Invasive Species Program 2014

by

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EXECUTIVE SUMMARY

The Great Lakes Indian Fish and Wildlife Commission (GLIFWC) is an organization exercising delegated authority from 11 federally recognized Ojibwe tribes in Minnesota, Wisconsin, and Michigan (Figure 1). These tribes retain hunting, fishing, and gathering rights in the territories ceded to the United States through various treaties. The degradation of native ecosystems by invasive species poses a serious threat to the continued exercise of these rights and the traditional lifeways they sustain.

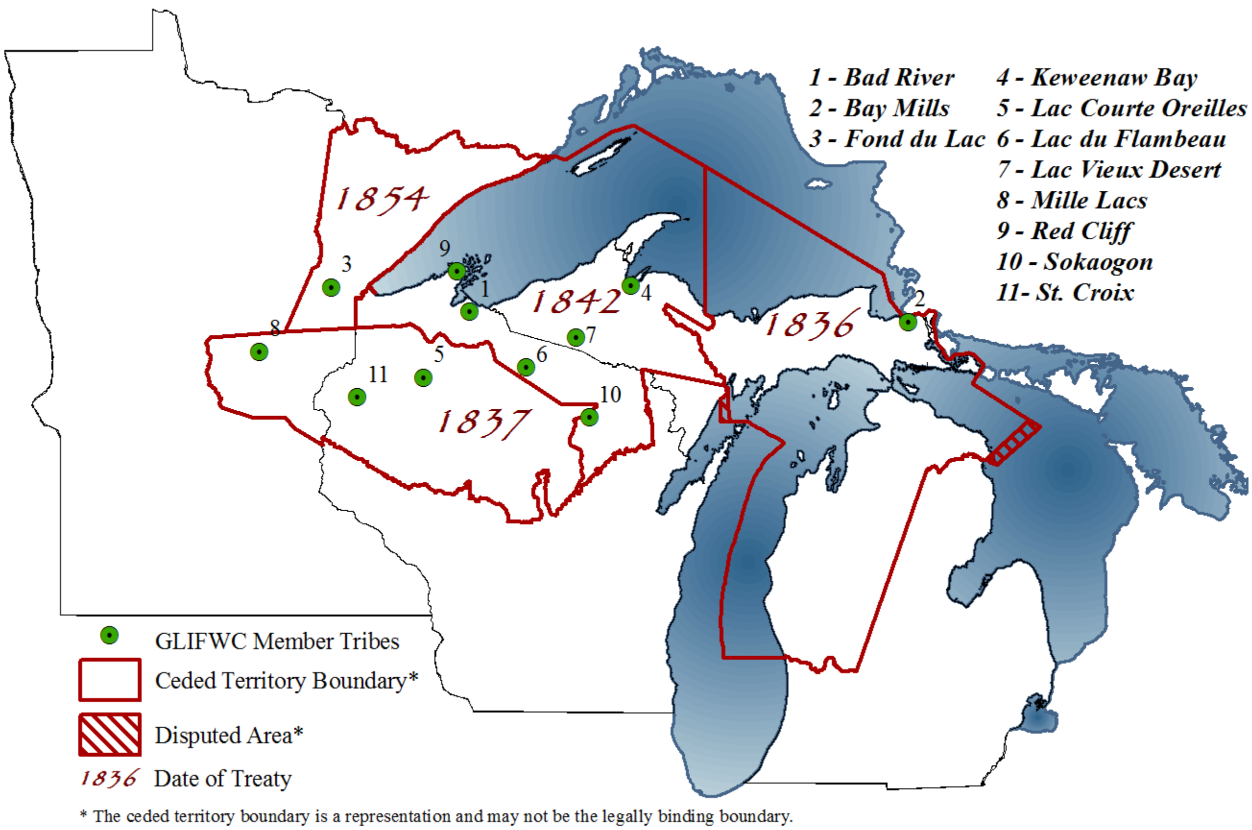

Figure 1. Location of GLIFWC member tribes and ceded territories.

This report summarizes the activities undertaken by GLIFWC staff during 2014 to address the spread of invasive species in the ceded territories. GLIFWC's invasive species program consists of 1) prevention, 2) early detection rapid response, 3) control and management, 4) research, and 5) coordination of these activities with cooperating tribes, government agencies and groups to maximize the efficient use of limited resources.

ACKNOWLEDGMENTS

The Great Lakes Indian Fish and Wildlife Commission acknowledges the following for their financial support of GLIFWC's invasive species program. The BIA continues to provide the foundation for developing new partnerships and leveraging additional resources for invasive species management (Figure 2). The activities summarized in this report were funded by:

- Bureau of Indian Affairs (BIA)
  - GLIFWC's base funding
  - Noxious Weed Program
  - Great Lakes Restoration Initiative (GLRI) Tribal AIS

- U.S. Fish and Wildlife Service (USFWS)
  - Great Lakes Restoration Initiative (GLRI) Tribal AIS
  - Wisconsin State ANS Plan
  - St. Croix Interstate ANS Plan

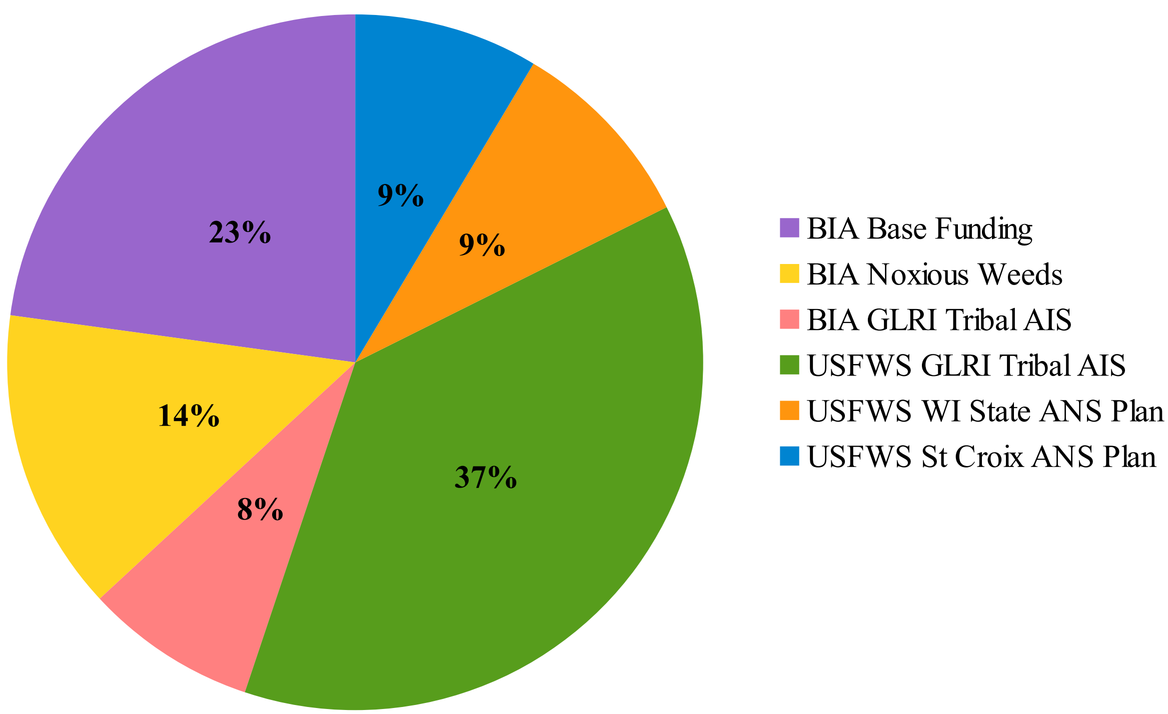

Figure 2. Funding sources for GLIFWC's Invasive Species Program in 2014.

PREVENTION

Introduction

The most effective approach to combat the spread of invasive species is to prevent their initial establishment. Because the vast majority of invasive species introductions can be attributed to human activities, effective prevention efforts depend on an informed public. A variety of education, outreach, and training materials are needed to alert a diverse public to the threats posed by invasive species and the actions required to prevent their spread.

Program Overview

A suite of educational materials have been compiled and/or developed to reach a broad range of audiences. These materials include ID cards, brochures, stickers, presentations, and videos. GLIFWC distributes educational material with the help of cooperating state and federal agencies throughout the ceded territories. Additional outreach is provided via GLIFWC's invasive species web site (glifwc.org/invasives) and quarterly newsletter - *Mazina'igan*.

Accomplishments

Mazina'igan Articles
GLIFWC's newsletter features articles on invasive species. Topics covered in 2014 included:

- "GLIFWC project assesses risk of invasive plants to native plants" by Miles Falck
  - Spring/Summer 2014 (glifwc.org/publications/mazinaigan/Summer2014)
- "Leafy spurge & phragmites targeted by GLIFWC" by Miles Falck
  - Fall 2014 (glifwc.org/publications/mazinaigan/Fall2014)
- "New zebra mussel biopesticide to be tested in Keyes Lake" by Sara Moses
  - Fall 2014 (glifwc.org/publications/mazinaigan/Fall2014)

Events, Presentations and Other Outreach Activities
Activities in 2014 included:

- Presented information at GLIFWC's creel clerk meeting on AIS and prevention measures tribal members can take during spring harvest.
  - 1,500 pocket size cards were printed and handed out with permits during spring spearing & netting season to educate tribal harvesters on steps to prevent the spread of AIS including how to clean equipment and specific tribal AIS regulations.
  - Fish measuring stickers with AIS prevention and tribal regulation information were handed out at tribal registration stations and GLIFWC events including educational displays at pow wows, fairs and tribal youth events.
- Presented "Early detection and rapid response to *Phragmites australis* in Bayfield County, Wisconsin" at the Upper Midwest Invasive Species Conference, October 21, 2014, Duluth, MN.

- Organized the 6th annual GLIFWC staff invasive species field day pulling garlic mustard along the Bad River (May 20, 2014). Staff assisted with a youth invasive species event hand pulling garlic mustard along the Montreal River (June 3, 2014).

invasives.glifwc.org

GLIFWC's invasive species web site features species abstracts for many of the regions' invasive plants, photos that can be downloaded for educational purposes, GLIFWC reports, and links to interactive maps and other Internet resources on invasive species. In 2014, species distribution models were completed and a new web application (invasives.glifwc.org/models) was created to view and download the distribution models.

EARLY DETECTION RAPID RESPONSE (EDRR)

Eradicating or containing invasive species is more feasible and cost effective when populations are at a pioneer stage of infestation. GLIFWC staff have conducted annual invasive species surveys since 1995 and have documented over 10,000 occurrences for several hundred species of invasive organisms throughout the ceded territories. This information provides a baseline to determine if newly detected occurrences are early detections, and whether rapid response efforts are warranted. Early detections by GLIFWC staff have led to successful rapid response control efforts for curly-leaf pondweed, Eurasian water-milfoil, garlic mustard, knotweed, phragmites, purple loosestrife, and teasel.

AQUATIC INVASIVE SPECIES

Introduction

Since the early 1800s, at least 183 species of fish, plants, invertebrates, algae and pathogens have been introduced into riparian and aquatic habitats of the Great Lakes (GLERL 2006). Many of these organisms have since invaded inland lakes and rivers in the ceded territory, and others are poised to do so. The most destructive of these invasives have caused major environmental and economic impacts (Pimentel *et al.* 2005).

GLIFWC staff surveyed select ceded territory waters in 2014 to 1) assess and document the scope of the problem, 2) detect small populations of the most ecologically destructive invasive species before they become large, environmentally damaging populations, and 3) prioritize education and management efforts.

Methods

In 2014, GLIFWC staff surveyed 23 waterbodies in northern Wisconsin and Michigan. Twenty-one lakes were surveyed for aquatic invasive species (AIS) and two lakes were surveyed for water fleas in response to reports from shoreline property owners and fishermen (Figure 3, Table 1). Lakes surveyed for AIS were chosen in coordination with management partners including tribal, state, county and other local partners. These surveys targeted lakes important to the tribes for *ogaa* (walleye) and *manoomin* (wild rice) harvest, as well as high-risk lakes with high visitation rates or lakes in close proximity to infested waters.

Lakes surveyed for AIS were visited once during the season and were surveyed for all invasive plants and animals. Qualitative surveys for invasive species were conducted on each lake by observing the littoral zone from the water's surface. The survey was conducted by slowly driving a boat back and forth between the shoreline and the outer edge of the littoral zone. Surveys focused on submergent, emergent and shoreline plants. These areas were also inspected for invasive animals or evidence of their presence. Surveys strived to cover as much of the shoreline (including island shorelines) as possible.

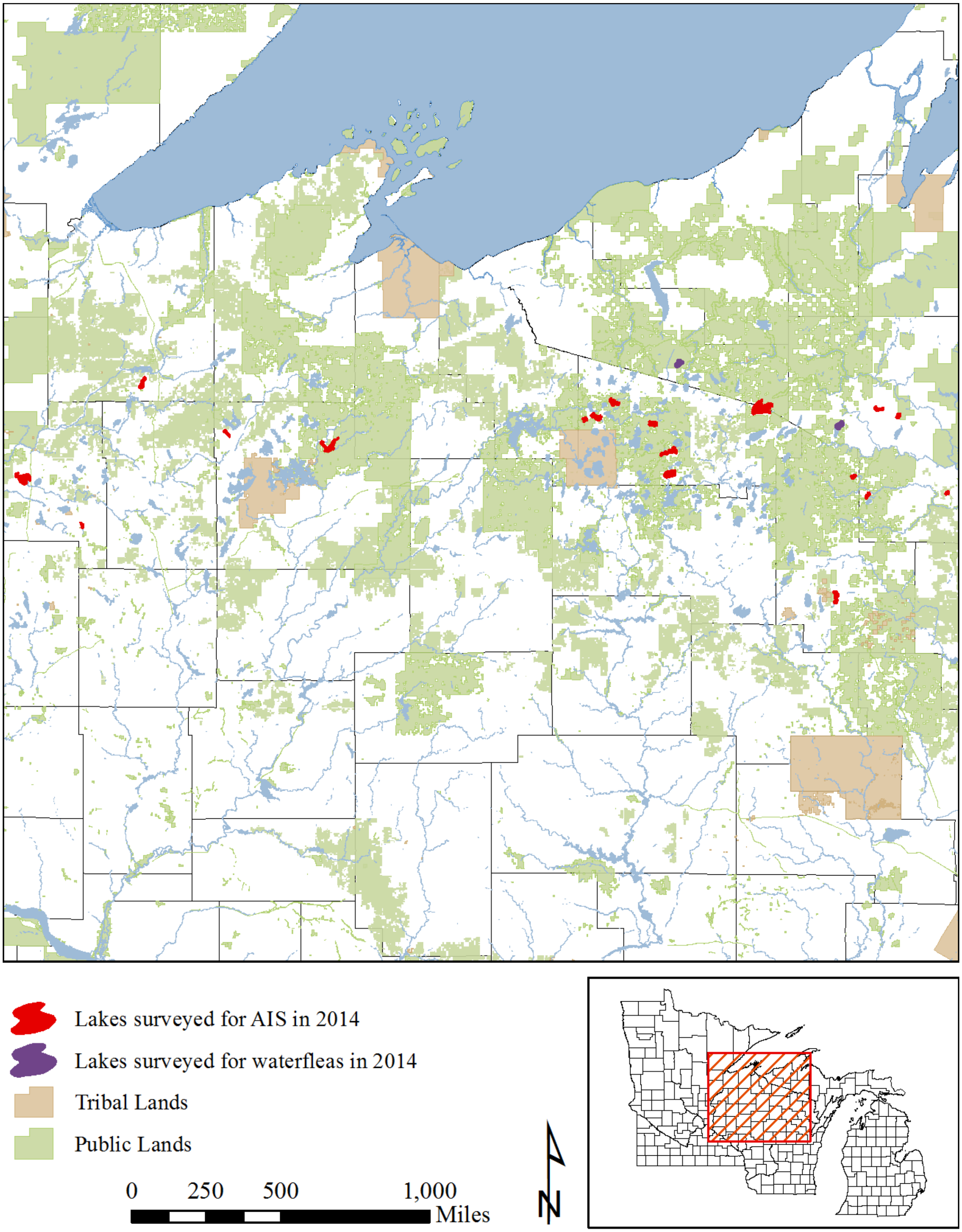

Figure 3. Lakes surveyed in 2014 for aquatic invasive species detection and management.

Table 1. Lakes surveyed for aquatic invasive species in 2014.

State	County	Waterbody	WBIC	Acres	Target Taxa	Dates Surveyed	# Samples Collected	
							Veliger	Water Flea
MI	Gogebic	Langford Lake	27-696	481	Water fleas	8/11	0	3
	Iron	Lake Emily	36-363	320	All AIS taxa	8/13	3	2
		Lake Ottawa	36-417	551	Water fleas	8/12	0	4
		Sunset Lake[a]	36-355	545	All AIS taxa	8/12	0	3
MI, WI	Vilas, Gogebic	Lac Vieux Desert[b]	1631900	4300	Eurasian water-milfoil; curly pondweed	6/16-19, 8/25	0	0
WI	Burnett	Bashaw Lake	2662400	171	All AIS taxa	6/26	1	1
		Little Yellow Lake	2674800	348	All AIS taxa	6/24-25	1	1
		Yellow Lake	2675200	2287	All AIS taxa	6/23-25	3	3
	Douglas	Bardon Lake[a]	2694000	832	All AIS taxa	7/2	0	3
	Florence	Emily Lake	651600	191	All AIS taxa	8/19-20	3	3
		Fay Lake	677100	247	All AIS taxa	8/18 & 8/21	3	3
	Forest	Riley Lake	557100	213	All AIS taxa	7/7	1	1
		Stevens Lake	683000	297	All AIS taxa	8/20	3	3
		Wabikon	556900	594	All AIS taxa	7/7-8	0	0
	Sawyer	Moose Lake[a]	2420600	1670	All AIS taxa	7/15	0	1
		Smith Lake	2726100	323	All AIS taxa	7/1-2	2	2
	Vilas	Big Lake	2334700	835	All AIS taxa	8/6	3	3
		Big Saint Germain Lake[a]	1591100	1617	All AIS taxa	7/16	0	3
		Dead Pike Lake[a]	2316600	297	All AIS taxa	8/6-7	0	3
		Little Star Lake[a]	2334300	244	All AIS taxa	8/6	0	3
		Manitowish Lake[a]	2329400	506	All AIS taxa	7/31, 8/5-6	0	3
		Plum Lake[a]	1592400	1033	All AIS taxa	7/30	0	4
		White Sand Lake[a]	2339100	734	All AIS taxa	7/28	0	3
Total							23	55

[a] Lakes considered not suitable to sustain a zebra mussel population, according to UW-Madison, Center for Limnology.

[b] Survey was designed to evaluate & guide Eurasian water-milfoil control efforts & monitor rate of curly pondweed spread.

Boat landings were the highest priority area for AIS surveys. All public and some private boat landings were surveyed. Shorelines, shallow water areas, pier supports, floating fragments, rocks and beach debris in the vicinity of the landings were inspected for invasive plants and animals. Rake tosses and D-net pulls were conducted at the main boat landing for five minutes. The material retrieved by each throw and pull was placed in a bin and inspected for invasive plants and animals.

The most ecologically destructive aquatic invasive species with limited abundance and distribution in the ceded territories were classified as “priority species” (Table 2). Discrete patches of vegetation and locations where invertebrates were detected were considered “sites”. Species with low abundance where rapid response control efforts were deemed feasible were classified as “pioneer” populations and were recorded at each site they were detected within a waterbody. Aquatic invasive species that can not be easily quantified such as invertebrates or crustaceans, species that were abundant and widespread within the waterbody, and terrestrial invasive plants were classified as “present” and only their initial occurrence within a waterbody was mapped.

If a “priority” invasive plant species was found on a lake where it was previously unrecorded, a specimen was collected and notes on habitat and location were taken. Specimens were also collected for species of special concern. Collections were sent to the Robert W. Freckmann Herbarium at the University of Wisconsin – Stevens Point. New observations of invasive snail species were collected and sent to UW-LaCrosse. Observations of *manoomin* and native populations of phragmites (*Phragmites australis* ssp. *americanus*) were also documented. Native phragmites location data were added to GLIFWC's database and shared with management partners.

Locations were mapped using a hand held GPS receiver. Attribute data for each site were entered directly into a GIS file format using ESRI's ArcPad software. ArcPad provided an integrated environment to display the current GPS location overlain on GIS layers including lakes and local roads.

Plankton nets were used to sample for zebra and quagga mussel veligers, spiny water fleas and fishhook water fleas. Vertical plankton tows were used to sample for zebra and quagga mussel veligers following Wisconsin DNR protocol (WDNR 2010). Veliger tows were only conducted on lakes that were suitable or borderline suitable to sustain a zebra or quagga mussel population. Lakes that do not have high enough calcium concentrations to sustain a zebra mussel population were not sampled for veligers. Lake suitability information was obtained from the University of Wisconsin Center for Limnology (see aissmartprevention.wisc.edu). Specific conductance was measured in the deepest basin of each lake at a depth of one meter using a YSI Model 30 meter to determine the current suitability of each lake. Lakes with a specific conductance reading of equal to or greater than 99uS are considered borderline or suitable and were sampled.

Horizontal plankton tows were used to sample for spiny and fishhook water fleas following the protocol of Johnson (2004). At each sampling point, the plankton net was towed through the water for 120 seconds at low speed. The water column was sampled by allowing the net to sink as close to the bottom as possible and then slowly pulling it back up.

For larger lakes, three veliger and water flea samples were taken for each lake. On smaller or shallow lakes, only one or two samples were taken. Where feasible, at least one sample was collected near the main boat landing. The remaining samples were collected from high visitation areas or other bays or basins. Immediately after collection, veliger and water flea samples were

Table 2. "Priority" species surveyed for in 2014.

Scientific Name	Common Name
Invertebrates	
Bithynia tentaculata	Faucet snail
Bythotrephes longimanus	Spiny water flea
Cercopagis pengoi	Fishhook water flea
Dreissena bugensis	Quagga mussel
Dreissena polymorpha	Zebra mussel
Potamopyrgus antipodarum	New Zealand mudsnail
Procambarus clarkii	Red swamp crayfish
Plants	
Butomus umbellatus	Flowering rush
Cabomba caroliniana	Fanwort
Callitriche stagnalis	Pond water-starwort
Crassula helmsii	Australian swamp stonecrop
Egeria densa	Brazillian waterweed
Eichhornia crassipes	Water hyacinth
Heracleum mantegazzianum	Giant hogweed
Hydrilla verticillata	Hydrilla
Hydrocharis morsus-ranae	European frog-bit
Myriophyllum aquaticum	Parrot feather
Myriophyllum spicatum	Eurasian water-milfoil
Najas minor	Slender-leaved naiad
Nymphoides pelata	Yellow floating heart
Phragmites australis ssp. *australis*	Common reed (Eurasian)
Pistia stratiotes	Water lettuce
Polygonum cuspidatum, P.sachalinense	Japanese and giant knotweed
Potamogeton crispus	Curly pondweed
Trapa natans	Water chestnut

condensed, transferred to sample bottles, labeled and preserved with 190 proof ethyl alcohol, at a ratio of four parts alcohol to one part plankton sample.

Veliger samples were sent to the WDNR Services Operations in Madison, Wisconsin for analysis. Water flea samples were examined by GLIFWC staff. Water flea samples were analyzed by taking five-10mL sub-samples of each sample collected in the field. Sub-samples were examined under a dissecting microscope for presence or absence of water fleas. The remainder of the sample was poured into a flat tray and visually inspected for water fleas. Water flea samples were also screened for the presence of bloody red shrimp, *Hemimysis anomala*, and another invasive water flea, *Daphnia lumholtzi*. All equipment was cleaned between lake samples.

The boat, trailer, and equipment were thoroughly disinfected after each survey was completed. Plant fragments and other debris were removed by hand or brush at the landing and the drain plug was removed in an area where the water would not run into the lake.

After leaving the lake, the washing location was chosen to ensure that the disinfection solution and rinse water would not run into storm water drains or other areas that might contaminate surface waters. The boat, trailer and all equipment that came into contact with the water (including plankton nets and cups, collection nets, ropes, weights, anchor and paddles) were sprayed with a 200 ppm bleach solution. After the appropriate contact time (10 minutes), the boat, trailer and all equipment were thoroughly rinsed. The boat motor was flushed with tap water by using a flushing attachment (flush muffs) for approximately five minutes. Veliger sampling equipment was disinfected with the bleach solution, rinsed and soaked in vinegar for 20 minutes. The vinegar solution was used to dissolve any veliger remains, thus ensuring there were no false positives in subsequent samples. Lakes with known infestations of easily spread invasives (i.e. water fleas, zebra mussels*)* were surveyed at the end of each week, as an extra precaution to minimize the risk of spreading them.

Results

A total of 98 invasive species sites comprising 23 taxa were mapped in 2014. “Priority” species accounted for 22 of the sites (22%). A total of 23 zebra mussel veliger and 55 water flea plankton samples were collected during 2014. No zebra or quagga mussel veligers or spiny or fishhook water fleas were detected in any of the samples. Voucher snail samples from nine lakes were collected and sent to UW-LaCrosse. Table 3 provides a summary of invasive species detected for each lake. Native phragmites (*Phragmites australis* ssp. *americanus*) was documented on seven of the survey lakes. Three lakes had species of special concern and were vouchered and sent to the UW-Stevens Point Freckmann Herbarium.

Discussion

Early detection of invasive species before they become large, environmentally damaging populations makes eradication more likely and reduces the amount of herbicide needed for effective control. Two lakes with small, pioneer infestations of AIS were detected by GLIFWC staff. Eurasian marsh thistle was found at low levels on Riley Lake. Non-native phragmites had been documented on Lake Emily by GLIFWC in 2007. Several isolated locations of non-native phragmites were documented along the shoreline. Occurrence data was shared with management partners for future control efforts. Three lakes with prior occurrence reports or active control efforts for non-native phragmites, were determined to contain only the native subspecies.

Table 3. Summary of aquatic invasive species detected in 2014.

			Species														
State	**County**	**Lake**	*Bellamya chinensis*	*Cirsium palustre*	*Craspedacusta sowerbii*	*Cyprinus carpio*	*Heterosporis*	*Iris pseudacorus*	*Lythrum salicaria*	*Orconectes rusticus*	*Osmerus mordax*	*Phragmites australis ssp.australis* [a]	*Potamogeton crispus* [a]	*Typha spp.*	*Vivaparus georgianus*	Total invasive taxa detected	Native Phragmites
MI	Iron	Lake Emily		X[b]			X					P	X	X	X	6	
	Iron	Sunset Lake							X[b]					X[b]		2	
WI	Burnett	Bashaw Lake				X			X				X	X[b]		4	X
	Burnett	Little Yellow Lake	X						X	X			X			4	X
	Burnett	Yellow Lake	X[bc]			X		X[b]	X	X			X	X[b]		7	X
	Douglas	Bardon Lake									X					1	
	Florence	Emily Lake	X[c]	X[b]					X[b]	X				X[b]		5	
	Florence	Fay Lake	X											X[b]	X[bc]	3	X
	Forest	Riley Lake		P[b]								N[d]				2	X
	Forest	Stevens Lake	X[b]							X					X[bc]	3	
	Forest	Wabikon										N				1	X
	Sawyer	Moose Lake												X[b]		1	
	Sawyer	Smith Lake	X						X			N[d]		X[b]	X[bc]	5	
	Vilas	Big Lake	X						X	X				X[b]	X	5	
	Vilas	Big Saint Germain Lake	X				X			X					X	4	
	Vilas	Dead Pike Lake									X			X[b]		2	X
	Vilas	Little Star Lake							X	X				X[b]		3	
	Vilas	Manitowish Lake	X[bc]						X	X			X			4	
	Vilas	Plum Lake	X[bc]		X					X					X[bc]	4	
	Vilas	White Sand Lake			X					X					X[bc]	3	
		Total	10	3	2	2	2	1	9	10	2	4	5	11	8		7

X = Present

N = Previously documented along shoreline, but determined to only have the native subsecies present.

P = Pioneer population

[a] Priority species

[b] Previously undocumented

[c] Voucher sent to UW-LaCrosse

[d] Voucher sent to UW-Stevens Point

<u>PHRAGMITES</u>

Introduction

Phragmites australis ssp. *australis* is a clonal wetland grass. Both a native (ssp. *americanus*) and a non-native (ssp. *australis*) subspecies of phragmites are present in North America. *Phragmites australis* ssp. *australis* is extremely invasive, growing in moist habitats and waters up to 1 meter deep as well as floating mats in deeper water. Phragmites can grow to heights of 6 meters, and densities of 200 stems per square meter. Phragmites can quickly establish dense clonal stands.

Phragmites spreads primarily by underground roots and overland runners, which can grow up to 16 feet per year. Long distance dispersal occurs via floating root fragments and wind-borne or floating seeds. Phragmites out-competes native wetland vegetation forming dense monotypic stands. Phragmites also alters hydrology and fire frequency and intensity.

Non-native phragmites poses a serious environmental risk to the freshwater estuaries of Lake Superior and inland *manoomin* (wild rice) waters. Phragmites is already common along the Lake Michigan shoreline, however it is not common in the Wisconsin and Michigan portion of the Lake Superior watershed. Considering the current limited distribution and abundance of phragmites in the Lake Superior watershed and the potential loss of coastal estuaries and nearshore open waters, phragmites is a high priority for control efforts before it spreads further and becomes too widespread to manage effectively.

Thirty two small populations of non-native phragmites were detected in 2013 along the western shoreline of Chequamegon Bay near wastewater treatment plants (WWTPs) in Red Cliff, Bayfield, and Washburn. The use of non-native phragmites in WWTPs to dewater sewage sludge (reed bed technology) is permitted by Wisconsin DNR, or EPA for tribal applications. It was initially thought that phragmites spread primarily by floating roots and rhizomes, and that it's seeds were not viable. However, recent studies suggest that seed viability is directly related to soil nutrients (Kettenring 2013). GLIFWC is actively engaged with all three communities and the permitting agencies to develop alternative species or facilities to remove these phragmites seed sources from the landscape. Continued surveillance will be required around the susceptible habitats of Chequamegon Bay until these seed sources are removed.

Additional surveillance was conducted in 2014 to assess the current distribution and abundance of phragmites in Lake Superior estuaries in Wisconsin and Minnesota, and to verify reports from prior years that lacked identification to the subspecies level.

Methods

<u>Surveys</u>:
GLIFWC staff surveyed waterbodies, roadsides and areas near prior phragmites reports where subspecies was unknown. Locations of previously reported sites and herbaria specimens were acquired from Wisconsin DNR, U.S. Forest Service and other cooperating agencies. Waterbodies

and roadsides with unverified phragmites reports were targeted for surveys. Reports near *manoomin* waters were a priority for surveillance. Five waterbodies were surveyed by driving a boat slowly around the perimeter of the waterbody looking for both native and non-native subspecies of phragmites. Roadside rights-of-way were surveyed by driving slowly, surveying both sides of the road (Table 4, Figure 4).

Control: Sites treated along Chequamegon Bay in 2013 were monitored and follow up treatments were applied where necessary. GLIFWC crews cut and disposed of phragmites seed heads if present, then applied imazapyr (Habitat®) herbicide with back-pack sprayers.

All native and non-native phragmites locations were recorded wherever they were encountered. Hand-held computers with GPS receivers and GIS software were used to document the locations of phragmites sites and control efforts. Data collected for each site included location, an estimate of the number of plants, acreage class, type of herbicide used, and an estimate of the amount of herbicide applied.

Table 4. Waters surveyed for *phragmites* in 2014.

State	County	Waterbody	WBIC	Extent of Survey (Acres)	Dates Surveyed	# Sites	
						Non-Native	Native
MN WI	St.Louis Douglas	St. Louis River Estuary	2843800 69129102 69129100	18,916	8/26-28 9/2-4 9/8-10	70	129
WI	Ashland Bayfield	Chequamegon Bay	---	10 miles (shoreline)	7/22-7/24	0	21
	Ashland Bayfield	Fish Creek Sloughs	2887800	54	7/23	0	8
	Forest	Lake Lucerne	396500	1,026	7/9	12	0
	Oneida	Pelican Lake	1579900	3,585	7/29	0	6

Results

Over 200 miles of shoreline and 750 miles of roadsides were surveyed in 2014 for phragmites. A total of 92 non-native phragmites occurrences and 226 native phragmites occurrences were detected. Thirty-eight phragmites reports were ground-truthed. One report was the non-native subspecies and 27 reports were the native subspecies of phragmites. No phragmites was detected at 10 of the previously reported sites.

Of the 32 sites that were originally detected and treated in 2013 near WWTP facilities along Chequamegon Bay, only four required follow up treatment. Three new pioneer locations (<0.25

acres) were also detected and treated near Chequamegon Bay in 2014. Figure 4 illustrates the distribution of phragmites survey and control efforts in 2014. Figures 5 and 6 illustrate the abundance of phragmites at each site treated and the amount of herbicide used at each site for 2013 and 2014.

GLIFWC staff facilitated a multi-agency meeting on October 27, 2014 to share results from surveys and coordinate follow up monitoring and control efforts for non-native phragmites along the Lower St. Louis River. GLIFWC staff also trained staff from 1854 Treaty Authority and interns from Lake Superior National Estuarine Research Reserve to conduct follow up phragmites surveys in the uplands adjacent to the Lower St. Louis River. All phragmites occurrences that have been verified as either native or non-native were published online to coordinate appropriate responses (invasives.glifwc.org/phragmites) among management partners.

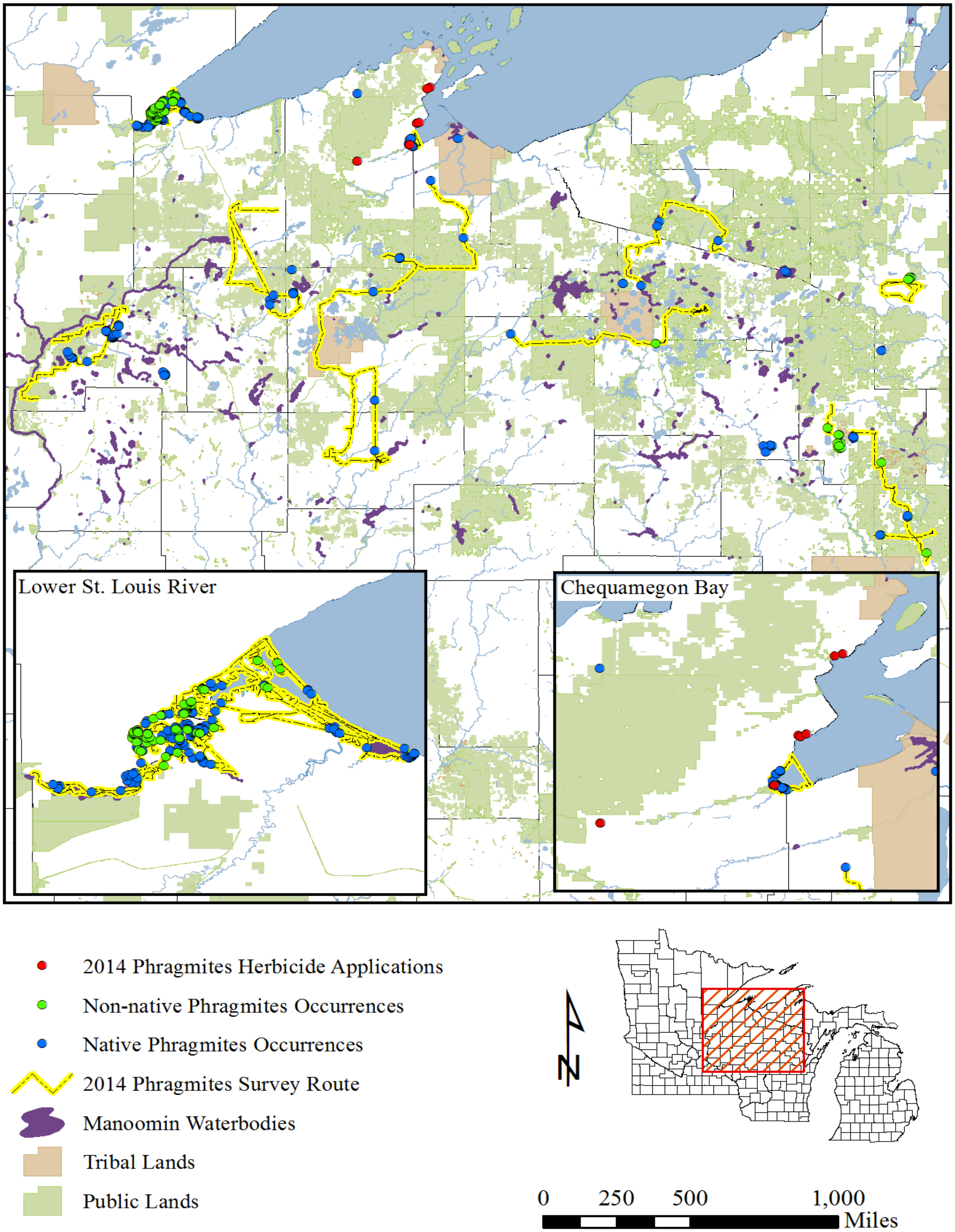

Figure 4. Distribution of *Phragmites* surveys and control efforts in 2014.

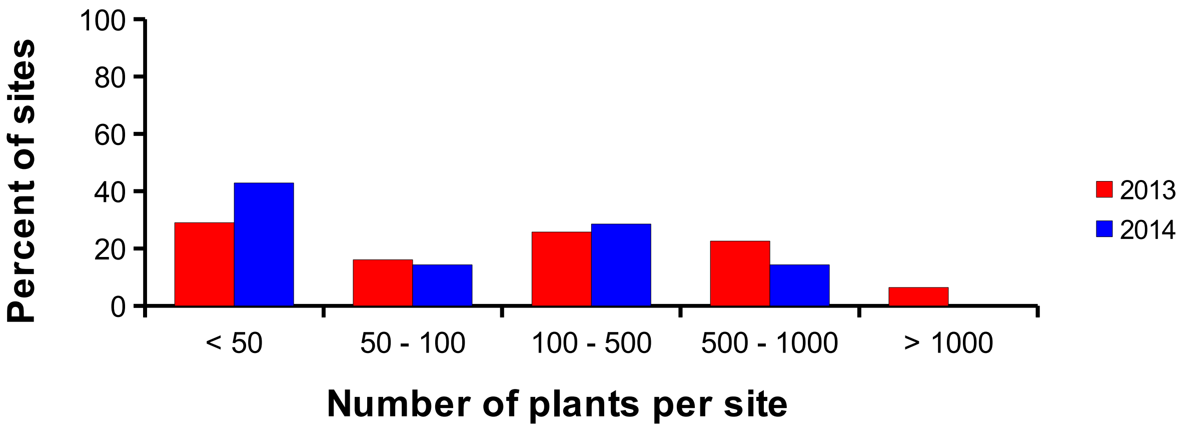

Figure 5. Abundance of non-native phragmites at sites treated in 2013-2014.

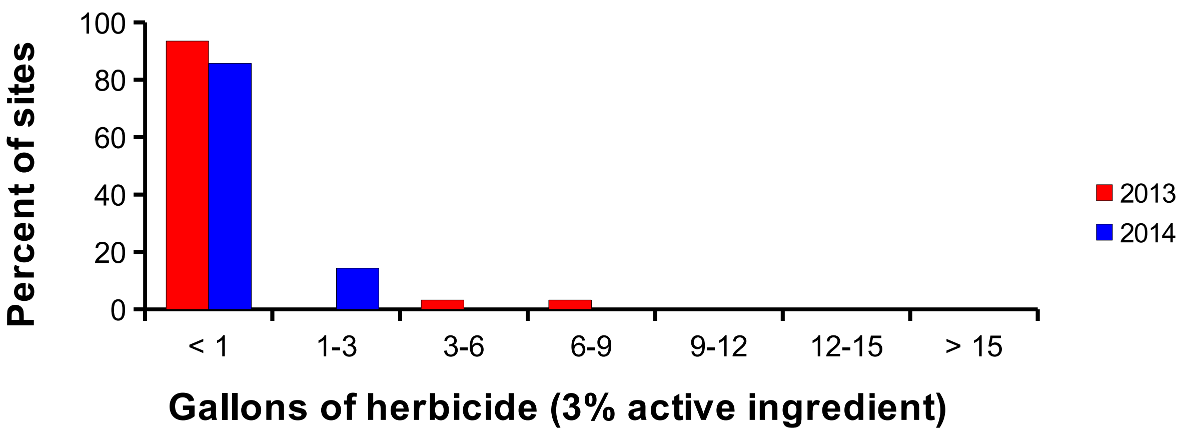

Figure 6. Amount of herbicide mix applied to non-native phragmites sites treated in 2013-2014.

CONTROL AND MANAGEMENT

When invasive species become established, the most effective action may be to prevent their spread or minimize their impacts through control measures. Integrated pest management (IPM) uses the most effective method or combination of methods while taking into consideration the cumulative environmental impacts. Methods may include manual, chemical and biological control.

LEAFY SPURGE

Introduction

Leafy spurge is a perennial herb native to Eurasia. It was first recorded in North America from Massachusetts in 1827. It is thought to have arrived in contaminated seed. By the early 1900's, leafy spurge had spread as far west as North Dakota.

Leafy spurge thrives in open, sunny habitats. The plant reaches heights of up to 1 meter, blooms in late May and early June, and produces clusters of inconspicuous flowers subtended by yellow bracts. The seed capsules of leafy spurge open explosively, dispersing seeds up to 15 feet. The seeds are often carried further by water, wildlife, and vehicles. Leafy spurge also spreads vegetatively, allowing the plant to dominate a site. The extensive root system of leafy spurge can penetrate as far as 15 feet underground.

Leafy spurge displaces native vegetation in open habitats including prairies, pine barrens, pastures, abandoned fields, and roadsides. It is especially dominant on dry or nutrient poor sites where its extensive root system and lack of natural enemies give it a substantial advantage over native vegetation. Because leafy spurge is unpalatable to cattle and deer, it can cause significant economic and ecological impacts.

Pine barrens habitats in northwestern Wisconsin are unique habitats that are especially vulnerable to the threats posed by leafy spurge. These areas provide habitat for a wide range of wildlife, as well as gathering (e.g. *miinan* - blueberries) and hunting (e.g. *waawaashkeshi* – white-tailed deer) opportunities for tribal members.

Methods

GLIFWC's integrated control efforts for leafy spurge are focused in the town of Washburn in Bayfield County, Wisconsin. GLIFWC crews applied imazapic (Plateau®) herbicide to leafy spurge in the fall when plants were senescing and drawing energy reserves back into their roots for the winter. Herbicide was applied until a hard freeze damaged or killed the shoots, preventing uptake by the plants. Shoot damage was monitored by checking for the presence of milky sap in broken stems. An assortment of biological control organisms have been approved by USDA-APHIS for controlling leafy spurge. Three of these have been released at leafy spurge sites in Bayfield County – *Aphthona lacertosa*, *A. nigriscutus* and *Oberea erythrocephala*.

Treated sites were mapped using a GPS receiver and GIS software. Attribute data collected for each site included an estimate of the number of plants, acreage class, type of control used (chemical or biological), and an estimate of the amount of control applied (amount of herbicide used or number of insects released).

Results

In 2014, GLIFWC staff treated 4 sites with herbicide. In addition, several thousand *Aphthona lacertosa* were collected by GLIFWC staff from a site at Douglas County Wildlife Area and released at 3 sites in Bayfield and Ashland Counties. Figure 7 illustrates the distribution of chemical and biological control efforts for leafy spurge in 2014. Road rights-of-way on the eastern edge of the Moquah Barrens near Washburn, Wisconsin comprised the core area of local leafy spurge populations and provided a massive seed source for dispersal via road maintenance activities such as mowing and grading.

Discussion

Annual control efforts have substantially reduced the abundance of leafy spurge. Figure 8 illustrates a trend towards more small sites and fewer large sites. As a consequence, the amount of herbicide used at each site has also trended downward (Figure 9). Integrated measures employing both herbicide and biological controls have shown great success on private lands west of Washburn, Wisconsin.

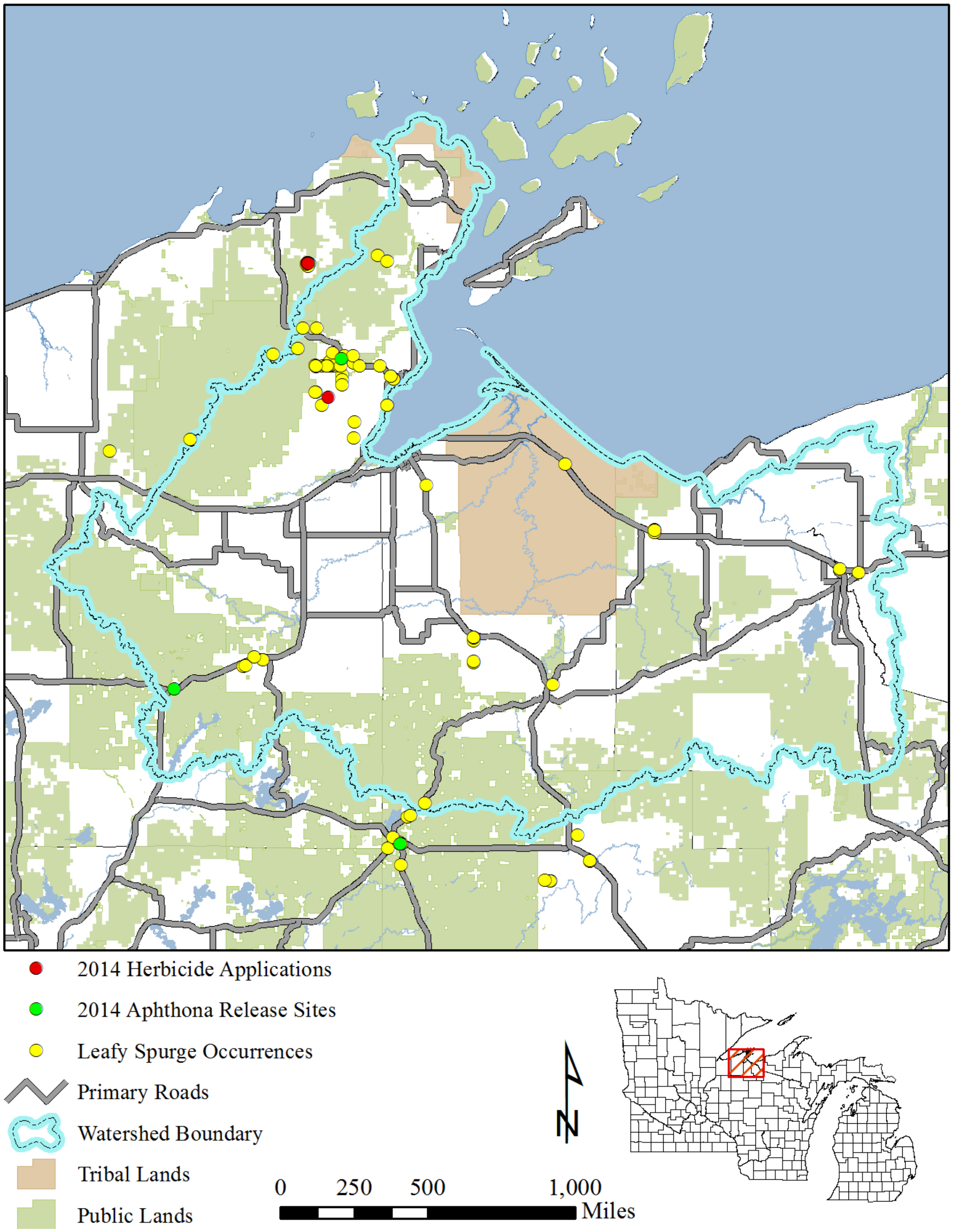

Figure 7. Distribution of leafy spurge integrated management efforts in 2014.

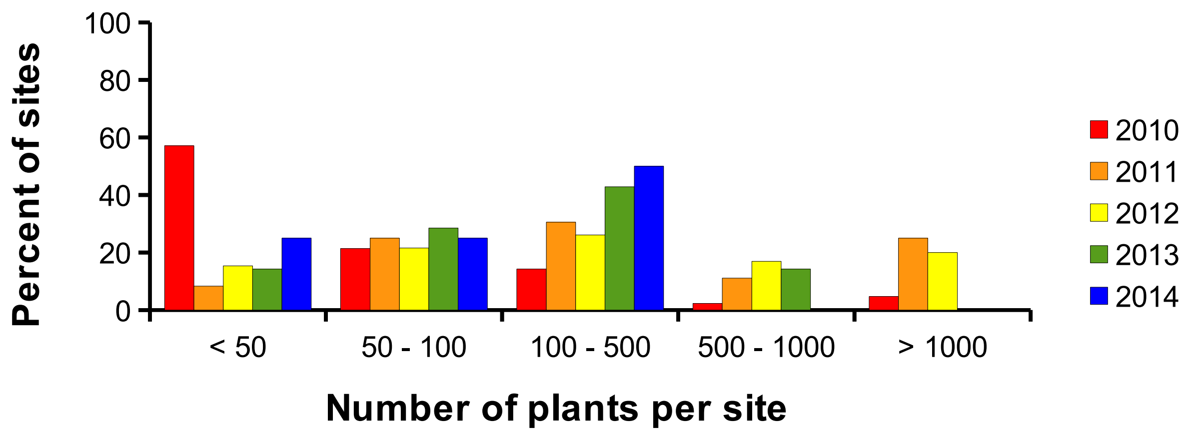

Figure 8. Abundance of leafy spurge at sites treated in 2010-2014.

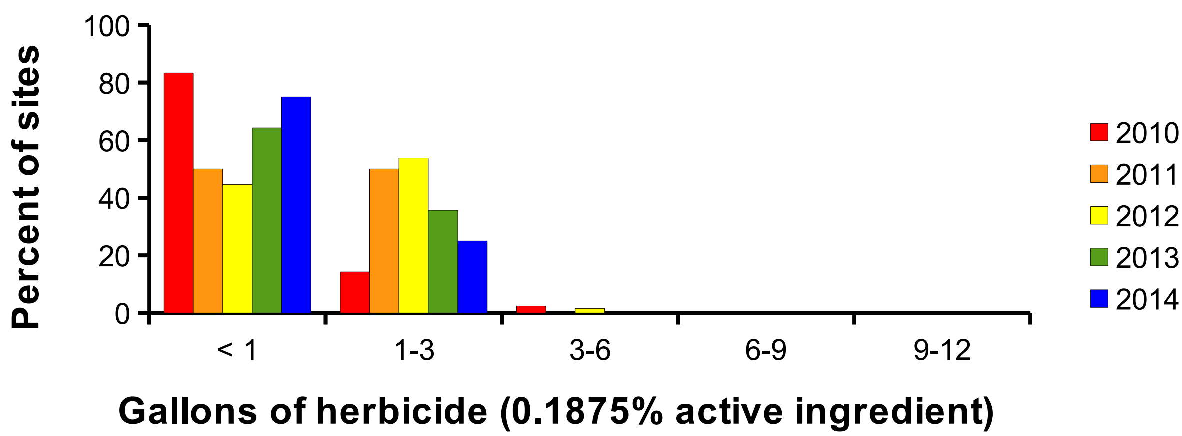

Figure 9. Amount of herbicide mix applied to leafy spurge sites treated in 2010-2014.

PURPLE LOOSESTRIFE

Introduction

Purple loosestrife is a perennial, herbaceous wetland plant native to Europe. It arrived in eastern North America in the early 1800's via plants brought by settlers, seeds carried within livestock, and in ballast soil carried by ships (Thompson *et al*. 1987). Its current distribution includes much of the U.S. and southern Canada.

Purple loosestrife can germinate in moist, exposed soils and tolerates a wide range of pH, nutrient, and light levels. Once established, seedlings can survive shallow flooding. The plant develops a large root crown and dense shoots that out-compete adjacent plant life. The stalks are square and commonly attain heights up to 2m on mature plants. The distinctive flowering spike of purple loosestrife blooms from mid July through early September in the upper Great Lakes region.

Purple loosestrife degrades wetland habitats by out-competing native vegetation. On exposed substrates, purple loosestrife seeds germinate at such a high density that they out-compete native vegetation. The herbivores and pathogens that keep loosestrife from dominating European wetlands are absent in North America. This lack of natural enemies combined with prolific seed production gives purple loosestrife a substantial advantage over native vegetation. Diverse wetland plant communities can quickly be displaced by monotypic stands of purple loosestrife. Reductions in native plant diversity result in a loss of food and shelter for the numerous insect, amphibian, mammal, and bird species that depend on healthy wetlands for their survival.

Methods

GLIFWC's integrated control efforts continued to focus on purple loosestrife within the Bad River/Chequamegon Bay watershed in northern Wisconsin. Small sites (< 0.5 acres) in upper reaches of the watershed were prioritized for chemical control. Control crews applied triclopyr (Garlon 3A® or Renovate®) to purple loosestrife plants. Renovate® is approved for over-water use and was used on sites with standing water, while Garlon 3A® was used where standing water was absent. Triclopyr is dicot-specific, allowing grasses and sedges to persist and re-colonize sites in a shorter time period. Chemical control efforts focused primarily on road rights-of-way between Mellen and Bayfield, Wisconsin. Private properties were also treated after consent forms were signed by the landowner.

Large sites (> 1 acre) and sites with poor access were a high priority for biological control. The release of *Galerucella* beetles (native to Europe) in the United States for biological control of purple loosestrife was approved by USDA - APHIS in 1992. GLIFWC has been rearing and releasing *Galerucella* beetles and collecting and redistributing in the watershed since 2000. Release sites from prior years were visited in early June and again in late summer to ascertain overwinter survival, assess suitability of sites for collection of adults, and to take site photos documenting the effects of beetle herbivory.

Treated sites were mapped using a GPS receiver and GIS software. Attribute data collected for each site included an estimate of the number of plants, acreage class, type of control used (chemical or biological), and an estimate of the amount of control applied (amount of herbicide used or number of insects released).

Results

In 2014, GLIFWC staff treated 112 purple loosestrife sites with herbicide. Figure 10 illustrates the distribution of chemical control efforts for purple loosestrife in 2014. Biological control efforts since 2000 have established over 60 *Galerucella* populations throughout the Bad River – Chequamegon Bay watershed and site visits continue to document their impacts (Figures 11-13).

Discussion

The use of biological controls has allowed GLIFWC’s control crew to place greater emphasis on treating small populations with herbicide before they become significant source populations (Figure 15). This strategy also reduces the amount of herbicide applied at each site (Figure 14). Biological control has been effective in general throughout the watershed, although results vary with size, disturbance, native seed bed quality, weather, and wetness of the site.

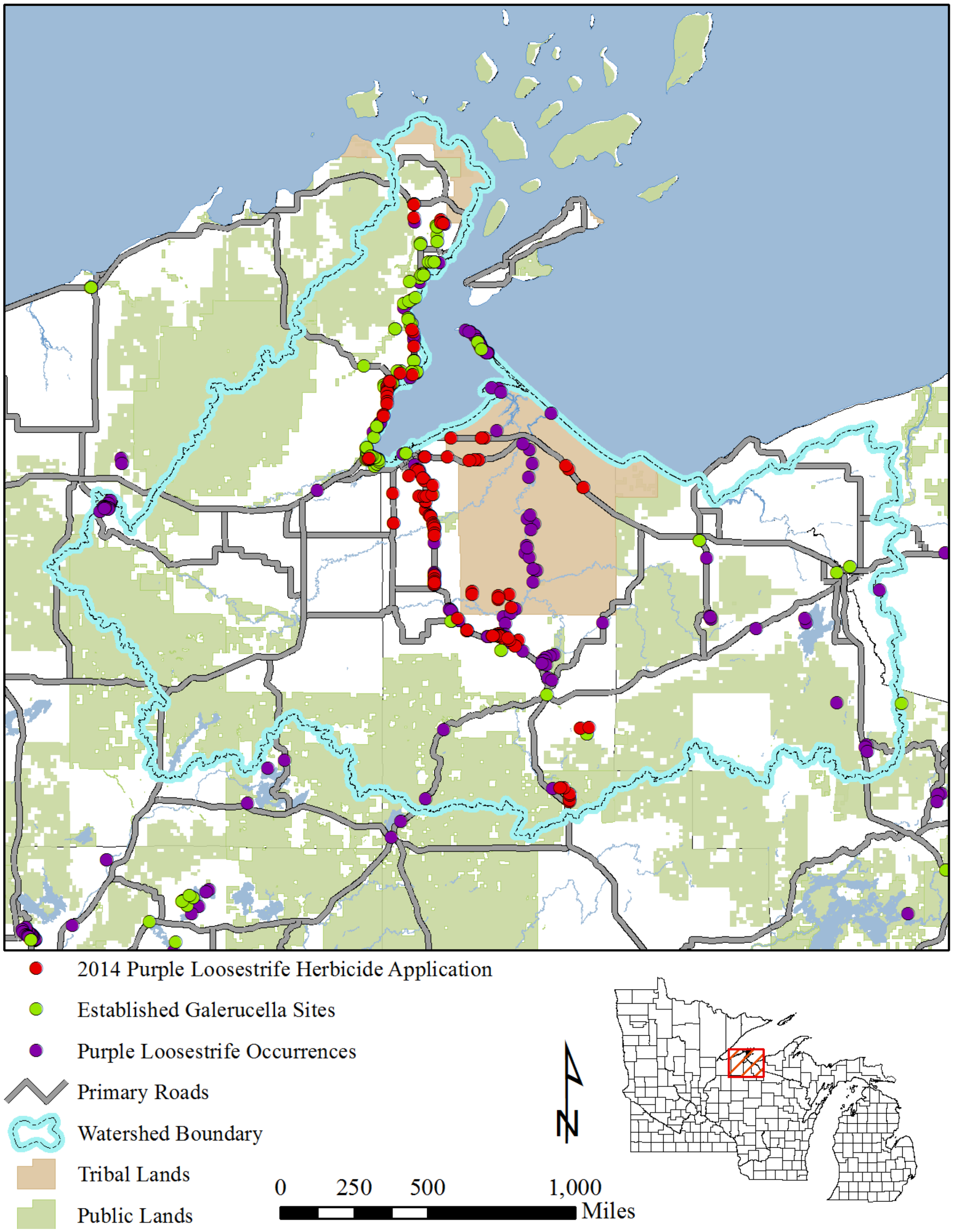

Figure 10. Distribution of purple loosestrife control efforts in 2014.

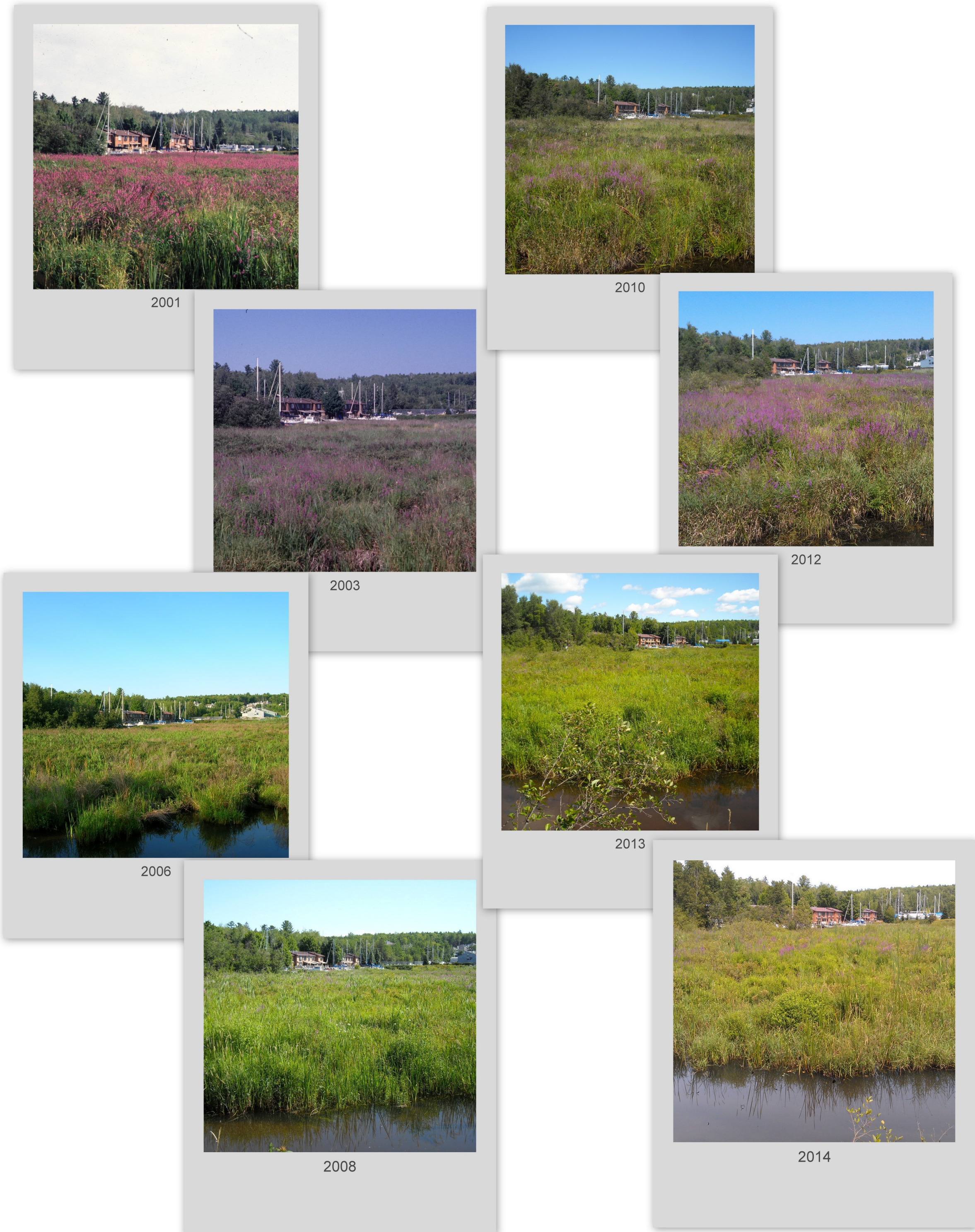

Figure 11. *Galerucella* release site north of Washburn, WI.

Figure 12. *Galerucella* release site near Bayfield, WI.

Figure 13. *Galerucella* release site near Washburn, WI.

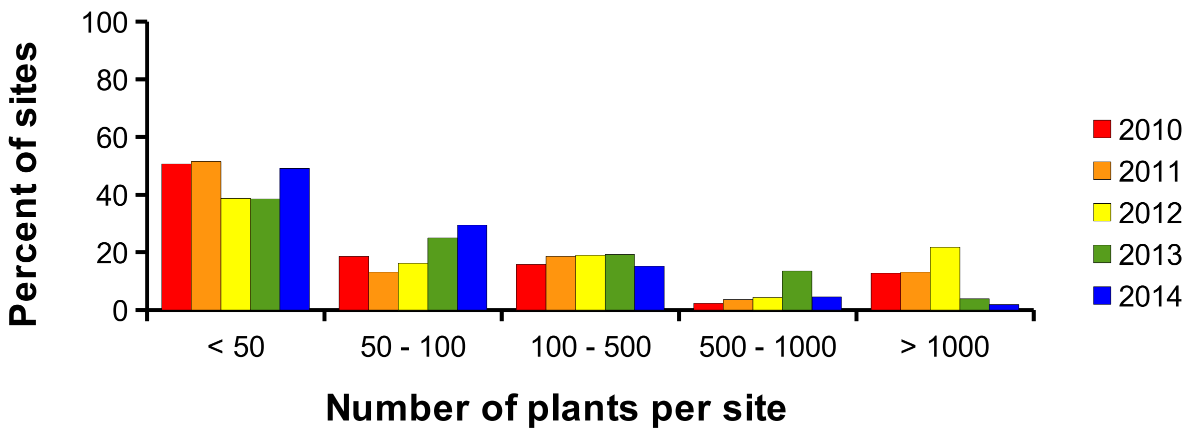

Figure 14. Abundance of purple loosestrife at sites treated in 2010-2014.

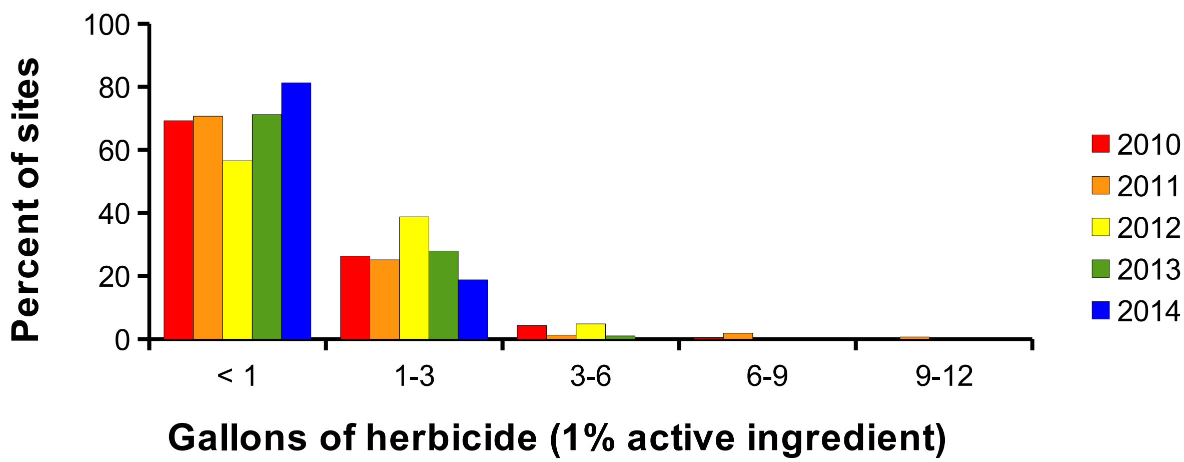

Figure 15. Amount of herbicide mix applied to leafy spurge sites 2010-2014.

RESEARCH

Introduction

New invasive species continue to be introduced to ceded territory habitats and new management techniques are always being developed to reduce their spread. Research is required to address gaps in knowledge as they become evident, especially with respect to understanding potential impacts of invasive species and identifying or informing selection of cost-effective management actions.

Accomplishments

Risk Assessment of Invasive Species to Tribal Resources
GLIFWC completed a project that attempted to quantify the relative risk of non-native invasive plants to culturally important native plants.

- A total of 23 invasive species and 12 native species distribution models (SDM) were created. These models were used to create co-occurrence models for 16 invasive/native pairs.
- A website was created to share the species distribution models, invasives.glifwc.org/models/, and they are also available through GLIFWC's web map services (wms.glifwc.org/?).
- The full project report can be found at data.glifwc.org/archive.bio/Project Report 14-01.pdf.

Other Activities
Activities in 2014 included:

- Staff attended a variety of conferences, webinars and workshops to continue to stay informed about new invasive species making their way to the ceded territories, new prevention measures, research and new management techniques. Events that staff attended in 2014 included:
  - Upper Midwest Invasive Species Conference, October 20-22, 2014, Duluth, MN
  - The Stewardship Network webinar, “How You Spray Matters – Innovative Application Methods for Improved Phragmites Control”, December 10, 2014.
  - Herbicide updates workshop to stay up to date on the most efficient and new treatment options, June 3, 2014, Spooner, WI.

COOPERATION AND COORDINATION

Introduction

Because invasive species disperse widely across the landscape and administrative boundaries, it is necessary to work cooperatively to achieve success. In addition, the introduction and spread of new invasive species in the region continues to out-pace control activities, and is too much for any one agency to manage alone. GLIFWC strives to coordinate its activities with invasive species management partners to maximize the efficient use of limited resources. Management partners include Tribes, U.S. Forest Service, National Park Service, U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, state agencies, county governments, municipalities, universities, and non-government organizations.

Accomplishments

GLIFWC staff are actively engaged in several long-term initiatives that seek to enhance inter-agency cooperation and coordination of invasive species management and planning:

Northwoods Cooperative Weed Management Area (NCWMA): Formally established in 2006, NCWMA provides a forum to share information, collaborate on planning and cooperate on management activities in Douglas, Bayfield, Ashland, and Iron Counties in northern Wisconsin. In 2014, GLIFWC staff worked with the NCWMA to organize several garlic mustard control days and coordinated Phragmites management efforts. GLIFWC staff also developed a project area map, list of invasive species in the project area and assigned a priority to each species for inclusion in the NCWMA management plan.

Wisconsin Headwaters Invasives Partnership (WHIP): Formally established in 2010, WHIP provides a forum to share information, collaborate on planning, and cooperate on management activities in Vilas and Oneida Counties in northern Wisconsin. GLIFWC has a history of surveying inland waters in Vilas and Oneida Counties for AIS and sharing the findings with WHIP partners. In 2014, staff also visited unconfirmed phragmites locations in the WHIP area, confirmed identification and passed information on to partners.

St. Croix National Scenic Riverway Comprehensive Interstate Management Plan for the Prevention and Control of Aquatic Nuisance Species: Completed in March of 1998 in cooperation with the Lower St. Croix Management Commission, Minnesota Department of Natural Resources, Minnesota-Wisconsin Boundary Area Commission, National Park Service, Wisconsin Department of Natural Resources, U.S. Fish and Wildlife Service, and the Upper St. Croix Management Commission. This plan makes GLIFWC eligible for funding from the U.S. Fish and Wildlife Service to implement tasks identified in the plan and helps facilitate cooperation on AIS issues within the St. Croix watershed.

Wisconsin's Comprehensive Management Plan To Prevent Further Introductions and Control Existing Populations of Aquatic Invasive Species: Completed in cooperation with the Wisconsin Department of Natural Resources and UW-Extension in September of 2003, this plan makes GLIFWC eligible for funding from the U.S. Fish and Wildlife Service to implement tasks identified in the plan and helps facilitate cooperation with the WDNR on AIS issues.

Global Invasive Species Information Network (GISIN): GLIFWC staff participated on the standards committee to develop this standardized information exchange protocol for sharing invasive species information. An early adopter of the technology, GLIFWC's node of the Global Invasive Species Information Network (gisin.glifwc.org) can be used to query multiple databases simultaneously and browse the results via an interactive table or map.

Phragmites Management and Cooperation in the Lower St. Louis River Estuary: GLIFWC staff facilitated a multi-agency meeting to share results from surveys and coordinate follow up monitoring and control efforts for non-native phragmites along the Lower St. Louis River. GLIFWC staff also trained staff from 1854 Treaty Authority and interns from Lake Superior National Estuarine Research Reserve to conduct follow up phragmites surveys in the uplands adjacent to the Lower St. Louis River.

maps.glifwc.org: The goal of this project is to facilitate collaboration by providing a common communications infrastructure. maps.glifwc.org provides a portal for viewing invasive species distribution and management in the context of the ceded territories and other GIS layers relevant to GLIFWC's member tribes such as *manoomin* and *ogaa* waters.

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