that have been tried for invasive *P. clarkii* and other invasive crayfish species that range from physical to chemical to biological control methods.

Physical Methods

Mechanical methods from invasive crayfish removal include baited minnow traps, fyke and seine nets and electrofishing (ISSG, 2011). These methods are all very work intensive and are most effective on small areas. The use of minnow traps is a long-term effort since some feedback can occur and some size preference exists for traps. Trapping appears to be most effective when coupled with a fish predator (Hein, Roth, Ives, & Vander Zanden, 2006). Additionally, physical and electrical barriers could be used to cut-off their movement (Kerby, Riley, Kats, & Wilson, 2005).

Chemical Methods

A variety of chemicals have been used to try and eradicate *P. clarkii*. No crayfish-specific biocide exists, so other invertebrates in the ecosystem are likely to be impacted by the chemical used. Biocides used in other areas have been organophosphate, organochloride, and pyrethroid insecticides (ISSG, 2011). In Kenya, Furadan 5G (active ingredient carbonfuran), commonly applied in rice paddies as a pesticide, was found to be lethal for red swamp crayfish (Rosenthal et al., 2005). Sodium hypochlorite (applied at 50 mg/l) was used in Germantown, WI with little success due to the burrowing nature of red swamp crayfish. Use of the sodium hypochlorite had to be approved by the state Agriculture, Trade, and Consumer Protection and the U.S. Environmental Protection Agency (WDNR, 2009b).

Biological Controls
Fish predators have been used to manage *P. clarkii* populations, especially when coupled with a mechanical removal technique. Eels, burbot, perch, and pike have all been found to eat crayfish (ISSG, 2011). There is also a sterilization technique that when 20 Gy x-ray ionizing radiation is applied to male *P. clarkii*, the reproduction success decreased and the hatchlings reduced by 43% (Aquiloni et al., 2009).

USEFUL WEBSITES
HTTP://WWW.ISSG.ORG/DATABASE/SPECIES/ECOLOGY.ASP?SI=608&FR=1&STS=&LANG=EN
HTTP://DNR.WI.GOV/INVASIVES/FACT/REDCRAYFISH2.PDF
HTTP://NAS.ER.USGS.GOV/QUERIES/FACTSHEET.ASPX?SPECIESID=217

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Viral Hemorrhagic Septicemia (VHS)

DISTRIBUTION
Wisconsin waters infected with viral hemorrhagic septicemia (VHS) include Lake Michigan, Lake Superior, and the Lake Winnebago System. Connected waters suspected (but not yet confirmed) of being infected with VHS, but not confirmed include the Mississippi River and all of its tributaries upstream to the first dam or barrier impassable to fish, including the Lower Wisconsin River to the Prairie du Sac Dam (Wisconsin Department of Natural Resources [WDNR], 2010). Testing for VHS has annually occurred in the Lower Wisconsin River since 2006. No positive tests have been found.

TRANSPORT
It is not known how VHS was initially introduced to the Great Lakes system; however, genetic evidence suggests that the virus originated from the Atlantic coast of North America, possibly via transport in ballast water or infected migratory fishes. Recent studies indicate that VHS distribution is not related to shipping or boating activity, though aquaculture activities are implicated in the spread of the virus. Waterfowl might also play a role in transmitting VHS. It appears that once VHS is established in a region, the virus will become widespread, hosted by fish without disease symptoms, and capable of persistence at low but detectable levels (Kipp & Ricciardi, 2010).

HABITAT & KNOWN LIMITING PARAMETERS

Temperature and pH
The optimum replication temperature for the virus is 14-15°C, whereas replication is low at 5.5°C and almost nonexistent at 20°C. The virus becomes inactive after 24 hours at 20°C in water, but can persist for five days at 24°C in water. Most infected fish will die when water temperatures are 3-12°C, and rarely die above 15°C. VHS is still stable at a pH of 5, while the optimum replication pH is 7.4–7.8 (Kipp & Ricciardi, 2010).

Lower Wisconsin River Basin
At this time there is no reason to suspect that the virus would not be capable of infecting fish in the Lower Wisconsin River. See below for information regarding specific species threatened.

IMPACT POTENTIAL
VHS is an RNA virus, 170-180 nm in length and 60-70 nm in width, which infects many species of fish. It requires an incubation period of approximately 7 to 15 days, depending on water temperature. Fishes are susceptible to infection at any age. VHS is transmitted to juvenile and adult fish most often via urine and reproductive fluids that enter a fish through secondary gill lamellae, or possibly through fin bases or via wounds; it cannot enter eggs and infect fish before hatching. Fish can also be infected when they eat an infected fish. Juvenile fish are generally more susceptible than adults. Virus particles in the water infect gill tissue first, and then move to the internal organs and the blood vessels. The blood vessels become weak, causing hemorrhages in the internal organs, muscle and skin. Symptoms that may be expressed by infected fish include internal hemorrhages, external hemorrhages, fluid in the abdomen, bulging eyes, and erratic swimming. Some fish species may be infected without showing signs of disease. These fish can spread the virus to other fish or locations and contaminate water sources or equipment (Kipp & Ricciardi, 2010).

Fish that survive the infection will develop antibodies to the virus. Antibodies will protect the fish against new VHS virus infections for some time. However, the concentration of antibodies in the fish will drop over time and the fish may start shedding virus again. This may create a cycle of fish kills that occurs on a regular basis (WDNR, 2010).

The North American VHS strain is less virulent to salmon and trout than the European strain and has not caused large fish kills of these species in the Great Lakes to date. However, mortality of other species has been documented. In 2005, VHS apparently caused large die-offs of freshwater drum (*Aplodinotus grunniens*) and round goby (*Neogobius melanostomus*) in eastern Lake Ontario, and muskellunge (*Esox masquinongy*) in Lake St. Clair (Wren & Lee, 2006). In the spring and summer of 2006, VHS was implicated as a cause of large die-offs of *N. melanostomus* and *E. masquinongy* in the Thousands Islands area of the St. Lawrence River and die-offs of *E. masquinongy*, northern pike (*Esox lucius*), American gizzard shad (*Dorosoma cepedianum*), smallmouth bass (*Micropterus dolomieui*), walleye (*Sander vitreus*), and yellow perch (*Perca flavescens*) in Lake St. Clair, Lake Erie and Lake Ontario (Kipp & Ricciardi, 2010).

Lower Wisconsin River Basin
In 2007, the United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Veterinary Services identified 28 fish species as having originated in freshwater locations in the United States and/or Canada, and as having been infected by VHS virus under natural (i.e. non-experimental) conditions of exposure; and from which VHS virus has been isolated by cell culture, with confirmation of strain identity through molecular detection. Included were several species that are prevalent in the Lower Wisconsin River, shorthead redhorse (*Moxostoma macrolepidotum*), *Micropterus dolomieui*, *Dorosoma cepedianum*, and emerald shiner (*Notropis atherinoides*). Also included are gamefish species that are present in the Lower Wisconsin River and its tributaries, including brown trout (*Salmo trutta*), channel catfish (*Ictalurus punctatus*), *Micropterus dolomieui*, and *Sander vitreus* (Lyons, 2011; United States Department of Agriculture [USDA], 2007).

PREVENTION AND CONTROL

Fish Hatcheries and Bait Dealers
WDNR and the Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP) are taking the following steps to prevent the spread of VHS: VHS testing and monitoring of wild fish and hatchery fish and water supplies, biosecurity measures at state fish hatcheries, fish health screening in the bait fish industry, mandatory disinfection of gear by DNR staff working in lakes and rivers, and added VHS prevention requirements for people seeking permits for waterfront projects. These efforts should be diligently continued.

Preventing the Moving and Collecting of Bait from VHS Infected Waters
In Wisconsin, VHS-affected (and VHS-suspected) waters are closed to all minnow harvesting (currently these include Lake Michigan, Lake Superior, the Mississippi River, Lake Winnebago, Fox River from Lake Winnebago to Green Bay, and all connecting waters upstream to the first barrier impassible to fish). The only exception is that suckers (which are legally considered to be minnows also) can be taken but may not be transported away alive. On other waters, minnows may be taken for personal use but may not be transported alive away from the water, or by Wisconsin bait dealers under a DNR wild bait harvest permit (WDNR, 2009).

Healthy Native Fisheries
Stress is an important factor in VHS outbreaks. Stress suppresses the immune system, causing infected fish to become diseased. Stressors include spawning hormones, poor water quality, lack of food, or excessive handling of fish (WDNR, 2010).

USFUL WEBSITES
USGS NAS Factsheet – http://nas.er.usgs.gov/queries/factsheet.aspx?SpeciesID=2656
USGS Point Map - http://nas2.er.usgs.gov/viewer/omap.aspx?SpeciesID=2656

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PAST AND CURRENT RIVER ALLIANCE OF WISCONSIN AIS EDUCATION AND OUTREACH ACTIVITIES IN THE LOWER WISCONSIN RIVER BASIN

In support of the development of the Lower Wisconsin River Basin Aquatic Invasive Species Strategic Plan, the River Alliance of Wisconsin engaged in educational outreach efforts around the subject of AIS in the Lower Wisconsin River basin. A summary of these activities is below.

<u>2010-2011 Clean Boats, Clean Waters courtesy watercraft inspections</u>

River Alliance of Wisconsin interns performed 10 Clean Boats, Clean Waters courtesy watercraft inspections at five different Lower Wisconsin River landings. Sauk Prairie River PAL conducted one courtesy watercraft inspection in coordination with local high school students.

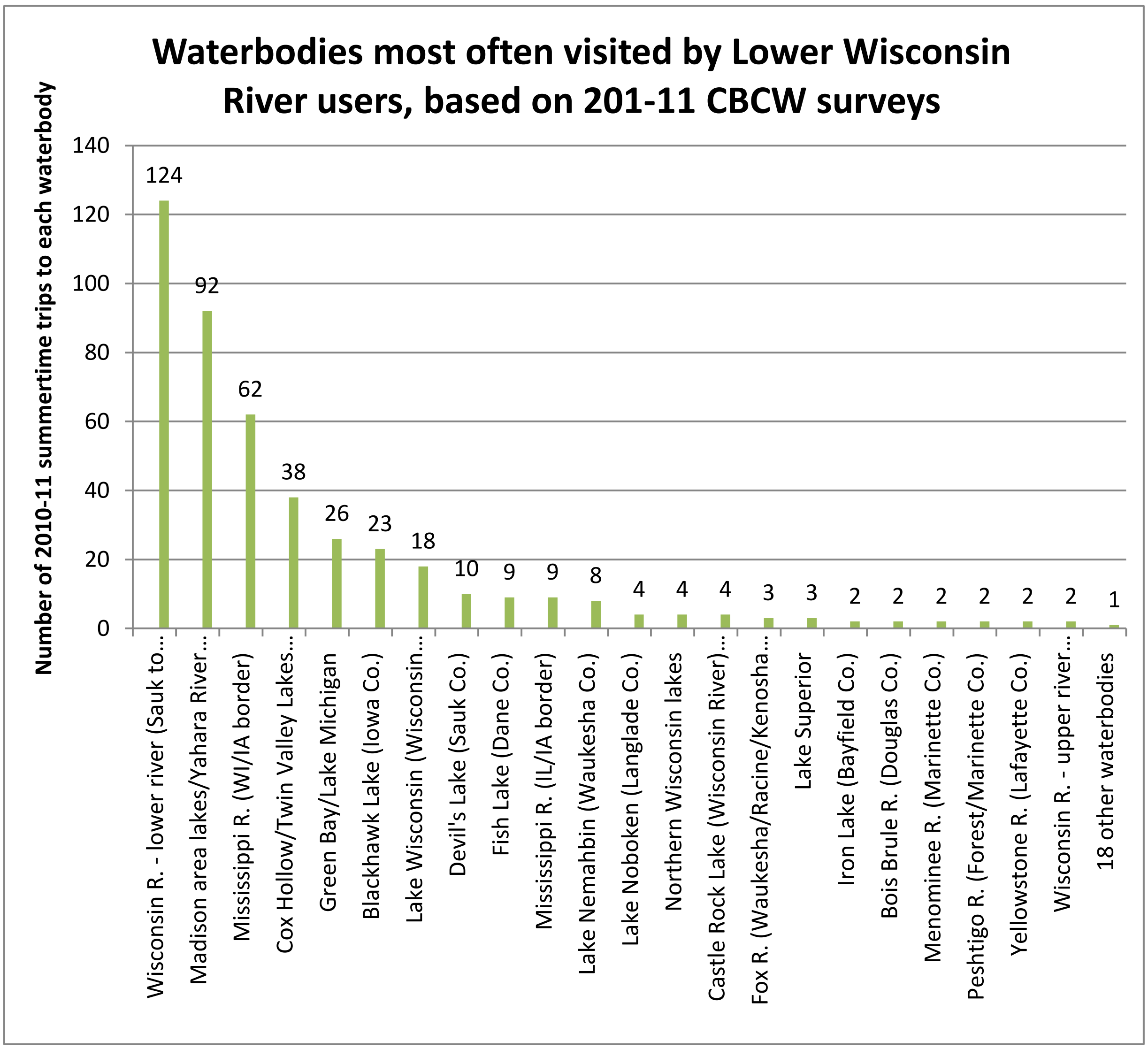

Figure 1: Clean Boats, Clean Waters data results from 2010-11 surveys performed by River Alliance of Wisconsin staff and interns on Lower Wisconsin River landings

2010-2011 River Alliance of Wisconsin CBCW data summary:

- 88 boats reached, 210 contacts
- 8% of respondents used their boat in the last 5 days
- 76% of respondents inspected and removed plants from their boat and equipment
- 77% of respondents disposed of unused bait in trash
- 83% of respondents drained water from boat, equipment prior to leaving landing
- 90% of respondents drained water from livewell prior to leaving landing
- 76% of respondents are aware of AIS laws
- 66% of respondents would use a wash station if one was provided
- Best ways to reach respondents with AIS info:
    - o 45% sign at boat landing
    - o 20% internet
    - o 19% person at landing
    - o 6% newspaper or magazine
    - o 4% billboard
    - o 4% TV
    - o 2% radio
- 0% plants were present on boats coming off water
- 0% violations occurred

<u>Lower Wisconsin River Basin AIS Strategic Plan community meetings</u>
The River Alliance of Wisconsin hosted two community meetings regarding the development of an AIS strategic plan for the Lower Wisconsin River basin. The meetings were held on March 10, 2011 and March 14, 2011, in Muscoda and Spring Green, respectively, and were attended by a wide range of state and county representatives, citizen groups, and concerned citizens.

<u>Distribution and placement of trout stream signs</u>
Approximately 30 signs have been posted on trout streams in the Lower Wisconsin River basin encouraging wading anglers to inspect their equipment, remove all plants and animals, drain all water, never move live fish or bugs, and to replace felt soled wading boots with rubber. This sign artwork may be seen in Appendix 6. The Black Earth Creek watershed has been sufficiently signed thanks to funding and support from Dane County and Southern Wisconsin Trout Unlimited. Other partners in the basin include the Coulee Chapter of Trout Unlimited and Southwest Badger Resource Conservation and Development (RC&D). The River Alliance and partners will continue to post signs at the most popular trout stream access points in 2012 thanks to continued funding from the WDNR.

<u>Project RED training</u>
On May 14, 2011, the River Alliance of Wisconsin hosted a Project RED (RIverine Early Detectors) training in partnership with Dane County. Citizen volunteers from the Lower Wisconsin River basin were taught to identify and report 16 invasive species of concern. The data they collect will be entered into the Wisconsin DNR SWIMS database.

WDNR stream biologists training

On July 6th and 7th, 2011 the River Alliance and the WDNR partnered to train 30 staff stream biologist how to identify and report invasive species in riparian corridors.

Clean Boats, Clean Waters training

The River Alliance of Wisconsin hosted a Clean Boats, Clean Waters training on April 30, 2011 to recruit and train local citizens in the performance of courtesy watercraft inspections at boat landings along the LWSR. Fifteen people attended, representing several organizations, including the Sauk Prairie River PAL, Sauk Prairie Middle School, U.S. Coast Guard & Auxiliary, Dane County Office of Lakes and Watersheds, Sauk Prairie High School, and the Lower Wisconsin State Riverway/Wisconsin DNR.

Partnership with WDNR Water Guard/Conservation Wardens

River Alliance of Wisconsin staff have partnered with the WDNR Water Guard and Conservation Wardens on AIS issues, on the Lower Wisconsin River, including education, communication, and outreach. Results of the partnership is a better understanding between respective organizations on priority AIS species and outreach opportunities on the Lower Wisconsin River.

Lower Wisconsin State Riverway boat landing signage

The River Alliance of Wisconsin and Lower Wisconsin State Riverway staff partnered to ensure consistent and up-to-date AIS signage was placed at public boat landings on the LWSR. Additionally, River Alliance interns gathered data on existing signage at municipally-owned LWSR landings, as a step to ensuring that these private landings also exhibit consistent and up-to-date AIS signage in the future.

AIS Action Day

On June 25, 2011, the River Alliance of Wisconsin partnered with Friends of the Lower Wisconsin (FLOW) to host AIS Action Day—an opportunity for citizens to experience and learn about the delicate ecosystems of the Lower Wisconsin River, and how they are threatened by AIS. Over 20 participants paddled from Prairie du Sac to Ferry Bluff, followed by a barbeque in August Derleth Park in Sauk City.

Press and media coverage

Wisconsin Waterfowl Magazine (Summer/Fall 2011) – An article was published in this popular waterfowl hunting magazine on the threat of faucet snails to waterfowl populations in Wisconsin. The article also brings attention to the applicability of NR 40 to the waterfowler (ex. Illegal to transport *Phragmites* into boat blinds).

Targeted outreach and partnership development

The following are key AIS constituent groups to whom the River Alliance of Wisconsin reached out by attending meetings and discussing the overall Lower Wisconsin basin AIS effort during plan development.

Friends of the Lower Wisconsin Riverway (FLOW) – On June 15, 2010, River Alliance staff attended a FLOW board meeting to inform the group about the LWR basin AIS effort, solicit their feedback, and invite their participation.

Sauk Prairie River P.A.L. – On October 4, 2010, River Alliance staff attended a Sauk Prairie River PAL meeting to inform the group about the LWR basin AIS effort, solicit their feedback, and invite their participation.

Trout Unlimited Wisconsin State Council – On February 5, 2011 River Alliance staff attended the TU State Council meeting in Stevens Point, WI with outreach materials regarding AIS and the Lower Wisconsin River AIS effort.

Badger Fly Fishers meeting – On February 28, 2011, the River Alliance was asked to present at the Badger Fly Fishers meeting in McFarland, WI regarding the role of the angler in preventing the spread of AIS. There were approximately 25 people in attendance.

Lower Wisconsin State Riverway Board – On March 10, 2011, River Alliance staff presented the purpose, scope, and goals of this strategic plan to the Lower Wisconsin State Riverway Board members.

SWTU meeting – On April 12, 2011, the River Alliance was asked to present at the Southern Wisconsin Trout Unlimited chapter meeting on the role of the angler in preventing the spread of AIS. There were approximately 50 individuals in attendance.

OVERVIEW OF POTENTIAL LOWER WISCONSIN RIVER BASIN AIS STAKEHOLDER GROUPS

Listed below are just a few of the potential AIS stakeholder groups active in the Lower Wisconsin River basin.

Governmental entities

- Wisconsin Department of Natural Resources (multiple bureaus)
- Lower Wisconsin State Riverway Board
- County government (Crawford, Dane, Grant, Iowa, Monroe, Richland, Sauk, Vernon counties)
- City government – population centers on the Lower Wisconsin River (Prairie du Sac, Sauk City, Arena, Spring Green, Richland Center, Muscoda, Boscobel, Prairie du Chien)
- University of Wisconsin Extension
- Local universities, technical schools, and high schools

Non-governmental organizations

- Friends of the Lower Wisconsin River
- Sauk Prairie River Project Association Limited (P.A.L.)
- Local Trout Unlimited chapters (Coulee Region, Southern Wisconsin, Aldo Leopold, Harry and Laura Nohr)
- Local Ducks Unlimited chapters
- Wisconsin Waterfowl Association
- Southern Wisconsin Invasives Team
- Izaak Walton League Southwestern Wisconsin chapter
- U.S. Coast Guard Auxiliary Flotilla 45-8
- Badger Fly Fishers
- Wisconsin Trappers Association
- Wisconsin River Sportsmen's Club
- Wisconsin Bowfishing Association
- Blackhawk Lake Recreation Area
- Ferry Bluff Eagle Council
- Valley Stewardship Network
- Wisconsin Smallmouth Bass Alliance
- Grade Boat Club

Commerce/Industry

- Alliant Energy
- Sporting good stores (e.g. Wilderness Fish and Game, Cabela's, Gander Mountain)
- Local campgrounds (e.g. Snuffy's Campground)
- Local canoe livery services (e.g. Wisconsin River Outings, Blackhawk River Runs)
- Local bait shops (e.g Wisconsin Riverside Resort, Lake Wisconsin Resort, Sauk Prairie Live Bait and Tackle)
- Local fly fishing shops (e.g. On the Creek, Driftless Angler)
- Fishing guides (e.g. Gary Engberg)

LOWER WISCONSIN RIVER BASIN AIS STRATEGIC PLAN TECHNICAL ADVISORY COMMITTEE MEMBERS

Listed below are the members of the Technical Advisory Committee that provided input and professional review during the development of the Lower Wisconsin River Basin Aquatic Invasive Species Strategic Plan.

Name	Title	Organization	Email	Phone
Don Barrette	Aquatic Invasive Species Coordinator	Southwest Badger Resource, Conservation, & Development	don.barrette@swbadger.org	608-348-7114
Pam Biersach	Water Regulations & Zoning Specialist	WDNR	pamela.biersach@wisconsin.gov	608-275-3282
Mark Cupp	Executive Director	Lower Wisconsin State Riverway Board	mark.cupp@wisconsin.gov	608-739-3188
Sue Graham	Lake Management Coordinator	WDNR	susan.graham@wisconsin.gov	608-275-3329
Pete Jopke	Water Resources Planner	Dane County	jopke@co.dane.wi.us	608-224-3733
Lisie Kitchel	Conservation Biologist	WDNR	lisie.kitchel@wisconsin.gov	608-266-5248
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Pam Thiel	Project Leader	U.S. Fish and Wildlife Service	pam_thiel@fws.gov	608-783-8431
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Scott Van Egeren	Water Resources Management Specialist	WDNR	scott.vanegeren@wisconsin.gov	608-264-8895
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Bob Wakeman	Statewide Aquatic Invasive Species Coordinator	WDNR	robert.wakeman@wisconsin.gov	608-266-9270
Timm Zumm	Co-chair	Friends of the Lower Wisconsin Riverway	wisriverfriends@yahoo.com	608-575-0325

LOWER WISCONSIN RIVER BASIN OUTSTANDING AND EXCEPTIONAL RESOURCE WATERS

WDNR designates Outstanding Resource Waters (ORWs) and Exceptional Resource Waters (ERWs) as being "surface waters which provide outstanding recreational opportunities, support valuable fisheries and wildlife habitat, have good water quality, and are not significantly impacted by human activities." These waterbodies are afforded additional anti-degradation protections, designed to prevent the lowering of water quality, including aquatic invasive species. Only 18.6% of the over 42,000 stream/river miles in the state receive either of these designations. In the Lower Wisconsin River basin, portions or all of the waterbodies listed below (10 ORWs and 60 ERWs) have been designated by the DNR. While all waterbodies in the basin should be protected against AIS introductions and spread, the protection of these waterbodies should be prioritized.

Waterbody name	**Start mile**	**End mile**	**WBIC**	**County**	**Water-body type**	**ORW/ERW status**
Babb Hollow Creek	0	3.04	1218400	Richland	River	ERW
Biser Creek	0	3.86	1236000	Sauk	River	ERW
Big Green River	1.93	15.14	1203900	Grant	River	ORW
Big Spring Branch	0	5.17	1212900	Grant, Iowa	River	ERW
Black Earth Creek	19.35	23.95	1248600	Dane	River	ORW
Black Earth Creek	16.83	19.35	1248600	Dane	River	ERW
Blue River	17.87	35.21	1211000	Grant, Iowa	River	ERW
Boydtown Creek	1	1.64	1205100	Crawford	River	ERW
Bishop Branch	0	4.2	1188500	Richland	River	ERW
Bufton Hollow Creek	0	2.78	1193100	Richland	River	ERW
Camp Creek	0	8.28	1192700	Richland	River	ORW
Cheyenne Valley Creek	0	7.6	1197000	Vernon	River	ERW
Coulter Hollow Creek	0	2.62	1218800	Richland	River	ERW
Crooked Creek	0.81	10.32	1205600	Grant	River	ERW
Cynthia Slough	N/A	N/A	1241300	Sauk	Lake	ERW
Doc Smith Branch (Cass Valley)	3.39	8.56	1212000	Grant	River	ERW
Dunlap Creek	6.07	10.03	1253300	Dane	River	ERW
East Branch Mill Creek	0	5.41	1217200	Richland	River	ERW
Elk Creek	1.91	6.2	1191700	Richland	River	ORW
Elvers Creek (Bohn Creek)	0	10.06	1251600	Dane	River	ERW
Fancy Creek	9.52	11.37	1227400	Richland	River	ERW
Fennimore Fork (Castle Rock Creek)	8.29	17.14	1211300	Grant	River	ORW
Fox Hollow Creek	0	4.6	1216700	Richland	River	ERW
Garfoot Creek	0	4.34	1249900	Dane	River	ERW
Gault Hollow Creek	2.19	5.73	1230200	Richland	River	ERW
Grinsell Branch	0	2.88	1232600	Richland	River	ERW
Hanzel Creek	0	3.24	1232300	Richland	River	ERW
Happy Hollow Creek	0	4.42	1223800	Richland	River	ERW

Harker Creek	1.02	6.15	1238400	Iowa	River	ERW
Higgins Creek	0	2.95	1219000	Richland	River	ERW
Hood Hollow Creek	0	2.3	1218300	Richland	River	ERW
Hoover Hollow Creek	0	1.37	1207000	Richland	River	ERW
Hutter Slough			1247000	Sauk	Lake	ERW
Jacquish Hollow Creek	0	2.16	1222100	Richland	River	ERW
Jones Slough			1247300	Sauk	Lake	ERW
Kepler Branch	0	2.84	1218900	Richland	River	ERW
Lee Creek	0	4.39	1238500	Iowa	River	ERW
Little Green River	0	4.12	1204000	Grant	River	ORW
Long Lake	N/A	N/A	1236600	Richland, Sauk	Lake	ERW
Lost Hollow Creek	0	2.69	1222900	Richland	River	ERW
Love Creek	0	3.94	1244400	Iowa	River	ORW
Marble Creek	0	3.51	1235700	Sauk	River	ERW
Marshall Creek	0	3.78	1228100	Richland	River	ERW
Martin Creek	0	1.6	1238600	Iowa	River	ERW
Melanchthon Creek	0	8.28	1232200	Richland, Vernon	River	ERW
Mill Creek	15.44	29.72	1215600	Richland	River	ERW
Miller Branch	0	2.43	1218000	Richland	River	ERW
Otter Creek	17.17	18.81	1258400	Sauk	River	ORW
Pine Valley Creek	0	2.75	1218200	Richland	River	ERW
Plum Creek	0	9.24	1182700	Crawford	River	ERW
Reads Creek (Black Bottom)	0	8.87	1187400	Vernon	River	ERW
Ryan Hollow Creek	0	2.85	1217900	Richland	River	ERW
Ryan Creek	0	6.44	1251400	Dane	River	ERW
Seas Branch	2.7	6.06	1189800	Vernon	River	ERW
Smith Hollow Creek	0	3.38	1223000	Richland	River	ERW
South Bear Creek	2.49	4.43	1193600	Richland	River	ERW
Strutt Creek	0	2.24	1244500	Iowa	River	ORW
Tainter Creek	2.45	15.03	1185500	Crawford, Vernon	River	ERW
Trout Creek	0	4.25	1243100	Iowa	River	ORW
Unnamed creek	0	1.35	5036632	Iowa	River	ERW
Unnamed creek 3-4d	0	0.86	1232625	Richland	River	ERW
Unnamed creek 4-9 T11nR1w	0	2.75	1228700	Richland	River	ERW
Unnamed creek 6-11 T11nR3w	0	3.22	1187600	Vernon	River	ERW
Unnamed creek 10-8 T11nR1w	0	1.27	1228600	Richland	River	ERW
Unnamed creek 24-3a T11nR1w	0	1.68	1227900	Richland	River	ERW
Unnamed creek 28-11 T10nR3e	0	0.49	5033105	Sauk	River	ERW
West Branch Mill Creek	0	7.66	1217700	Richland	River	ERW
Wheat Hollow Creek	0	2.99	1222800	Richland	River	ERW
Willow Creek	7.99	20.26	1220900	Richland	River	ERW
Wisconsin River	0	90.94	1179900	Crawford, Dane, Grant, Iowa, Richland, Sauk	River	ERW

LOWER WISCONSIN RIVER BASIN “IMPAIRED” WATERS

Section 303(d) of the federal Clean Water Act requires states to develop a list of impaired waters (“303(d) list”). A waterway is considered impaired if a) the current water quality does not meet the numeric or narrative criteria in a water quality standard or b) the designated use that is described in Wisconsin Administrative Code is not achieved. Impaired waterways generally do not display the abundance of healthy native species and ecosystems that build resilience against AIS invasions; in short, they are waterways in which AIS may likely appear. Listed in the table below are the 15 impaired waterbodies (some with multiple designations) in the Lower Wisconsin River basin.

Waterbody name	Start mile	End mile	WBIC	County	Pollutant	Impairment	303d status
Blue River	32.05	35.21	1211000	Iowa	Sediment/Total suspended solids	Degraded habitat	303d listed
Fennimore Fork (Castle Rock Creek)	17.14	26.25	1211300	Grant	Sediment/Total suspended solids	Degraded habitat	TMDL approved
Gunderson Valley Creek	0	5.4	1212600	Grant	Total phosphorus; Sediment/Total suspended solids	Low dissolved oxygen; Degraded habitat	TMDL approved
Halls Branch	1.97	5.16	1184300	Crawford	Sediment/Total suspended solids	Degraded habitat	303d listed
Jug Creek	0	4.65	1195500	Vernon	Sediment/Total suspended solids	Degraded habitat	TMDL approved
Kickapoo River	19.05	25.45	1182400	Crawford	Mercury	Contaminated fish tissue	303d listed
Little Bear Creek	0	6.77	1234700	Richland, Sauk	Total phosphorus; Sediment/Total suspended solids	Degraded biological community; Elevated water temperature; Degraded habitat	303d listed
Little Willow Creek	0	7.73	1221300	Richland	Sediment/Total suspended solids	Degraded habitat	TMDL approved
Otter Creek [reach 1]	0	19.86	1237100	Iowa	Sediment/Total suspended solids	Degraded habitat	TMDL approved
Otter Creek [reach 2]	21.37	23.30	1237100	Iowa	Sediment/Total suspended solids	Degraded habitat	TMDL approved
Rush Creek	0	6.02	1240100	Iowa	Sediment/Total suspended solids	Degraded habitat	303d listed
Shannahan Valley Creek	0	1.3	1257900	Sauk	Ammonia (unionized) toxin; Elevated water temperature; BOD	Chronic aquatic toxicity; Elevated water temperature; Low dissolved oxygen	303d listed
Wendt Creek	0	8.27	1248900	Dane	Sediment/Total suspended solids	Degraded habitat	303d listed

Halfway Prairie Creek	0	8	1248800	Dane	Sediment/Total suspended solids	Degraded habitat	303d listed
Vermont Creek	0	3.46	1249200	Dane	Sediment/Total suspended solids	Elevated water temp, degraded habitat	303d listed
Wisconsin River	57.66	90.94	1179900	Crawford, Dane, Grant, Iowa, Richland, Sauk	PCBs	Contaminated fish tissue	303d listed

DRAFT PLAN TO PREVENT UPSTREAM MOVEMENT OF AIS AND PATHOGENS THROUGH THE PRAIRIE DU SAC DAM

In a 2002 provision of its Federal Energy Regulatory Commission (FERC) license, Alliant Energy was directed to provide for upstream fish passage at the Prairie du Sac Dam, designed specifically for four target species: lake sturgeon (*Acipenser fulvescens*), shovelnose sturgeon (*Scaphirhynchus platorynchus*), paddlefish (*Polyodon spathula*), and blue sucker (*Cycleptus elongatus*). As such, an upstream fish passage facility is scheduled to be operational by 2014. In preparation for the fish passage facility, an AIS prevention plan (currently in draft form, with a final draft expected in 2012) for the facility has been developed by WDNR, addressing concerns such as the upstream movement of invasive fish such as Asian carp species, as well as VHS-infected fish.

MEDIA OUTLETS IN THE LOWER WISCONSIN RIVER BASIN

In the event of a rapid response to an AIS infestation, timely distribution of information to the public is critical. The following Lower Wisconsin River basin media outlets would be essential in disseminating information to the public.

Name	Distribution area	Format
Baraboo News Republic	Baraboo	Newspaper
Boscobel Dial	Boscobel	Newspaper
Capital Times	Madison	Newspaper
Crawford County Independent & Kickapoo Scout	Gays Mills	Newspaper
Dodgeville Chronicle	Dodgeville	Newspaper
Epitaph News	Viola	Newspaper
Fennimore Times	Fennimore	Newspaper
Grant County Herald Independent	Lancaster	Newspaper
La Crosse Tribune	La Crosse	Newspaper
Middleton Times Tribune	Middleton	Newspaper
Mount Horeb Mail	Mount Horeb	Newspaper
News Sickle Arrow	Arena, Black Earth, Cross Plains, Mazomanie	Newspaper
Prairie du Chien Courier Press	Prairie du Chien	Newspaper
Progressive	Muscoda	Newspaper
Richland Observer	Richland Center	Newspaper
Sauk Prairie Eagle	Prairie du Sac, Sauk City	Newspaper
Sauk Prairie Star	Sauk City	Newspaper
Spring Green Home News	Spring Green	Newspaper
Tri-County Press	Cuba City	Newspaper
Vernon County Broadcaster	Viroqua	Newspaper
Westby Times	Westby	Newspaper
WDMP-AM	AM Dodgeville	Radio station
WDMP-FM	FM Dodgeville	Radio station
WGLR-FM	FM Platteville	Radio station
WJTY-FM	FM Lancaster	Radio station
WNFM-FM	FM Reedsburg	Radio station
WPRE-AM	AM Prairie Du Chien	Radio station
WQPC-FM	FM Prairie Du Chien	Radio station
WRCO-AM	AM Richland Center	Radio station
WRCO-FM	FM Richland Center	Radio station
WRPQ-AM	AM Baraboo	Radio station
WVRQ-AM	AM Viroqua	Radio station
WVRQ-FM	FM Viroqua	Radio station

SUMMARY OF COMMENTS AT LOWER WISCONSIN RIVER BASIN AIS COMMUNITY MEETINGS

The River Alliance of Wisconsin hosted two public meetings in March 2011 in the Lower Wisconsin River basin, to gather stakeholder input regarding the strategic plan. Listed below are groups in attendance as well as attendee comments and input to the plan.

<u>Muscoda community meeting, 3/10/11 (following Lower Wisconsin State Riverway Board meeting)</u>

Entities represented:

Iowa County Land and Conservation Department, Sauk County Board, U.S. Coast Guard & Auxiliary, Department of Natural Resources, Lower Wisconsin State Riverway Board

Synthesis of comments from participants during presentation:

- I'm concerned about zebra mussels and how they smother native mussels. I've noticed them in the Wisconsin River outside of my house.
- Should a list of contractors who work on river/stream restoration for people to contact about the project. County and state workers should have a list of "approved" contractors.
- You should give short presentations at local fishing or conservation clubs. Recommends Wilderness Fish and Game in Sauk Prairie (next to ACE), Dane County Wilderness League, Ultimate Radio.
- It is important to "hit" the people who fish below the dam and then go fish above the dam (sometimes this move is within an hour). The key places are the boat launches.
- It is important to place pressure on local wardens about what is important to the citizens and the wardens will enforce those laws more.
- People aren't coming to these meetings because they don't see AIS as a problem.
- I recommend using BioGreen Clean instead of chlorine.

Synthesis of comments from participants after presentation:

- The presentations were very interesting. I recommend focusing on school-aged students (high school, middle school, and home school).
- The Grand Ave. School does a good fieldtrip with 1st and 4th graders who would benefit from a water safety class on their fieldtrip day. The students then take the idea of AIS back home to their families.
- River Alliance should get volunteers at the boat landings. Should have family orientated event focus. It is good to focus on the youth, but it is important to make

sure the parents come along.

- For future meetings, need more of a focus on the group at meeting (ex: fishermen or duck hunters). Stronger focus for targeted groups.
- There is an online survey (called Lake Link) for local fisherman. Maybe the River Alliance could get some information from them for where to go on which days for the boater surveys to get a better turnout.*
- The River Alliance has very "attractive" information for the public. It would be good for community events.
- The WDNR Spring Hearings would be a good place to introduce the River Alliance's ideas.
- It would be good to have a 15 minute PowerPoint that people could use in their community to help get the word out there. The program for the coast guard for new trainees includes a discussion on AIS for when they do vessel exams.
- Boy and Girl Scouts and Eagle Scouts look for environmental projects. Marcia can give contacts for them. Would also be good to look into 4H clubs and local schools.

<u>Spring Green community meeting, 3/14/11</u>

Entities represented:

Sauk Prairie River PAL, Crawford County Land Conservation Department, Sauk County Land Conservation Department, Wisconsin Smallmouth Alliance, Wisconsin River Sportsmens Club, Friends of the Lower Wisconsin River, Wisconsin Department of Natural Resources, Dane County Office of Lakes & Watersheds

Synthesis of comments from participants after presentation:

- There's an Advanced Placement Biology Sauk City teacher and an ongoing training on environmental issues. They have 12 hours of volunteer time. Maybe you could work with students through this project.
- It's important to let folks know that the "education" time about NR 40 is finished, and now fines will start to be issued.
- Cabela's and other sports fishing stores are still selling the felt boots. Are manufacturers making rubber boot soles and would sporting good stores be worked with on this?

  It would seem that sporting goods store would be on board with pushing the rubber soled boots, but at this point aren't to my knowledge. Not sure what other manufacturers besides Orvis and Simms are taking the lead on phasing out felt soles due to AIS concerns.

WDNR NR 40 LIST OF PROHIBITED AND RESTRICTED SPECIES

Chapter NR 40

INVASIVE SPECIES IDENTIFICATION, CLASSIFICATION AND CONTROL

NR 40.01 Purpose. The purpose of this chapter is to identify, classify and control invasive species in Wisconsin as part of the department's statewide program required by s. 23.22 (2) (a), Stats.

History: CR 08–074 : cr. Register August 2009 No. 644, eff. 9–1–09.

NR 40.02 Definitions. For purposes of this chapter:

(1) "Algae" means a predominately photosynthetic eukaryotic organism ranging from unicellular to macroscopic forms, lacking true roots, stems, leaves, and embryos.

(2) "Animal" means all vertebrate and invertebrate species, including but not limited to mammals, birds, reptiles, amphibians, fish, mollusks, arthropods, insects, and their eggs, larvae or young, but excluding humans.

(3) "Aquatic animal" means any vertebrate or invertebrate species that lives or grows only in water during any life stage, and includes the eggs, larvae or young of those species.

(3m) "Aquatic invasive species" means any invasive species that dwells in water or wetlands.

(4) "Aquatic plant" means a submergent, emergent, free–floating or floating–leaf plant and includes any part of the plant.

(5) "Attached" means in, on, or physically connected to in any way.

(6) "Boat" means any device capable of being used as a means of transportation on water

(7) "Category" means a grouping of species designated by administrative rule for which there are specific legal requirements or restrictions.

(7g) "Cave" means any naturally occurring void, cavity, recess or system of interconnected passageways beneath the surface of the earth or in a bluff, cliff or ledge, including pits and sink holes, but does not include a rock shelter

(7r) "Commercial cave or mine" means a cave or mine that has more than 1,000 visitors per year and charges a fee.

(8) "Contain" or "containment" means to prevent spread beyond a designated boundary

(9) "Control" has the meaning given it in s. 23.22 (1) (a), Stats. In addition, "control" includes activities to eliminate or reduce the adverse effects of invasive species including decreasing or eradicating their population or limiting their introduction or spread, and includes destroying the aboveground, and when necessary, the belowground portions of a plant in a manner and at the proper time to prevent the development and distribution of viable seeds or other propagules. For plants that reproduce vegetatively, "control" includes the use of methods that contain or reduce the vegetative spread of the plant.

Note: Section 23.22 (1) (a), Stats., states that "control" means to cut, remove, destroy, suppress, or prevent the introduction or spread of.

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(12) "DATCP" means the Wisconsin department of agriculture, trade and consumer protection.

(13) "Department" means the Wisconsin department of natural resources.

(14) "Disposal" means the lawful discharge, deposit, dumping or placing of any invasive species into or on any land or water in a manner that prevents the establishment, introduction or spread of the disposed species.

(15) "Eradicate" means to remove an entire population of an invasive species and all its propagules from an area of infestation.

(16) "Established" means, for algae and cyanobacteria, plants, terrestrial invertebrates and plant disease–causing microorganisms, aquatic invertebrates except crayfish, and terrestrial and aquatic vertebrates except fish, present in an area as a self–sustaining population that is dispersed to the extent that eradication is either infeasible or will take a significant effort over a period of several years.

(17) "Established nonnative fish species and established nonnative crayfish species" means alewife (Alosa pseudoharengus), common carp (Cyprinus carpio), rainbow smelt (Osmerus mordax), round goby (Neogobius melanostomus), ruffe (Gymnocephalus cernuus), sea lamprey (Petromyzon marinus), three–spine stickleback (Gasterosteus aculeatus), tubenose goby (Proterorhinus marmoratus), white perch (Morone americana), and rusty crayfish (Orconectes rusticus).

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(20) "Identified carrier of an invasive species" means any material identified in a department infestation control designation under s. 26.30 (7), Stats., a DATCP quarantine under s. 94.01, Stats., or a United States Department of Agriculture Animal and Plant Health Inspection Service quarantine declaration under 7 USC section 7714 or 7715 as potentially carrying an invasive species.

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(23) "Introduce" means to stock, plant, release or otherwise put an invasive species into the outdoor environment or use an invasive species in this state anywhere except within an indoor facility which is designed to physically contain the organism, including but not limited to a laboratory, greenhouse, growth chamber or fermenter

(24) "Invasive species" has the meaning given it in s. 23.22 (1) (c), Stats. In addition, "invasive species" means nonnative species including hybrids, cultivars, subspecific taxa, and genetically modified variants whose introduction causes or is likely to cause economic or environmental harm or harm to human health, and includes individual specimens, eggs, larvae, seeds, propagules and any other viable life–stages of such species. For fish, "invasive species" includes all nonnative species.

Chapter NR 40

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(24) "Invasive species" has the meaning given it in s. 23.22 (1) (c), Stats. In addition, "invasive species" means nonnative species including hybrids, cultivars, subspecific taxa, and genetically modified variants whose introduction causes or is likely to cause economic or environmental harm or harm to human health, and includes individual specimens, eggs, larvae, seeds, propagules and any other viable life–stages of such species. For fish, "invasive species" includes all nonnative species.

Chapter NR 40

INVASIVE SPECIES IDENTIFICATION, CLASSIFICATION AND CONTROL

NR 40.01 Purpose. The purpose of this chapter is to identify, classify and control invasive species in Wisconsin as part of the department's statewide program required by s. 23.22 (2) (a), Stats.

History: CR 08–074: cr. Register August 2009 No. 644, eff. 9–1–09.

NR 40.02 Definitions. For purposes of this chapter:

(1) "Algae" means a predominately photosynthetic eukaryotic organism ranging from unicellular to macroscopic forms, lacking true roots, stems, leaves, and embryos.

(2) "Animal" means all vertebrate and invertebrate species, including but not limited to mammals, birds, reptiles, amphibians, fish, mollusks, arthropods, insects, and their eggs, larvae or young, but excluding humans.

(3) "Aquatic animal" means any vertebrate or invertebrate species that lives or grows only in water during any life stage, and includes the eggs, larvae or young of those species.

(3m) "Aquatic invasive species" means any invasive species that dwells in water or wetlands.

(4) "Aquatic plant" means a submergent, emergent, free–floating or floating–leaf plant and includes any part of the plant.

(5) "Attached" means in, on, or physically connected to in any way.

(6) "Boat" means any device capable of being used as a means of transportation on water

(7) "Category" means a grouping of species designated by administrative rule for which there are specific legal requirements or restrictions.

(7g) "Cave" means any naturally occurring void, cavity, recess or system of interconnected passageways beneath the surface of the earth or in a bluff, cliff or ledge, including pits and sinkholes, but does not include a rock shelter

(7r) "Commercial cave or mine" means a cave or mine that has more than 1,000 visitors per year and charges a fee.

(8) "Contain" or "containment" means to prevent spread beyond a designated boundary

(9) "Control" has the meaning given it in s. 23.22 (1) (a), Stats. In addition, "control" includes activities to eliminate or reduce the adverse effects of invasive species including decreasing or eradicating their population or limiting their introduction or spread, and includes destroying the aboveground and when necessary, the belowground portions of a plant in a manner and at the proper time to prevent the development and distribution of viable seeds or other propagules. For plants that reproduce vegetatively, "control" includes the use of methods that contain or reduce the vegetative spread of the plant.

Note: Section 23.22 (1) (a), Stats., states that "control" means to cut, remove, destroy, suppress, or prevent the introduction or spread of.

(10) "Cultivate" means, for plants, intentionally maintaining an individual or population of a plant.

(11) "Cyanobacteria" means a predominately photosynthetic prokaryotic organism occurring singly or in colonies.

(12) "DATCP" means the Wisconsin department of agriculture, trade and consumer protection.

(13) "Department" means the Wisconsin department of natural resources.

(14) "Disposal" means the lawful discharge, deposit, dumping or placing of any invasive species into or on any land or water in a manner that prevents the establishment, introduction or spread of the disposed species.

(15) "Eradicate" means to remove an entire population of an invasive species and all its propagules from an area of infestation.

(16) "Established" means, for algae and cyanobacteria, plants, terrestrial invertebrates and plant disease–causing microorganisms, aquatic invertebrates except crayfish, and terrestrial and aquatic vertebrates except fish, present in an area as a self–sustaining population that is dispersed to the extent that eradication is either infeasible or will take a significant effort over a period of several years.

(17) "Established nonnative fish species and established nonnative crayfish species" means alewife (Alosa pseudoharengus), common carp (Cyprinus carpio), rainbow smelt (Osmerus mordax), round goby (Neogobius melanostomus), ruffe (Gymnocephalus cernuus), sea lamprey (Petromyzon marinus), three–spine stickleback (Gasterosteus aculeatus), tubenose goby (Proterorhinus marmoratus), white perch (Morone americana), and rusty crayfish (Orconectes rusticus).

(18) "Feral" means existing in an untamed or wild, unconfined state, having returned to such a state from domestication.

(19) "Genetically modified" refers to an organism whose genome, chromosomal or extrachromosomal, is modified permanently and heritably using recombinant nucleic acid techniques, and includes the progeny of any genetically modified organism.

(20) "Identified carrier of an invasive species" means any material identified in a department infestation control designation under s. 26.30 (7), Stats., a DATCP quarantine under s. 94.01, Stats., or a United States Department of Agriculture Animal and Plant Health Inspection Service quarantine declaration under 7 USC section 7714 or 7715 as potentially carrying an invasive species.

(21) "Import" means to bring into Wisconsin or to arrange for another person to bring into Wisconsin.

(22) "Incidental" means something is done inadvertently when performing an otherwise legal activity

(23) "Introduce" means to stock, plant, release or otherwise put an invasive species into the outdoor environment or use an invasive species in this state anywhere except within an indoor facility which is designed to physically contain the organism, including but not limited to a laboratory, greenhouse, growth chamber or fermenter

(24) "Invasive species" has the meaning given it in s. 23.22 (1) (c), Stats. In addition, "invasive species" means nonnative species including hybrids, cultivars, subspecific taxa, and genetically modified variants whose introduction causes or is likely to cause economic or environmental harm or harm to human health, and includes individual specimens, eggs, larvae, seeds, propagules and any other viable life–stages of such species. For fish, "invasive species" includes all nonnative species.

Chapter NR 40

INVASIVE SPECIES IDENTIFICATION, CLASSIFICATION AND CONTROL

NR 40.01 Purpose. The purpose of this chapter is to identify, classify and control invasive species in Wisconsin as part of the department's statewide program required by s. 23.22 (2) (a), Stats.

History: CR 08–074: cr. Register August 2009 No. 644, eff. 9–1–09.

NR 40.02 Definitions. For purposes of this chapter:

(1) "Algae" means a predominately photosynthetic eukaryotic organism ranging from unicellular to macroscopic forms, lacking true roots, stems, leaves, and embryos.

(2) "Animal" means all vertebrate and invertebrate species, including but not limited to mammals, birds, reptiles, amphibians, fish, mollusks, arthropods, insects, and their eggs, larvae or young, but excluding humans.

(3) "Aquatic animal" means any vertebrate or invertebrate species that lives or grows only in water during any life stage, and includes the eggs, larvae or young of those species.

(3m) "Aquatic invasive species" means any invasive species that dwells in water or wetlands.

(4) "Aquatic plant" means a submergent, emergent, free–floating or floating–leaf plant and includes any part of the plant.

(5) "Attached" means in, on, or physically connected to in any way.

(6) "Boat" means any device capable of being used as a means of transportation on water

(7) "Category" means a grouping of species designated by administrative rule for which there are specific legal requirements or restrictions.

(7g) "Cave" means any naturally occurring void, cavity, recess or system of interconnected passageways beneath the surface of the earth or in a bluff, cliff or ledge, including pits and sink holes, but does not include a rock shelter

(7r) "Commercial cave or mine" means a cave or mine that has more than 1,000 visitors per year and charges a fee.

(8) "Contain" or "containment" means to prevent spread beyond a designated boundary

(9) "Control" has the meaning given it in s. 23.22 (1) (a), Stats. In addition, "control" includes activities to eliminate or reduce the adverse effects of invasive species including decreasing or eradicating their population or limiting their introduction or spread, and includes destroying the aboveground, and when necessary, the belowground portions of a plant in a manner and at the proper time to prevent the development and distribution of viable seeds or other propagules. For plants that reproduce vegetatively, "control" includes the use of methods that contain or reduce the vegetative spread of the plant.

Note: Section 23.22 (1) (a), Stats., states that "control" means to cut, remove, destroy, suppress, or prevent the introduction or spread of.

(10) "Cultivate" means, for plants, intentionally maintaining an individual or population of a plant.

(11) "Cyanobacteria" means a predominately photosynthetic prokaryotic organism occurring singly or in colonies.

(12) "DATCP" means the Wisconsin department of agriculture, trade and consumer protection.

(13) "Department" means the Wisconsin department of natural resources.

(14) "Disposal" means the lawful discharge, deposit, dumping or placing of any invasive species into or on any land or water in a manner that prevents the establishment, introduction or spread of the disposed species.

(15) "Eradicate" means to remove an entire population of an invasive species and all its propagules from an area of infestation.

(16) "Established" means, for algae and cyanobacteria, plants, terrestrial invertebrates and plant disease–causing microorganisms, aquatic invertebrates except crayfish, and terrestrial and aquatic vertebrates except fish, present in an area as a self–sustaining population that is dispersed to the extent that eradication is either infeasible or will take a significant effort over a period of several years.

(17) "Established nonnative fish species and established nonnative crayfish species" means alewife (Alosa pseudoharengus), common carp (Cyprinus carpio), rainbow smelt (Osmerus mordax), round goby (Neogobius melanostomus), ruffe (Gymnocephalus cernuus), sea lamprey (Petromyzon marinus), three–spine stickleback (Gasterosteus aculeatus), tubenose goby (Proterorhinus marmoratus), white perch (Morone americana), and rusty crayfish (Orconectes rusticus).

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(19) "Genetically modified" refers to an organism whose genome, chromosomal or extrachromosomal, is modified permanently and heritably using recombinant nucleic acid techniques, and includes the progeny of any genetically modified organism.

(20) "Identified carrier of an invasive species" means any material identified in a department infestation control designation under s. 26.30 (7), Stats., a DATCP quarantine under s. 94.01, Stats., or a United States Department of Agriculture Animal and Plant Health Inspection Service quarantine declaration under 7 USC section 7714 or 7715 as potentially carrying an invasive species.

(21) "Import" means to bring into Wisconsin or to arrange for another person to bring into Wisconsin.

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(24) "Invasive species" has the meaning given it in s. 23.22 (1) (c), Stats. In addition, "invasive species" means nonnative species including hybrids, cultivars, subspecific taxa, and genetically modified variants whose introduction causes or is likely to cause economic or environmental harm or harm to human health, and includes individual specimens, eggs, larvae, seeds, propagules and any other viable life–stages of such species. For fish, "invasive species" includes all nonnative species.

Chapter NR 40

INVASIVE SPECIES IDENTIFICATION, CLASSIFICATION AND CONTROL

NR 40.01 Purpose. The purpose of this chapter is to identify, classify and control invasive species in Wisconsin as part of the department's statewide program required by s. 23.22 (2) (a), Stats.

History: CR 08–074: cr. Register August 2009 No. 644, eff. 9–1–09.

NR 40.02 Definitions. For purposes of this chapter:

(1) "Algae" means a predominately photosynthetic eukaryotic organism ranging from unicellular to macroscopic forms, lacking true roots, stems, leaves, and embryos.

(2) "Animal" means all vertebrate and invertebrate species, including but not limited to mammals, birds, reptiles, amphibians, fish, mollusks, arthropods, insects, and their eggs, larvae or young, but excluding humans.

(3) "Aquatic animal" means any vertebrate or invertebrate species that lives or grows only in water during any life stage, and includes the eggs, larvae or young of those species.

(3m) "Aquatic invasive species" means any invasive species that dwells in water or wetlands.

(4) "Aquatic plant" means a submergent, emergent, free–floating or floating–leaf plant and includes any part of the plant.

(5) "Attached" means in, on, or physically connected to in any way.

(6) "Boat" means any device capable of being used as a means of transportation on water

(7) "Category" means a grouping of species designated by administrative rule for which there are specific legal requirements or restrictions.

(7g) "Cave" means any naturally occurring void, cavity, recess or system of interconnected passageways beneath the surface of the earth or in a bluff, cliff or ledge, including pits and sink holes, but does not include a rock shelter

(7r) "Commercial cave or mine" means a cave or mine that has more than 1,000 visitors per year and charges a fee.

(8) "Contain" or "containment" means to prevent spread beyond a designated boundary

(9) "Control" has the meaning given it in s. 23.22 (1) (a), Stats. In addition, "control" includes activities to eliminate or reduce the adverse effects of invasive species including decreasing or eradicating their population or limiting their introduction or spread, and includes destroying the aboveground, and when necessary, the belowground portions of a plant in a manner and at the proper time to prevent the development and distribution of viable seeds or other propagules. For plants that reproduce vegetatively, "control" includes the use of methods that contain or reduce the vegetative spread of the plant.

Note: Section 23.22 (1) (a), Stats., states that "control" means to cut, remove, destroy, suppress, or prevent the introduction or spread of.

(10) "Cultivate" means, for plants, intentionally maintaining an individual or population of a plant.

(11) "Cyanobacteria" means a predominately photosynthetic prokaryotic organism occurring singly or in colonies.

(12) "DATCP" means the Wisconsin department of agriculture, trade and consumer protection.

(13) "Department" means the Wisconsin department of natural resources.

(14) "Disposal" means the lawful discharge, deposit, dumping or placing of any invasive species into or on any land or water in a manner that prevents the establishment, introduction or spread of the disposed species.

(15) "Eradicate" means to remove an entire population of an invasive species and all its propagules from an area of infestation.

(16) "Established" means, for algae and cyanobacteria, plants, terrestrial invertebrates and plant disease–causing microorganisms, aquatic invertebrates except crayfish, and terrestrial and aquatic vertebrates except fish, present in an area as a self–sustaining population that is dispersed to the extent that eradication is either infeasible or will take a significant effort over a period of several years.

(17) "Established nonnative fish species and established nonnative crayfish species" means alewife (Alosa pseudoharengus), common carp (Cyprinus carpio), rainbow smelt (Osmerus mordax), round goby (Neogobius melanostomus), ruffe (Gymnocephalus cernuus), sea lamprey (Petromyzon marinus), three–spine stickleback (Gasterosteus aculeatus), tubenose goby (Proterorhinus marmoratus), white perch (Morone americana), and rusty crayfish (Orconectes rusticus).

(18) "Feral" means existing in an untamed or wild, unconfined state, having returned to such a state from domestication.

(19) "Genetically modified" refers to an organism whose genome, chromosomal or extrachromosomal, is modified permanently and heritably using recombinant nucleic acid techniques, and includes the progeny of any genetically modified organism.

(20) "Identified carrier of an invasive species" means any material identified in a department infestation control designation under s. 26.30 (7), Stats., a DATCP quarantine under s. 94.01, Stats., or a United States Department of Agriculture Animal and Plant Health Inspection Service quarantine declaration under 7 USC section 7714 or 7715 as potentially carrying an invasive species.

(21) "Import" means to bring into Wisconsin or to arrange for another person to bring into Wisconsin.

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Chapter NR 40

INVASIVE SPECIES IDENTIFICATION, CLASSIFICATION AND CONTROL

NR 40.01 Purpose. The purpose of this chapter is to identify, classify and control invasive species in Wisconsin as part of the department's statewide program required by s. 23.22 (2) (a), Stats.

History: CR 08–074: cr. Register August 2009 No. 644, eff. 9–1–09.

NR 40.02 Definitions. For purposes of this chapter:

(1) "Algae" means a predominately photosynthetic eukaryotic organism ranging from unicellular to macroscopic forms, lacking true roots, stems, leaves, and embryos.

(2) "Animal" means all vertebrate and invertebrate species, including but not limited to mammals, birds, reptiles, amphibians, fish, mollusks, arthropods, insects, and their eggs, larvae or young, but excluding humans.

(3) "Aquatic animal" means any vertebrate or invertebrate species that lives or grows only in water during any life stage, and includes the eggs, larvae or young of those species.

(3m) "Aquatic invasive species" means any invasive species that dwells in water or wetlands.

(4) "Aquatic plant" means a submergent, emergent, free–floating or floating–leaf plant and includes any part of the plant.

(5) "Attached" means in, on, or physically connected to in any way.

(6) "Boat" means any device capable of being used as a means of transportation on water.

(7) "Category" means a grouping of species designated by administrative rule for which there are specific legal requirements or restrictions.

(7g) "Cave" means any naturally occurring void, cavity, recess or system of interconnected passageways beneath the surface of the earth or in a bluff, cliff or ledge, including pits and sinkholes, but does not include a rock shelter.

(7r) "Commercial cave or mine" means a cave or mine that has more than 1,000 visitors per year and charges a fee.

(8) "Contain" or "containment" means to prevent spread beyond a designated boundary.

(9) "Control" has the meaning given it in s. 23.22 (1) (a), Stats. In addition, "control" includes activities to eliminate or reduce the adverse effects of invasive species including decreasing or eradicating their population or limiting their introduction or spread, and includes destroying the aboveground, and when necessary, the belowground portions of a plant in a manner and at the proper time to prevent the development and distribution of viable seeds or other propagules. For plants that reproduce vegetatively, "control" includes the use of methods that contain or reduce the vegetative spread of the plant.

Note: Section 23.22 (1) (a), Stats., states that "control" means to cut, remove, destroy, suppress, or prevent the introduction or spread of.

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(15) "Eradicate" means to remove an entire population of an invasive species and all its propagules from an area of infestation.

(16) "Established" means, for algae and cyanobacteria, plants, terrestrial invertebrates and plant disease–causing microorganisms, aquatic invertebrates except crayfish, and terrestrial and aquatic vertebrates except fish, present in an area as a self–sustaining population that is dispersed to the extent that eradication is either infeasible or will take a significant effort over a period of several years.

(17) "Established nonnative fish species and established nonnative crayfish species" means alewife (Alosa pseudoharengus), common carp (Cyprinus carpio), rainbow smelt (Osmerus mordax), round goby (Neogobius melanostomus), ruffe (Gymnocephalus cernuus), sea lamprey (Petromyzon marinus), three–spine stickleback (Gasterosteus aculeatus), tubenose goby (Proterorhinus marmoratus), white perch (Morone americana), and rusty crayfish (Orconectes rusticus).

(18) "Feral" means existing in an untamed or wild, unconfined state, having returned to such a state from domestication.

(19) "Genetically modified" refers to an organism whose genome, chromosomal or extrachromosomal, is modified permanently and heritably using recombinant nucleic acid techniques, and includes the progeny of any genetically modified organism.

(20) "Identified carrier of an invasive species" means any material identified in a department infestation control designation under s. 26.30 (7), Stats., a DATCP quarantine under s. 94.01, Stats., or a United States Department of Agriculture Animal and Plant Health Inspection Service quarantine declaration under 7 USC section 7714 or 7715 as potentially carrying an invasive species.

(21) "Import" means to bring into Wisconsin or to arrange for another person to bring into Wisconsin.

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Chapter NR 40

INVASIVE SPECIES IDENTIFICATION, CLASSIFICATION AND CONTROL

NR 40.01 Purpose. The purpose of this chapter is to identify, classify and control invasive species in Wisconsin as part of the department's statewide program required by s. 23.22 (2) (a), Stats.

History: CR 08–074 : cr. Register August 2009 No. 644, eff. 9–1–09.

NR 40.02 Definitions. For purposes of this chapter:

(1) "Algae" means a predominately photosynthetic eukaryotic organism ranging from unicellular to macroscopic forms, lacking true roots, stems, leaves, and embryos.

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(4) "Aquatic plant" means a submergent, emergent, free–floating or floating–leaf plant and includes any part of the plant.

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(7) "Category" means a grouping of species designated by administrative rule for which there are specific legal requirements or restrictions.

(7g) "Cave" means any naturally occurring void, cavity, recess or system of interconnected passageways beneath the surface of the earth or in a bluff, cliff or ledge, including pits and sink holes, but does not include a rock shelter

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Chapter NR 40

INVASIVE SPECIES IDENTIFICATION, CLASSIFICATION AND CONTROL

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(4) "Aquatic plant" means a submergent, emergent, free–floating or floating–leaf plant and includes any part of the plant.

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(12) "DATCP" means the Wisconsin department of agriculture, trade and consumer protection.

(13) "Department" means the Wisconsin department of natural resources.

(14) "Disposal" means the lawful discharge, deposit, dumping or placing of any invasive species into or on any land or water in a manner that prevents the establishment, introduction or spread of the disposed species.

(15) "Eradicate" means to remove an entire population of an invasive species and all its propagules from an area of infestation.

(16) "Established" means, for algae and cyanobacteria, plants, terrestrial invertebrates and plant disease–causing microorganisms, aquatic invertebrates except crayfish, and terrestrial and aquatic vertebrates except fish, present in an area as a self–sustaining population that is dispersed to the extent that eradication is either infeasible or will take a significant effort over a period of several years.

(17) "Established nonnative fish species and established nonnative crayfish species" means alewife (Alosa pseudoharengus), common carp (Cyprinus carpio), rainbow smelt (Osmerus mordax), round goby (Neogobius melanostomus), ruffe (Gymnocephalus cernuus), sea lamprey (Petromyzon marinus), three–spine stickleback (Gasterosteus aculeatus), tubenose goby (Proterorhinus marmoratus), white perch (Morone americana), and rusty crayfish (Orconectes rusticus).

(18) "Feral" means existing in an untamed or wild, unconfined state, having returned to such a state from domestication.

(19) "Genetically modified" refers to an organism whose genome, chromosomal or extrachromosomal, is modified permanently and heritably using recombinant nucleic acid techniques, and includes the progeny of any genetically modified organism.

(20) "Identified carrier of an invasive species" means any material identified in a department infestation control designation under s. 26.30 (7), Stats., a DATCP quarantine under s. 94.01, Stats., or a United States Department of Agriculture Animal and Plant Health Inspection Service quarantine declaration under 7 USC section 7714 or 7715 as potentially carrying an invasive species.

(21) "Import" means to bring into Wisconsin or to arrange for another person to bring into Wisconsin.

(22) "Incidental" means something is done inadvertently when performing an otherwise legal activity

(23) "Introduce" means to stock, plant, release or otherwise put an invasive species into the outdoor environment or use an invasive species in this state anywhere except within an indoor facility which is designed to physically contain the organism, including but not limited to a laboratory, greenhouse, growth chamber or fermenter

(24) "Invasive species" has the meaning given it in s. 23.22 (1) (c), Stats. In addition, "invasive species" means nonnative species including hybrids, cultivars, subspecific taxa, and genetically modified variants whose introduction causes or is likely to cause economic or environmental harm or harm to human health, and includes individual specimens, eggs, larvae, seeds, propagules and any other viable life–stages of such species. For fish, "invasive species" includes all nonnative species.

Chapter NR 40

INVASIVE SPECIES IDENTIFICATION, CLASSIFICATION AND CONTROL

NR 40.01 Purpose. The purpose of this chapter is to identify, classify and control invasive species in Wisconsin as part of the department's statewide program required by s. 23.22 (2) (a), Stats.

History: CR 08–074: cr. Register August 2009 No. 644, eff. 9–1–09.

NR 40.02 Definitions. For purposes of this chapter:

(1) "Algae" means a predominately photosynthetic eukaryotic organism ranging from unicellular to macroscopic forms, lacking true roots, stems, leaves, and embryos.

(2) "Animal" means all vertebrate and invertebrate species, including but not limited to mammals, birds, reptiles, amphibians, fish, mollusks, arthropods, insects, and their eggs, larvae or young, but excluding humans.

(3) "Aquatic animal" means any vertebrate or invertebrate species that lives or grows only in water during any life stage, and includes the eggs, larvae or young of those species.

(3m) "Aquatic invasive species" means any invasive species that dwells in water or wetlands.

(4) "Aquatic plant" means a submergent, emergent, free–floating or floating–leaf plant and includes any part of the plant.

(5) "Attached" means in, on, or physically connected to in any way.

(6) "Boat" means any device capable of being used as a means of transportation on water

(7) "Category" means a grouping of species designated by administrative rule for which there are specific legal requirements or restrictions.

(7g) "Cave" means any naturally occurring void, cavity, recess or system of interconnected passageways beneath the surface of the earth or in a bluff, cliff or ledge, including pits and sink holes, but does not include a rock shelter

(7r) "Commercial cave or mine" means a cave or mine that has more than 1,000 visitors per year and charges a fee.

(8) "Contain" or "containment" means to prevent spread beyond a designated boundary

(9) "Control" has the meaning given it in s. 23.22 (1) (a), Stats. In addition, "control" includes activities to eliminate or reduce the adverse effects of invasive species including decreasing or eradicating their population or limiting their introduction or spread, and includes destroying the aboveground, and when necessary, the belowground portions of a plant in a manner and at the proper time to prevent the development and distribution of viable seeds or other propagules. For plants that reproduce vegetatively, "control" includes the use of methods that contain or reduce the vegetative spread of the plant.

Note: Section 23.22 (1) (a), Stats., states that "control" means to cut, remove, destroy, suppress, or prevent the introduction or spread of.

(10) "Cultivate" means, for plants, intentionally maintaining an individual or population of a plant.

(11) "Cyanobacteria" means a predominately photosynthetic prokaryotic organism occurring singly or in colonies.

(12) "DATCP" means the Wisconsin department of agriculture, trade and consumer protection.

(13) "Department" means the Wisconsin department of natural resources.

(14) "Disposal" means the lawful discharge, deposit, dumping or placing of any invasive species into or on any land or water in a manner that prevents the establishment, introduction or spread of the disposed species.

(15) "Eradicate" means to remove an entire population of an invasive species and all its propagules from an area of infestation.

(16) "Established" means, for algae and cyanobacteria, plants, terrestrial invertebrates and plant disease–causing microorganisms, aquatic invertebrates except crayfish, and terrestrial and aquatic vertebrates except fish, present in an area as a self–sustaining population that is dispersed to the extent that eradication is either infeasible or will take a significant effort over a period of several years.

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RELEVANT LOWER WISCONSIN RIVER BASIN PLANS AND REPORTS

i. *Lower Wisconsin State of the Basin Report* (2002). Wisconsin DNR, in cooperation with the Lower Wisconsin River Basin Partnership Team and stakeholders. http://dnr.wi.gov/water/basin/lowerwis/lwis_final_7_2_02.pdf

ii. *Wisconsin's Comprehensive Management Plan To Prevent Further Introductions and Control Existing Populations of Aquatic Invasive Species* (2003). Wisconsin DNR, in cooperation with University of Wisconsin – Sea Grant and Great Lakes Indian Fish and Wildlife Commission. http://www.anstaskforce.gov/State%20Plans/Wisconsin_ans_plan.pdf

iii. *Lower Wisconsin State Riverway Board Strategic Plan* (updated 2006). Lower Wisconsin State Riverway Board. http://lwr.state.wi.us/docview.asp?docid=6052&locid=50

iv. *Aquatic Invasive Species Research Priorities for the Great Lakes* (2009). Great Lakes Panel on Aquatic Nuisance Species. http:/www.glc.org/ans/pdf/2010-01-04-GLP%20RCC%20Priorities_for%20distribution.pdf

v. *Dane County Aquatic Invasive Species Prevention and Control Plan* (2009). Dane County Office of Lakes and Watersheds, in cooperation with major Dane County stakeholder groups. http://danedocs.countyofdane.com/webdocs/pdf/lwrd/lakes/AIS_Plan_Final.pdf

vi. *Biotic Inventory and Analysis of the Lower Wisconsin State Riverway* (2011). Natural Heritage Inventory Program, Bureau of Endangered Resources, Wisconsin DNR. http://dnr.wi.gov/org/land/er/nhi/projects/pdfs/LWSR_Biotic_Inventory_Report_ext.pdf

vii. *Survey of Lower Wisconsin River Floodplain Lakes Fisheries* (2009). Marshall, Dave. Sauk Prairie River PAL. http://www.spriverpal.org/archives/programs/slough-survey/floodplain-fisheries-rpt.pdf

viii. *Surveys of Crawford County Floodplain Lakes* (2009). Marshall, Dave. Crawford County Land Conservation Department. http://crawfordcountywi.org/landconservation/downloads/Notices/Surveys%20o%20fCrawford%20County%20Floodplain%20Lakes.pdf

ix. *Surveys of Grant County Floodplain Lakes* (2010). Marshall, Dave. River Alliance of Wisconsin. http://prodoasjava.dnr.wi.gov/swims/downloadDocument.do?id=51655808

x. *Surveys of Lower Wisconsin River Floodplain Lakes of Dane County* (2010). Marshall, Dave. Dane County Department of Land and Water Resources.

xi. *Surveys of Richland County Floodplain Lakes* (2010). Marshall, Dave. Richland County Land Conservation Department.

xii. *Surveys of River Floodplain Habitats for Fish Species with Inventory Needs, SGCN and Associated Off-channel Fish Populations* (2011). Wisconsin Department of Natural Resources.

xiii. *A Creel Survey of the Lower Wisconsin River, 1990-1991* (1994). Wisconsin DNR Research Report 160. Paul W. Rasmussen, Jean M. L. Unmuth, John Lyons, Gene Van Dyck. http://digicoll.library.wisc.edu/cgi-bin/EcoNatRes/EcoNatRes-idx?type=turn&entity=EcoNatRes.DNRRep160.p0001&id=EcoNatRes.DNRRep160&isize=M

RELEVANT REGIONAL AND NATIONAL AIS INSTITUTIONS

Aquatic Nuisance Species Task Force: an interagency group with both Federal and ex-officio members that seeks to prevent the introduction and spread of ANS. The Service acts as the administrative staff for and works closely with the ANSTF.

Great Lakes Panel on Aquatic Nuisance Species: Regional panel of the Aquatic Nuisance Species Task Force. Mississippi River Basin Panel on Aquatic Nuisance Species: Regional panel of the Aquatic Nuisance Species Task Force.

Great Lakes-Mississippi River Interbasin Study: www.glmris.anl.gov

FUNDING, REFERENCES AND TOOLS FOR AIS RAPID RESPONSE

Army Corps of Engineers' Aquatic Plant Research Program: The Aquatic Plant Control Research Program (APCRP) is the Nation's only federally authorized research program directed to develop technology for the management of non-indigenous aquatic plant species. The program provides effective, economical, and environmentally compatible methods for assessing and managing problem aquatic plants.

Outline for a Model Rapid Response Plan for Aquatic Invasive Species in the Mississippi River Basin: MRBP Executive Committee submitted a funding proposal to NOAA for the development of a model Rapid Response Plan for AIS in the Mississippi River Basin. The proposal has been funded by NOAA. The document is intended to be a brief readable document with detailed actions provided in appendices. The plan will eventually have an appendix for fish, plants, and invertebrates, but the panel is only obligated to develop the body of the plan and the fish appendix by the end of the project period in June 2010.

Overview of EPA Authorities for Natural Resource Managers Developing Aquatic Invasive Species Rapid Response and Management Plans: Resource for decision makers considering the development of Rapid Response and Mgmt plans. Document outlines anticipated necessary federal permits for carrying out Rapid Response plans, per Clean Water Act Sections 402 and 404, and Federal Insecticide, Fungicide, and Rodent Act (FIFRA) Sections 18 and 24.

Office of Technology Assessment. U.S. Congress (OTA). 1993. Harmful NonIndigenous Species in the United States. OTA Publication OTA-F-565. US Government Printing Office, Washington DC: Availability: http://www.wws.princeton.edu:80/~ota/disk1/1993/9325_n.html