Purple Loosestrife Surveys in Wisconsin and Michigan during 1995

by

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Introduction

The purpose of this report is to provide the results of the 1995 purple loosestrife surveys in portions of the Bad River and Chequamegon Bay watersheds in Wisconsin and the Sturgeon River Sloughs Wildlife Area in Michigan, and to give a brief summary of the season's control efforts in Wisconsin.

Purple loosestrife (*Lythrum salicaria*) is an exotic perennial plant which was introduced into the United States from Europe in the early 1800s and became established along the eastern seaboard by the 1830s. Since its introduction this emergent aquatic plant has spread across mid-latitude North American wetlands subsequently invading the Midwest in the early 1940s (Stuckey 1980; Thompson et al. 1987). Several modes of introduction or escape into previously uninfested areas were probable including from ships' ballast, livestock bedding and forage, wool, and purposeful import as seeds or rootstocks for gardens, herb beds, and use by beekeepers.

Any moist soil that is exposed to sunlight can provide favorable substrate for the germination of purple loosestrife seeds (Skinner et al. 1994). Often these sites are associated with some type of disturbance such as that found at construction sites, in mowed roadside ditches, or other areas where some soil disturbance has taken place. Water flowing past stream banks and drought-caused or intentional drawdowns in lakes can leave areas of exposed soil which may also serve as germination sites for loosestrife seeds. Although the seeds require moist sunlit soils to germinate, established plants can take advantage of a variety of different water levels, soil types, and nutrient levels. Favorable loosestrife habitat includes wetland areas, lake shores, rivers, streams, and roadside ditches.

Early on loosestrife was observed to have negative impacts on aquatic ecosystems. Degradation in the quality of waterfowl nesting sites (McKeon 1959), loss of open water, loss of mud flats for foraging shore birds, and a reduction in the quantity of valuable wildlife food plants (Smith 1959) were observed ecological consequences of a loosestrife invasion within a wetland system. One important wildlife food plant, cattail, can be replaced by purple loosestrife. Muskrats may even help the establishment of loosestrife by selectively feeding on cattail, loosestrife's primary competitor (Skinner et al. 1994). For these reasons the Wisconsin Legislature designated all members of the genus *Lythrum* as nuisance weeds in 1987 (AB 141 1987).

Although purple loosestrife has invaded the northern counties of Wisconsin (Thompson et al. 1987) and the Upper Peninsula of Michigan to a lesser extent, the Great Lakes Indian Fish and

Wildlife Commission (GLIFWC) recognized the threat purple loosestrife posed to ceded territory wetland communities and initiated a pilot control project in Fish Creek Sloughs during the summer of 1989. This site was chosen due to its high degree of loosestrife infestation and the likelihood that seed from this area would promote the establishment of additional loosestrife populations in the Kakagon and Bad River Sloughs. The loosestrife control project has since expanded to include work in more loosestrife infested areas. Methods developed as a control procedure are described in a previous GLIFWC publication (Gilbert and Parisien 1989). A brief summary of the 1995 control efforts can be found in Appendix 3 of this report.

After effective control methodologies were developed the search began for other ceded territory wetlands where purple loosestrife surveys and control measures could be carried out, tested, and further developed or refined. Three important areas were focused on in 1994 and 1995. They are the Bad River and Chequamegon Bay watersheds in Wisconsin and the Sturgeon River Sloughs Area in Michigan.

The Kakagon and Bad River Sloughs, the largest, healthiest, fully functioning estuarine system remaining in the upper Great Lakes Basin (Meeker 1992) and recognized as a National Natural Areas Landmark (National Registry 1983), are an integral part of the reserved home and culture of the Bad River Band of Lake Superior Chippewa. The vast and nearly pristine sloughs contain ten natural communities in a complex mosaic that support an abundance of wild rice beds, crucial spawning grounds for Lake Superior fisheries, and provide critical nesting habitats for migratory waterfowl (Meeker 1992). The pristine nature and complexity is a reflection and product of Ojibwa culture and values. Respect for life, recognizing that all things are related, taking only what is necessary, giving thanks for what is taken, and considering the consequence of today's actions on the next seven generations are important guiding themes in the culture and life of the Bad River community.

The ecological health of the sloughs is dependent upon the activities and events within the approximately 1,100 square mile watershed that provides the sloughs with a continual supply of water, sediment, and nutrients. In order to scientifically determine the current status and health of the Kakagon and Bad River Sloughs and to develop a long-term watershed protection plan, the Wisconsin Chapter of The Nature Conservancy and the Bad River Band initiated a watershed conservation project in 1993.

In 1994, GLIFWC conducted a purple loosestrife survey of the Kakagon and Bad River Sloughs watersheds as a component of this larger project. The objective was to record baseline data on the location of purple loosestrife stands, stand size, and plant density. These data were integrated into the Bad River Band's geographic information system (GIS) to provide a basis for systematic monitoring of loosestrife infestation patterns and evaluation of control measures (Gilbert et al. 1994).

In 1995, the purple loosestrife survey continued on the Bad River watershed. It was also extended to include much of the area on the west side of Chequamegon Bay, loosestrife stands in this

bay could also be seed sources for the Kakagon and Bad River Sloughs.

In addition to the Bad River and Chequamegon Bay surveys, a one-week survey for loosestrife in the Sturgeon River Sloughs Wildlife Area and surrounding areas near Keweenaw Bay in the Upper Peninsula of Michigan was conducted. The 1,215-hectare Sturgeon River Sloughs Wildlife Area is managed by the Michigan Department of Natural Resources (DNR) for waterfowl and waterfowl hunting. With its 979 acres of impoundments and several goose pastures, it provides an important stopover for migratory waterfowl (R. Aho pers. comm.). By keeping water in the impoundments and providing herbaceous cover the Michigan DNR hopes to increase duck production and make a contribution to efforts to change the recent trend of low duck numbers in North America. The Michigan DNR has also cooperated with GLIFWC and the Keweenaw Bay Indian Community in seeding wild rice into the impoundments. These impoundments which have been divided into eight field units received a total of 604 kilograms of rice in 1993 and 1994 (David 1994 and 1995).

Management activities and concerns in the Sturgeon River Sloughs Wildlife Area go beyond waterfowl and wild rice. Members of the Keweenaw Bay Indian Community use the area for waterfowl hunting and it also maybe important to fish. The Sturgeon River is used for spawning by sturgeon and biologists speculate that the associated wetland and slough areas may be important to larval and juvenile sturgeon as well (M. Donofrio pers. comm.). The flow of water through the Sturgeon River is controlled by a hydroelectric dam located south of the Wildlife Area. Since 1990 the tribe has been involved in interagency efforts to keep a more consistent flow of water running through the river which would not only be beneficial for fisheries but for waterfowl and other wildlife. For these reasons and because of the relatively pristine nature of the sloughs, GLIFWC initiated an inventory program in 1995 to begin gathering baseline information on the location and distribution of loosestrife patches in this area.

Bad River and Chequamegon Bay Watersheds, Wisconsin

The Bad River watershed covers approximately 2,800 km^2 throughout much of Ashland, Iron and Bayfield Counties in northern Wisconsin (Figure 1). A portion of this area was covered in GLIFWC's purple loosestrife survey in 1994 (Gilbert et al. 1995) and still more was surveyed in 1995. Areas in the watershed surveyed in 1995 were: the Bad River from its junction with the Marengo River to Copper Falls State Park, Beartrap Creek, Krause Creek, Highway 169, and County Road A (Ashland County) from Old Odanah to 11th Street in Ashland.

A portion of the Chequamegon Bay watershed was also surveyed (Figure 2). Survey efforts were concentrated along Highway 13 and the shoreline of the bay especially at creek entrances. Areas covered included: Whittlesey Creek from Highway 13 to the creek mouth, Highway 13 from

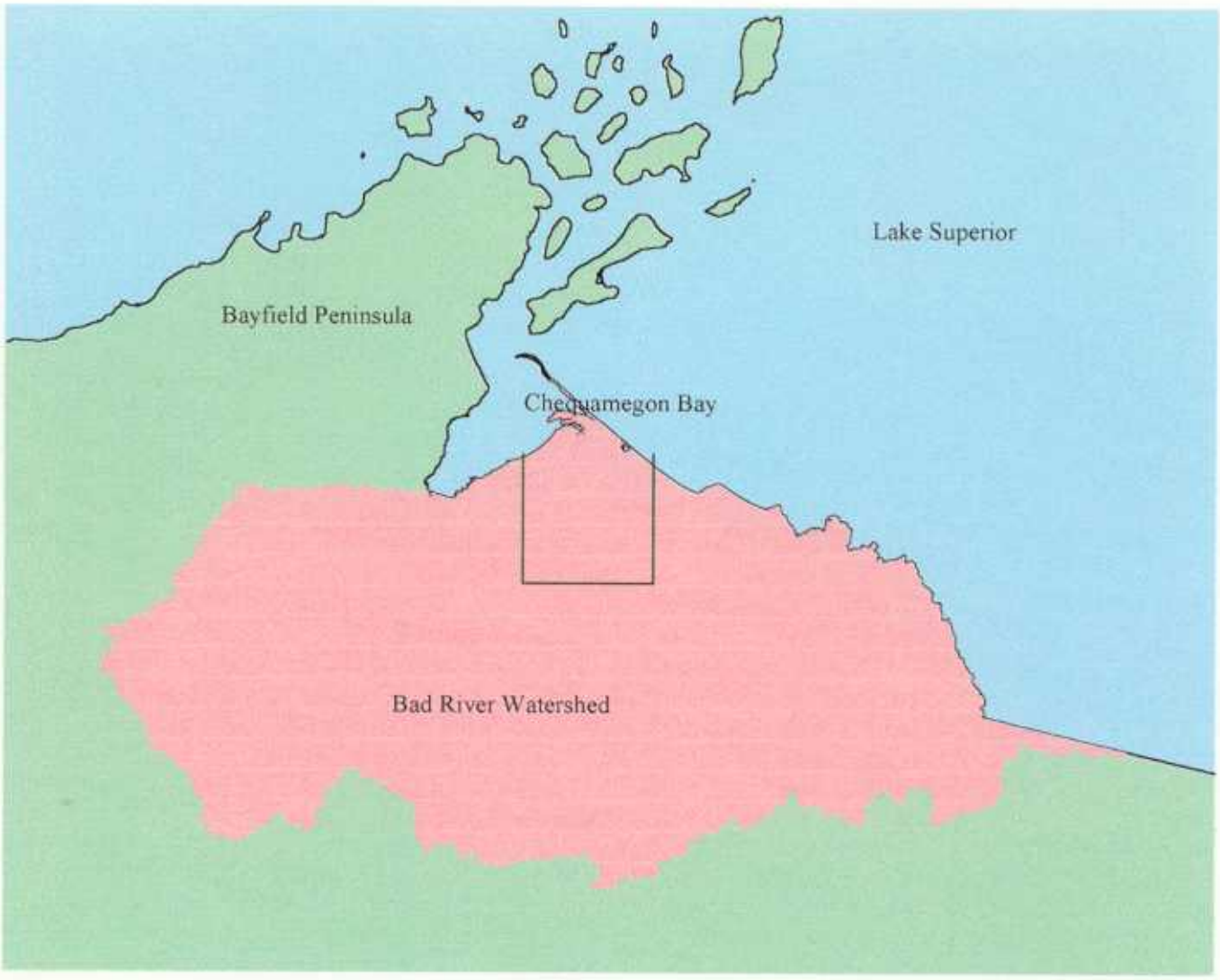
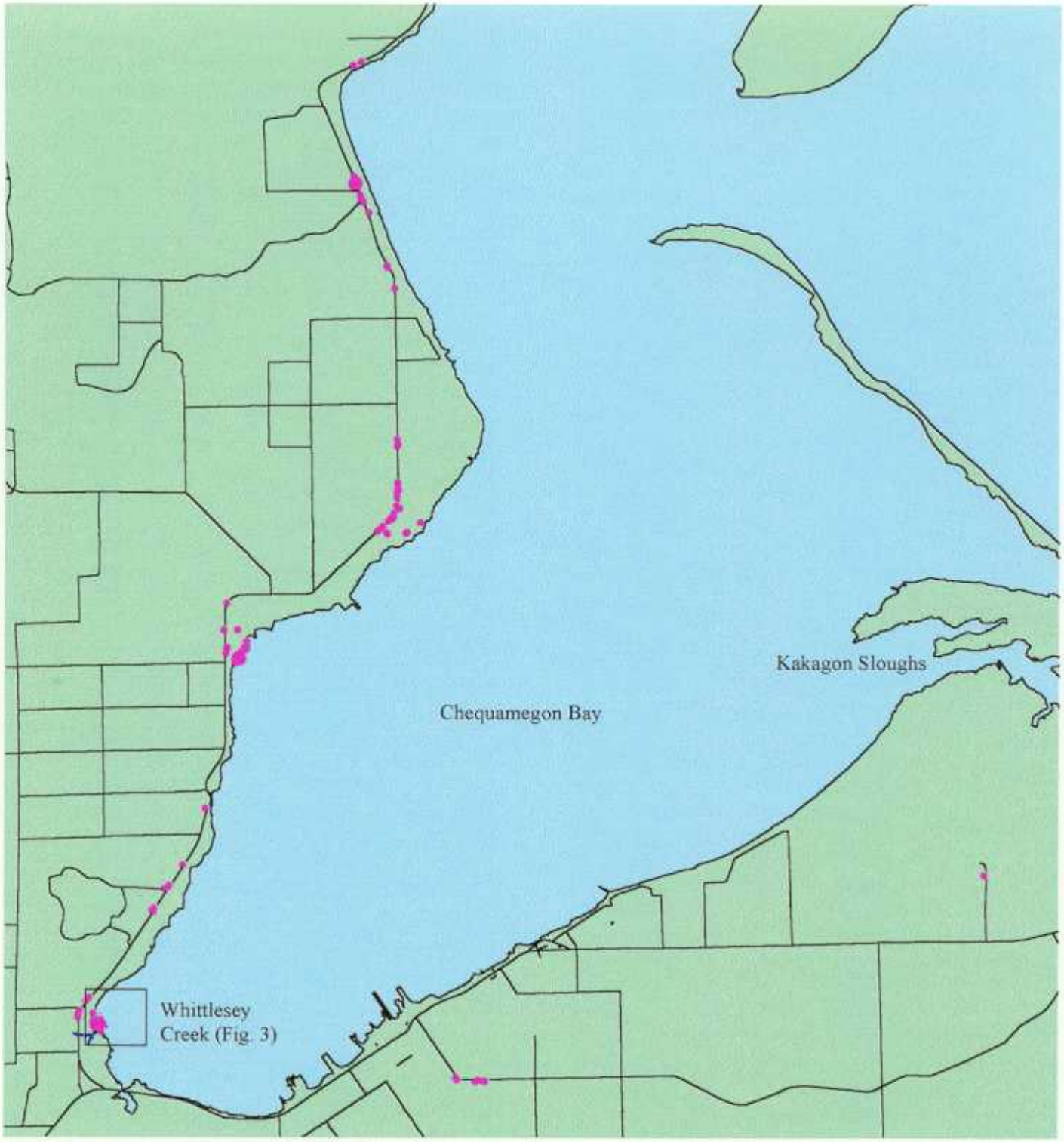


Figure 1. Location of the Bad River Watershed, Wisconsin.



Area occupied by loosestrife patch

- < 0.3 ha.
- 0.3 - 1.1 ha.

N
W E
S

1 0 1 2 3 4 Kilometers

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Figure 2. Location of purple loosestrife along Chequamegon Bay, 1995.

Highway 2 to the Bayfield Fish Hatchery, and the shore of Chequamegon Bay from Port Superior Marina in Pike's Bay to the mouth of Whittlesey Creek.

Methods

Key Contacts

Prior to beginning field work, a number of people affiliated with several different organizations were contacted for assistance in gaining information on where stands of loosestrife were located (Appendix 1). These contacts resulted in the location of several important loosestrife stands, including the Whittlesey Creek stand and improved the efficiency of survey work.

Priority Areas

Priority areas were identified before conducting surveys. Favorable loosestrife habitats include wetland areas, lake shores, rivers and streams, and roadside ditches. Priority sites within the Bad River and Chequamegon Bay Watersheds which fell into these categories were identified as key search areas.

A code system was devised by the survey team to identify specific survey areas. Individual patches were given unique identification numbers. These unique numbers helped in the recording and organization of the survey data.

Maps & Data Sheets

Two sets of USGS topographic maps representing the Chequamegon Bay watershed were compiled. In addition, maps of the Bad River watershed prepared by the loosestrife survey team in 1994 were used. One set of maps was laminated and used to record locations of loosestrife stands while in the field. The other set was kept in the office and information from the field maps was transferred to them later. These maps should provide quick, easy-to-use stand location and identification information for future crews to efficiently locate loosestrife populations for further survey and control work.

Data sheets were prepared for collecting information on patch size, class distribution, and plant density. Other pertinent information for each survey site included disturbances (especially human caused), site descriptions, the source of colonization if known, and any other unique features of the area (Appendix 2). Field notebooks were also used to record other information which did not fit under a category on the data sheets. For example, questions and concerns brought up by some landowners about possible future treatment of loosestrife located on their land were noted.

Landowner Contacts

Since several loosestrife stands were located on private property landowner contacts were made before surveying began. Nearly all landowners contacted granted access to their property. Many were aware of purple loosestrife and were also familiar with the ecological problems associated with it. In the few cases where no landowner contact was established visual estimates were made of the patch area, class distribution, and density of the plants.

Mapping

Assessments of purple loosestrife stands were made in the field to determine the best survey techniques. Each stand had its own unique features and challenges and different survey techniques worked better for different stands.

Generally, one or more transects were run in patches with an axis of 15 or more meters. If the coefficient of variation (CV) was greater than 20% of the mean of the first transect, then more transects were run until the CV was less than 20%. Conducting a transect involved stretching a meter tape down the middle of a patch along its longest axis. A square meter was centered over the tape at intervals equal to $^1/_{10}$ the patch length. At each sample plot, class 1, class 2, and class 3 plants were counted and recorded. These class determinations were the same as those used during the 1994 loosestrife survey and were based on methods used by Thompson et al. (1982).

In patches less than 15 meters in length transects were not usually conducted because sufficient information could be collected from fewer sample plots (i.e. with less intensive sampling). Instead data were collected at a number of random locations within the patch. The first sample plot was usually located at the edge of the patch and subsequent points were determined by walking several meters and randomly tossing the square meter into the patch. The number of sample plots and the distance between the plots was determined by the overall size of the plot. Usually one third of the total patch size was sampled. However, in patches of only 1 to 3 m^2, all plants were counted. When single plants were found the location and class of the plant were recorded.

Several exceptions were made to the above guidelines as special circumstances in some patches were encountered. For example, in patches that were very swampy and difficult to walk through transects were run along the edge of the patch rather than through the center. It is likely that this variation in technique resulted in overestimates in plant density in some patches and underestimates in others depending on the characteristics of the individual patch. In cases where patches were not reached, estimates of area, class determinations, and densities were made.

GPS

A global positioning system (GPS) unit was used to collect accurate and spatially correct locational information. The Geo Explorer (Trimble, Sunnyvale, CA), a compact data logger with built-in antenna and receiver, proved helpful during challenging surveys in swamps and brushy, wet ditches. Before conducting surveys a data dictionary specific to the purple loosestrife project was created on a PC using the Pathfinder software. This data dictionary was then downloaded to the data logger for use in the field.

At each survey location a new file was started on the data logger to record the information for that patch. The perimeter of a loosestrife patch was recorded by walking around the patch with the Geo Explorer and at each sample plot along a transect the numbers of each class of plant were recorded. For patches of 1 m^2 or less, the Geo Explorer was not used to record the perimeter.

Each day the information collected on the Geo Explorer was downloaded to a PC. When the survey work was finished all of the files were differentially corrected using data which was downloaded from a bulletin board maintained by Minnesota Power in Duluth, Minnesota. After being corrected each file could be displayed on the screen as an outline of a loosestrife patch with any transects also appearing. For each patch, area and plant class information could also by displayed.

The GPS information was converted into GIS format and a coverage created using ArcInfo.

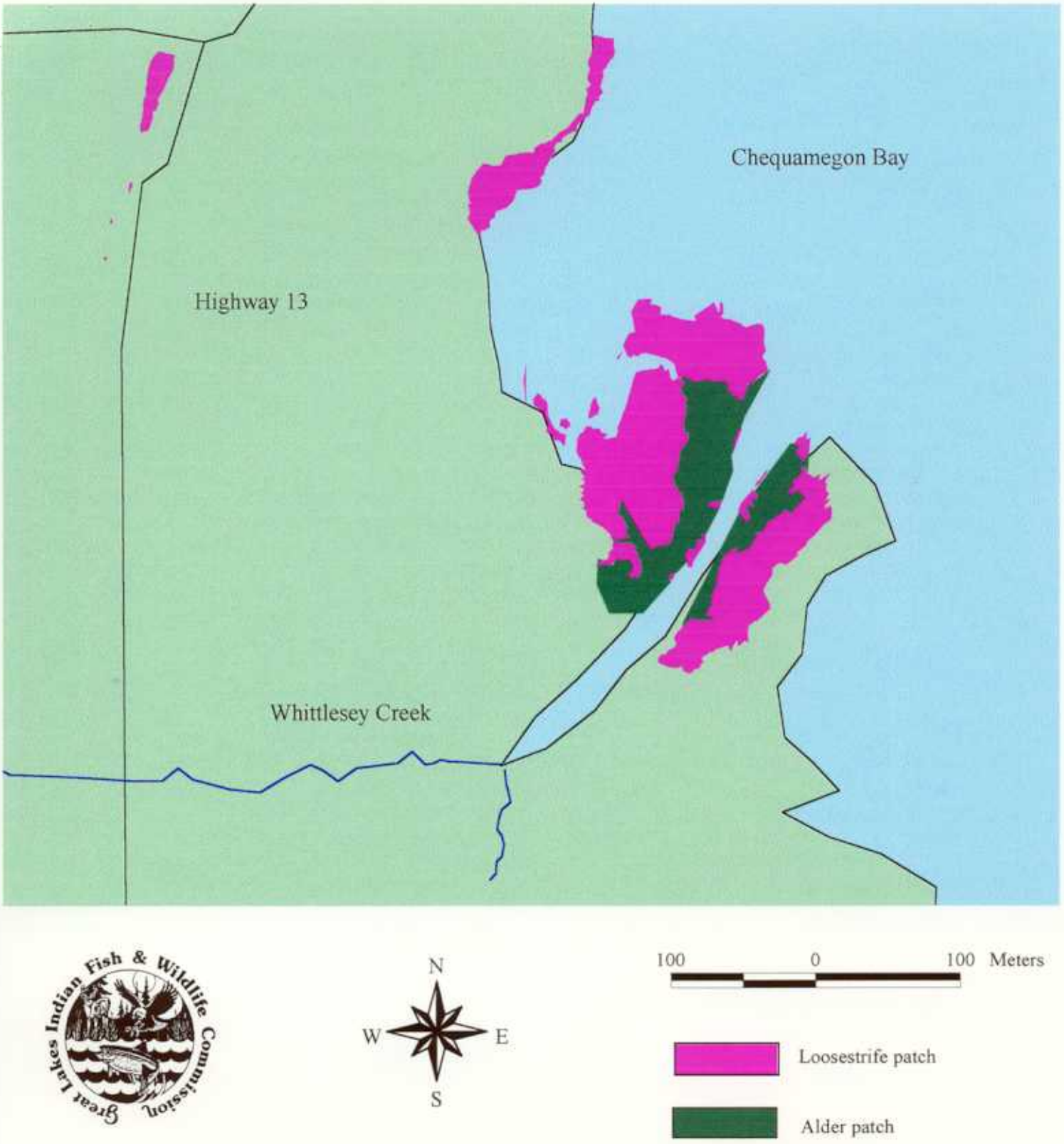

Figure 3. Locations of purple loosestrife at the mouth of Whittlesey Creek, 1995.

Results

Distribution and Density

A total of 6.94 hectares of loosestrife was found in the Bad River and Chequamegon Bay watersheds in 1995 (Table 1). The majority of this (63.0%) was located within the Bad River watershed along Highway 13. The Chequamegon Bay shoreline and Whittlesey Creek together made up 35.9% of the total area of loosestrife found. The highest total density of plants (8.07 plants/m^2) was found in the Whittlesey Creek population. Whittlesey Creek loosestrife patches also had the highest densities of class 2 (2.82 plants/m^2) and class 3 (1.60 plants/m^2) plants. The highest density of class 1 plants (4.20 plants/m^2) was located in the one patch along Highway 169. This population also had a high total density (5.80 plants/m^2). Although not large contributors to the total amount of loosestrife found, substantial densities of class 1 and class 2 plants were located along Beartrap Creek (1.31, 2.53, respectively) and County Road A (1.00, 1.16, respectively). In all of the surveyed populations the density of class 3 plants was low compared to the densities of class 1 and Class 2 plants.

Table 1. Density (per m^2) and distribution of three classes of purple loosestrife plants in the Bad River and Chequamegon Bay watersheds, Wisconsin 1995.

Location	Watershed	Area (hectares)	Density Class 1	Density Class 2	Density Class 3	Total Density
Highway 169	Bad River	.0005 (<.01%)	4.20	1.00	.60	5.80
County Road A	Bad River	.0735 (1.0%)	1.00	1.16	.11	2.27
Beartrap Creek	Bad River	.001 (<.01%)	1.31	2.53	.30	4.14
Whittlesey Creek	Chequamegon Bay	1.36 (19.6%)	3.65	2.82	1.60	8.07
Chequamegon Bay Shoreline[1]	Chequamegon Bay	1.13 (16.3%)	-	-	-	-
Highway 13	Both	4.37 (63.0%)	2.32	2.48	.71	5.51
Total Area		6.94				
Average Density (Weighted)			2.19	2.13	.76	5.08

[1] In these patches areas were estimated but no class distribution or density information was recorded.

Population Estimates

An estimated 352,000 purple loosestrife plants were found in the six discrete areas developed to describe loosestrife distribution within the Bad River and Chequamegon Bay watersheds (Table 2). Overall there were more class 1 plants than in any other class. Class 1 plants were more numerous than either class 2 or class 3 plants in all populations except the County Road A and Beartrap Creek locations. The large numbers of class 3 plants in both the Whittlesey Creek and Highway 13 populations indicate mature and well-established stands which probably served as important seed sources for some of the newer populations. The high numbers of class 1 plants overall suggest that loosestrife is expanding throughout the watersheds. Population estimates for class 3 plants were low compared to population estimates for class 1 and class 2 plants in all locations as well as in the total population estimate.

Table 2. Population estimates (% of population) of purple loosestrife in the Bad River and Chequamegon Bay watersheds, Wisconsin 1995.

Location	Area (hectares)	Pop. est. Class 1	Pop. est. Class 2	Pop. est. Class 3	Total Pop. est.
Highway 169	.0005	21 (72%)	5 (17%)	3 (10%)	29
County Road A	.0735	734 (44%)	853 (51%)	79 (47%)	1667
Beartrap Creek	.001	13 (32%)	25 (61%)	3 (7%)	41
Whittlesey Creek	1.36	49,773 (45%)	38,446 (45%)	21,757 (13%)	109,978
Chequamegon Bay Shoreline[1]	1.13	-	-	-	-
Highway 13	4.37	101,579 (42%)	108,199 (45%)	30,923 (13%)	240,702
Total Area	6.94				
Total Population Estimate		152,121(43%)	147,529 (42%)	52,767 (15%)	352,418

[1] In these patches areas were estimated but no class distribution or density information was recorded.

Survey Observations

This section provides a summary of the loosestrife found in each area surveyed, as well as other pertinent information. Any special concerns or unique findings are also reported.

Bad River

Area Surveyed: from Bad River's junction with the Marengo River to the border of Copper Falls State Park.

Quad Map: High Bridge.

Because of its inaccessibility this stretch of the Bad River was not surveyed in 1994. An aerial survey was conducted in 1995. Flying at an altitude of approximately 500 feet, any fairly large patch of loosestrife should have been visible as a haze of purple. Based on the remoteness and topography of this portion of the river, no loosestrife was expected to be found here. As predicted none was found, although single plants would not have been possible to spot.

Krause Creek

Area Surveyed: several discontinuous areas including the stretch of the creek that runs through the Mellen Country Club, a stretch from Golf Course Road back to the old railroad grade, and any locations where the creek crossed roads.

Quad Map: Mellen.

The section of the creek that runs through the Country Club was mowed right down to the creek allowing plenty of sunlight to reach it. After leaving the Country Club, the canopy became quite closed over the creek. Most of the stretch from Golf Course Road to the railroad grade was pasture. However, closer to the railroad grade, it became more brushy and beaver activity was evident here. Much of this stretch of the creek was quite shady, but there were some open areas with mud flats where loosestrife could potentially become established. No loosestrife was found on any surveyed portion of Krause Creek.

Highway 169

Area Surveyed: from north of Mellen to Highway 2.

Quad Maps: Mellen, Mt. Whittlesey, Gurney, Cedar.

One patch of loosestrife located 1.3 miles north of Copper Falls State Park was found. Twenty-nine total plants in a 5 m^2 patch were counted in a roadside ditch with a small trickle of a stream running through it. Twenty-one of these where class 1, five were class 2, and three were class 3. Though no loosestrife was found anywhere else along Highway 169, the loosestrife could spread throughout the roadside ditches quite easily from the one patch that was found.

County Road A (Ashland County)

Area Surveyed: from Old Odanah to 11th Street in Ashland.
Quad Maps: Odanah, Ashland East.

Four patches of loosestrife totaling 735 m^2 were found. All were located along the roadside near Bayside Timber Corporation. The ditches along the road had been mowed and some of the loosestrife was located in these mowed areas, but the majority was found more toward the center of the ditches in lower areas. Some standing water is likely present in these low ditches at some times of the year. One patch, not located in a ditch, but near a ditch on higher ground contained loosestrife growing interspersed with willow and other brush.

No loosestrife was found elsewhere along County A. However, there are several wet, lowland areas and roadside ditches which could provide suitable loosestrife habitat.

Beartrap Creek

Area Surveyed: from a private boat launch on Goslin Road to approximately one half mile upstream from the bridge on Highway 2, and other locations where the creek crossed roads.
Quad Maps: Ashland West, Ashland East, Odanah.

Five loosestrife patches covering 10 m^2 were found along Beartrap Creek. Two of the patch locations were open and sunny, while the other three were quite shady and probably only received sunlight during part of the day. Cattail, arrow root, jewelweed, ferns, and many grass species were growing with the loosestrife. Wild rice growing along Beartrap Creek where it enters the Kakagon Sloughs is threatened by these upstream patches.

Whittlesey Creek

Area Surveyed: from Highway 13 to the mouth of the creek, and areas surrounding the mouth.
Quad Map: Ashland West.

The surveyed portion of Whittlesey Creek supported 1.4 hectares of loosestrife. The vast majority of this was found in areas surrounding the mouth of the creek.

Whittlesey Creek loosestrife patches were found in a variety of habitats. Patch WC-3, for example, covered 475 m^2 in a shallow portion of the bay close to shore and consisted of 118 class 1 plants (Figure 3). These seedlings were growing in very sandy bottom in several inches of moving water. Some plants were completely submerged by water at all times, while others were submerged from time to time with the wave motion of the water. Patch WC-12, on the other hand, covered 2,584 m^2 and consisted of large class 3 plants along with some class 1 and class 2 plants (Figure 3). Several of the Whittlesey Creek patches may have either overestimated or underestimated density information due to the problem with getting to patch centers to run transects as was described above.

Loosestrife was also found in several narrow patches along the creek bank. The plants found in these patches were mainly class 2, but class 1 and class 3 plants were found as well. In some of these patches, the loosestrife extended quite a distance back into the brush and trees which reached almost out to the creek bank in most of the surveyed portion of the creek.

The patches along the creek bank were concentrated near the mouth. Farther upstream the loosestrife became more scattered and eventually disappeared. It appears that the loosestrife around the mouth of Whittlesey Creek is not coming from an upstream source but rather became established from other seed sources - possibly other loosestrife populations along the bay or in the Fish Creek Sloughs. The populations that currently exist at the mouth of the creek could certainly continue to spread seed upstream as wind, seiche tides or animals disperse the seeds. They also pose a serious threat as a seed source for the Kakagon and Bad River Sloughs.

Highway 13

Area Surveyed: from Highway 2 to the Bayfield Fish Hatchery including some areas between Highway 13 and Chequamegon Bay.

Quad Maps: Ashland West, Washburn, Long Island, Bayfield, Mt. Ashwabay.

A total of 4.4 hectares of loosestrife were found in a variety of habitat types including roadside ditches, yards, meadows, swamps, and brushy areas on higher ground. Several of these patches may have overestimated or underestimated density information due to transects having been run along patch edges rather than through patch centers.

Loosestrife was very visible in scattered ditch patches the entire surveyed length of Highway 13. All of these ditches had been mowed and in many of them the loosestrife was coming back in high densities. Many of the ditches appeared to be wet for at least part of the summer, but were completely dry during the time of the surveys. Others ranged from slightly wet to very wet, and even somewhat swampy. In many cases the ditches were bordered on the side away from the road by either brush (typically willow and alder) or large trees. Generally, the loosestrife thinned out and eventually ceased to be found further into the brush. However, several patches were found in which the loosestrife persisted throughout thick brush, showing its tolerance for somewhat lower light levels. Common plants found growing in the ditches with loosestrife included many grass species, cattail, willow and alder brush, goldenrod, thistle, jewelweed, lupine, trefoil, and ferns.

Several lowland swamp areas were also encountered along Highway 13. Patch 13-22 (not visible in Figure 2) provided an excellent example of a dense, monotypic population of class 3 plants. Many of these were 6 to 8 feet tall and had 20 or more stalks coming from the same root mass. This particular patch was almost completely loosestrife dominated, but cattail and jewelweed as well as several grass, sedge, and bedstraw species were also noted. These plants were commonly associated with loosestrife in other swampy areas as well.

Chequamegon Bay Shoreline

Area Surveyed: from Port Superior Marina in Pike's Bay to the mouth of Whittlesey Creek.
Quad Maps: Bayfield, Mt. Ashwabay, Washburn, Long Island, Ashland West.

The Chequamegon Bay Shoreline was surveyed by boat. Much of this area is cliffs and rocks and does not provide favorable loosestrife habitat. Primary search areas were lowland areas found mostly along creek mouths. In these patches areas were estimated but no class distribution or density information was recorded. The Geo Explorer was not used at these sites.

Approximately 1.1 hectares of loosestrife were located, most in expected areas - near creek mouths or lowland areas. A small patch was found along the mouth of Boyd Creek, and another was located at the mouth of a small stream just south of Boyd Creek. A small clump of several plants was found on the shore near Memorial Park at the north end of Washburn. Two large patches of approximately 5,000 m^2 each, located at the mouth of Pike's Creek and Port Superior Marina, made up the majority of the loosestrife found along the entire shoreline. Areas of the Sioux River Slough visible by boat were also surveyed. One fairly large patch of approximately 1,250 m^2 was located near the mouth of the slough with scattered plants present along the channel moving further into the slough area. Very little loosestrife was visible extending back into the slough from the channel, although loosestrife may have been hidden by tall cattails.

Sturgeon River Sloughs Wildlife Area, Michigan

The Sturgeon River Sloughs and surrounding areas in Michigan were included for the first time in GLIFWC's purple loosestrife surveys in 1995 (Figures 4 and 5). Because of the importance of the slough area for waterfowl, fisheries, wildlife, and wild rice production, purple loosestrife would be an unwelcome invader. Habitats suspected of supporting purple loosestrife in and around the sloughs were surveyed. These areas included Portage Lake, Portage River, Upper and Lower Portage Entries, Torch Lake, Torch Bay, Sturgeon River, Snake River, Pike River, Otter Lake, and Highway 41 north of Chassell.

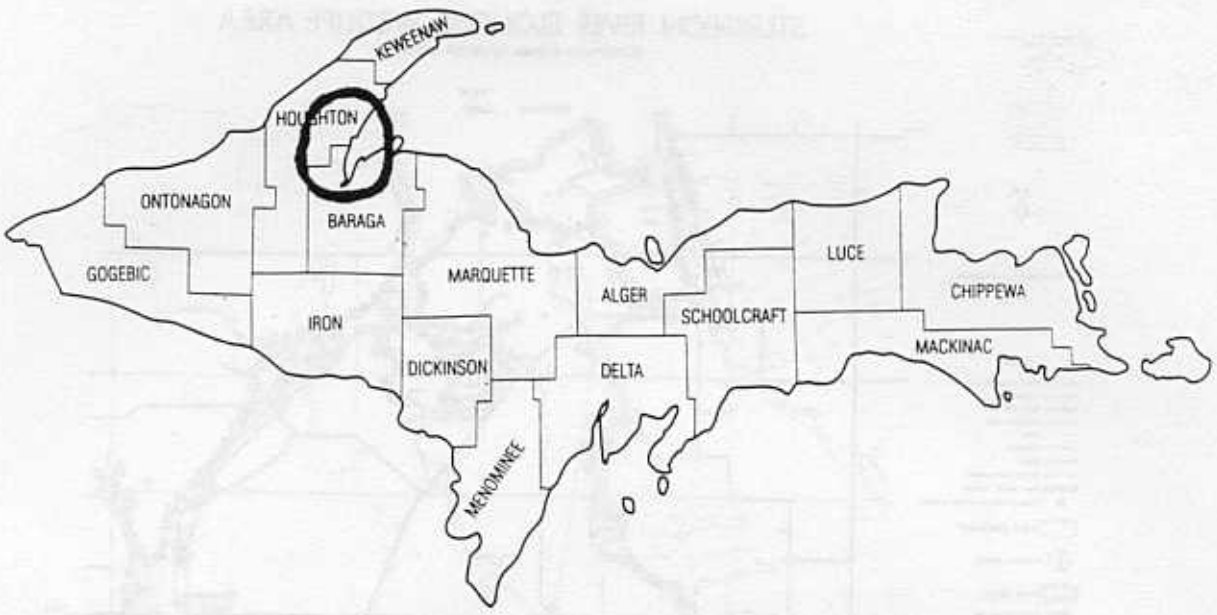

Figure 4. The Upper Peninsula of Michigan showing the general area of purple loosestrife surveys in 1995.

Methods

Key Contacts and Priority Areas

Priority survey areas in Michigan were determined after consulting with Rob Aho, Michigan DNR Wildlife Habitat Biologist. Topographic maps were also used to gain a better understanding of the watershed, the local topography, and potential sites for purple loosestrife.

Maps & Data Sheets

Two sets of USGS topographic maps representing the surveyed areas in Michigan were compiled. One set of maps was laminated and used to record locations of loosestrife stands while in the field. The other set was kept in the office and information from the field maps was transferred to them later. These maps should provide quick, easy-to-use stand location and identification information so that future survey teams will know which areas have already been surveyed. They will also be helpful in aiding future crews to efficiently locate loosestrife populations for further survey and control work.

Field notebooks were used to record qualitative information on each survey area. When quantitative data were collected, the data sheets used for the Bad River and Chequamegon Bay surveys were used (Appendix 2). Information on patch size, class distribution, and plant density was

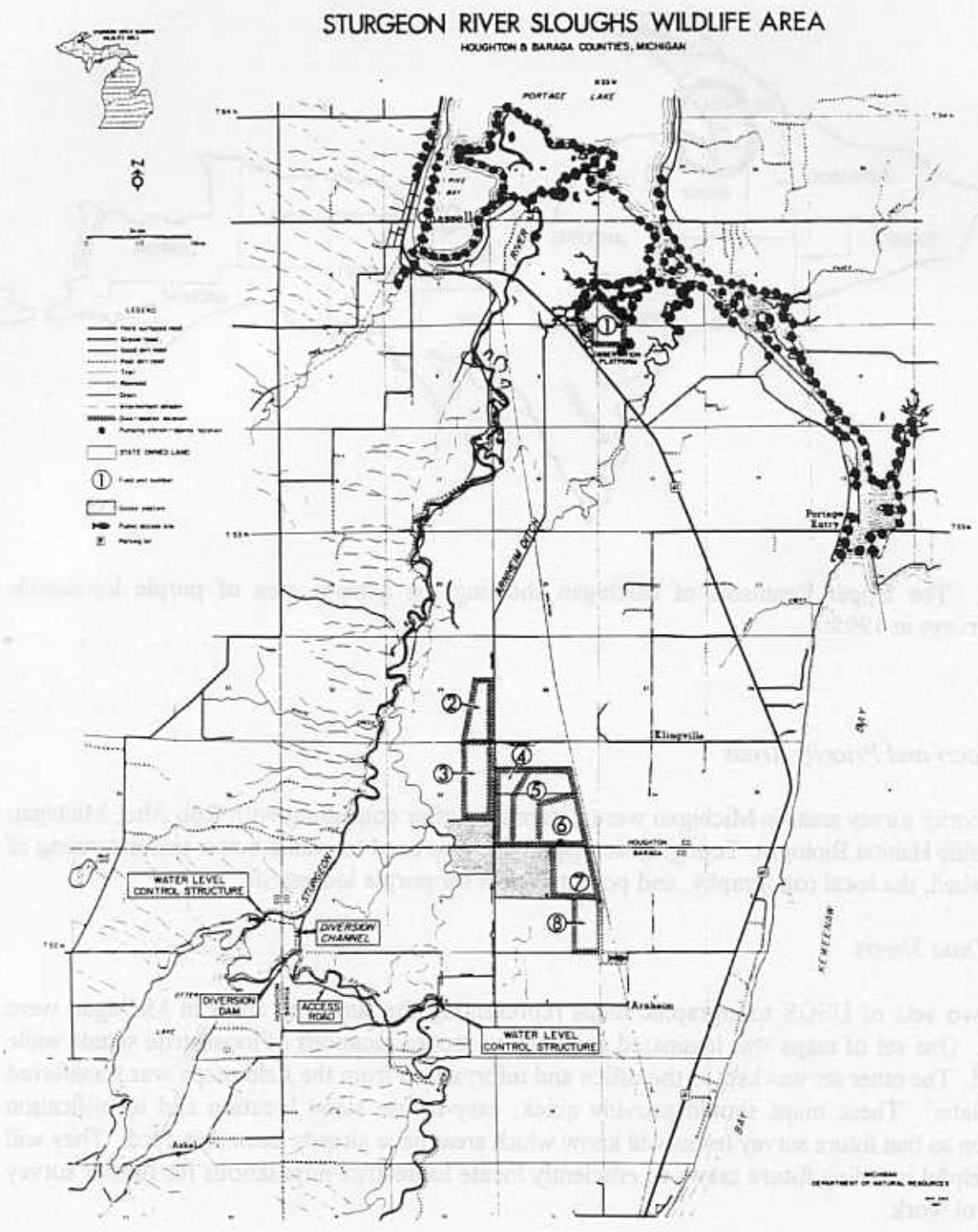

Figure 5. Purple loosestrife locations in areas surrounding the Sturgeon River Sloughs Wildlife Area, Michigan 1995 (loosestrife locations indicated by black dots).

collected as well as other pertinent information for each survey site including disturbances (especially human caused), site descriptions, the source of colonization if known, and any other unique features of the area.

Mapping

Several important factors played a role in determining the methods used in surveying the Sturgeon River Sloughs in Michigan. Limited time, the large geographic area to cover, and the extensiveness of loosestrife made it impractical and impossible to conduct intensive quantitative surveys. As a result, it was determined that gathering baseline information on the locations of loosestrife populations would prove most valuable. The majority of the surveying was done by boat with other surveying done by canoe and car. At each location loosestrife populations were recorded on field maps and notes were taken. However, some quantitative data were collected at Unit 1 of the Sturgeon River Sloughs Wildlife Area (Figure 5).

Results

Density, Distribution & Population Estimates

From four transects run in and around Unit 1, an estimated total of 5,290 loosestrife plants covering approximately 0.2 hectares were found (Table 3). The relatively high density and number of class 1 and class 2 plants compared to class 3 plants indicates that the loosestrife population in this area is fairly young. This information along with observations made during surveys indicates that loosestrife is spreading into Unit 1 from the surrounding slough area.

Table 3. Loosestrife density (plants/m^2) and population estimates (% of population) for Unit 1 of the Sturgeon River Sloughs Wildlife Area, Michigan in 1995.

	Class 1	Class 2	Class 3	Total
Density	1.49	1.14	.10	2.74
Population Estimate	2,878 (54%)	2,212 (42%)	200 (4%)	5,290

Survey Observations

This section provides a summary of the loosestrife found in each area surveyed, as well as other pertinent information. Any special concerns or unique findings are also reported.

Sturgeon River Sloughs Wildlife Area

Area Surveyed: Units 1-8 and the main channel that runs through the upper slough area from Highway 41 to the Portage River.

Quad Maps: Point Mills, Otter Lake, Keweenaw Bay.

All of the impoundments were surveyed by driving on the dikes between the impoundments. No loosestrife was found in Units 2-8 (Figure 5). From the dike around Unit 1, loosestrife could be seen stretching back into the slough area away from Unit 1. Prior to the survey Rob Aho, Michigan DNR, reported having seen loosestrife outside Unit 1, but not inside. However, during the survey some loosestrife was noted inside Unit 1, but only class 1 plants with the majority located fairly close to the berms. Loosestrife movement and population characteristics around and in Unit 1 should continue to be monitored.

The loosestrife appeared to be fairly consistently scattered throughout the sloughs. Along the channel edge class 1 and class 2 plants were seen. While the plants in the distance were more difficult to see, they appeared to be mostly class 2 and some class 3 plants. Closer to the Portage River the loosestrife seemed to get denser and extended even further back into the sloughs.

Portage River and Lower Portage Entry

Area Surveyed: Portage River to its lower entry into the Keweenaw Bay.

Quad Maps: Point Mills, Portage Entry.

The Portage River had a variety of large patches as well as individual loosestrife plants scattered discontinuously along most of the shoreline. Much of the river's shore was dotted with homes and cabins and it was common to find loosestrife associated with these dwellings. In some locations the loosestrife patches appeared to be neatly groomed and well cared for by the landowner.

Several spoil islands were located in the middle of the Portage River channel. All supported some loosestrife but the distribution differed from island to island. For example, one island rose quite quickly from the water into a hill. Trees were more common on this island and loosestrife was found only thinly scattered along the edges of the islands. A couple of the lowland islands had cattail spread throughout them and loosestrife was typically scattered within the cattail. Brush was found in the centers of several islands and in these cases the loosestrife seemed to taper off as it reached the brush line.

Scattered loosestrife populations continued to be found along the river to its entry into Keweenaw Bay. Several islands located at the entry had loosestrife populations on them as well.

Portage Lake and Upper Portage Entry

Area Surveyed: the southern shore of Portage Lake including Pike Bay to Chassell, and the Portage Channel to its upper entry into Lake Superior.

Quad Maps: Point Mills, Chassell.

Loosestrife was found consistently scattered along the entire southern shore of Portage Lake as well as throughout Pike Bay. From the boat it was clear that one short stretch at the north end of Pike Bay consisted of very large class 3 plants. This large size was not typical of most plants along the shoreline and from a distance the majority of loosestrife appeared to be class 2. The channel from just above Houghton and Hancock to the Upper Portage Entry had no loosestrife.

Several areas of Portage Lake were not surveyed. They included: the channel through Houghton and Hancock to just north of Chassell, the north end of Portage Lake between Grosse Point and Houghton/Hancock, and the eastern shore of the lake from Torch Bay south to where the Portage River begins. Based on survey findings in surrounding locations it is likely that loosestrife is established in these areas. Due to the prevalence of loosestrife in Pike Bay and along Highway 41, the shoreline north of Chassell likely has loosestrife. The eastern shore of the lake is surrounded to the north (Torch Bay) and south (Portage River) by healthy loosestrife populations as well. Loosestrife could be seen along the distant shore of the lake using binoculars. It seems likely that loosestrife extends along the entire eastern shore.

Torch Lake and Torch Bay

Area Surveyed: Torch Lake and Torch Bay to Portage Lake.

Quad Maps: Laurium, Point Mills.

The entire shore of Torch Lake was free of loosestrife. On the east side of Torch Bay loosestrife was associated with the many lake homes in the area. The west side of Torch Bay also consisted of scattered loosestrife along the shoreline, again associated with cottage development. One small plant was found in the mine dump area near Grosse Point.

Snake River

Area Surveyed: approximately 1 mile of the river beginning at the Portage River and going south.

Quad Map: Point Mills.

The mouth of the Snake River had a fairly dense concentration of loosestrife and scattered loosestrife continued to be found upstream, with the exception of one short stretch of brushy area where loosestrife was absent. Approximately one half mile upstream from the mouth loosestrife tapered off and only two more isolated plants were located. Shortly before the end of the survey area, the trees and brush came quite close to the river's shore and this habitat didn't appear to be very

suitable for loosestrife. It remains possible that more loosestrife is present upstream beyond where the survey ended.

Sturgeon River

Area Surveyed: from the mouth at Portage Lake to approximately one half mile south of Highway 41.

Quad Maps: Point Mills, Chassell.

Loosestrife was found regularly scattered along the Sturgeon River from its mouth to approximately three quarters of a mile upstream. The concentration was greatest at the mouth and at one other location where loosestrife reached beyond the shore into the surrounding lowland. After this point the loosestrife tapered off and only a few more individual plants were found. The last of these was located approximately three quarters of a mile upstream.

The side channel that flows between the Sturgeon River and Pike Bay was also surveyed. This entire area was lowland and dense patches of loosestrife were found on both sides of the channel's entry into Pike Bay. Several plants were also located at the confluence of the side channel and the main river channel. Moving upstream from the mouth, the lowlands surrounding the river became more brushy and eventually graded to woodlands. This wooded shoreline was less suitable habitat for loosestrife. The few individual plants that were located in the more tree-lined areas were in small open patches where more sunlight could come through.

Pike River

Area Surveyed: several discontinuous locations from the mouth to the bridge off of Lower Pike Road.

Quad Map: Chassell.

The mouth of the Pike River was surveyed by boat from Pike Bay and had loosestrife scattered on both sides. The loosestrife could be seen extending upstream as well. The river was also surveyed from the bridge on new Highway 41 and the bridge on old Highway 41. From both areas, dense concentrations of loosestrife could be seen stretching upstream. From the bridge on old Highway 41 loosestrife was visible as far as could be seen with binoculars. With such dense concentrations at the mouth and the two bridges, it seems likely that loosestrife is established along much of the river.

Otter Lake

Area Surveyed: shoreline of Otter Lake.

Quad Map: Otter Lake.

Since Otter Lake feeds into the Sturgeon River and loosestrife was found in several areas along the river as well as at its mouth, it was thought that loosestrife located on Otter Lake might be

providing seeds for the populations downstream on the Sturgeon River. This suspicion proved untrue as no loosestrife was found around Otter Lake.

Highway 41

Area Surveyed: from Chassell to Houghton.
Quad Map: Chassell.

Loosestrife was found scattered in the roadside ditches along Highway 41 from Chassell to just south of Pilgrim Point near Houghton. Large, dense patches of mature plants, as well as small individual plants were common. Part of this stretch of highway was under construction. In addition to spreading seed mechanically by movement of machinery this construction will create freshly disturbed areas which may serve as favorable habitat for the continued spread of loosestrife.

Discussion

Results of surveys in both Wisconsin and Michigan clearly indicate that purple loosestrife is taking a strong foothold over a large area and in a wide range of habitats. From data collected during 1994 and 1995, it appears that many loosestrife populations, although not yet fully established and mature, are moving toward becoming so. Loosestrife stands found in the 1995 survey appeared to be older than those found in the 1994 survey. In 1995, densities of class 1 and class 2 plants were high compared to class 3 plants (Table 1). This is in contrast to the 1994 loosestrife survey which found high densities of class 1 plants and relatively low densities of class 2 and class 3 plants (Gilbert et al. 1995).

By studying and comparing the habitat in locations surveyed similarities in the distribution patterns were noted. This observation may help direct future efforts to locate and control loosestrife and prevent further spread into uninfested or sparsely infested areas.

In many surveyed areas where brush and woody vegetation was more predominant loosestrife tended to thin out and often was not found at all. However, there were exceptions in some areas of very thick brush where loosestrife was able to grow. Since loosestrife seeds require moist, sunlit soils to germinate, these shady brush areas were generally not favorable sites for colonization. Plants found growing in these areas may have become established prior to the growth of the brush. Thick brush will most likely not prevent continued growth of loosestrife since established plants can survive in 50% of full sunlight (Skinner et al. 1994). Loosestrife reached far back into thick brush in several areas including patches near Whittlesey Creek and Highway 13 where roadside ditch stands extended back into the tree line. Similar situations likely exist in some of the survey areas in Michigan; however, extensive surveys like those in Wisconsin were not performed.

Since loosestrife seeds float and can be dispersed by flowing water (Skinner et al. 1994), seeds would be expected to flow from an upstream loosestrife patch to a location further downstream. This

pattern was observed in two places in Wisconsin. The Highbridge loosestrife population has infested the Silver Creek. Loosestrife has spread downstream and has reached the Marengo River. No loosestrife has been found up the Marengo River from the confluence with Silver Creek but much loosestrife was observed down stream from the confluence (Gilbert et al. 1995). The Fish Creek Slough population has contributed to the establishment of loosestrife in Kakagon Sloughs. Although not located on a river system, the flow of water in Chequamegon Bay is generally from Fish Creek to Kakagon Sloughs.

Conversely, in many areas where loosestrife was found downstream or at creek mouths there appeared to be no seed source upstream. For example, Otter Lake in Michigan had no loosestrife, yet it fed the Sturgeon River which had an abundant loosestrife population further downstream and at its mouth. Similarly, both the Pike and Snake Rivers in Michigan had large populations of loosestrife near their mouths that diminished further upstream. The mouth of Whittlesey Creek and surrounding areas in the Wisconsin survey also had large amounts of loosestrife. Moving upstream, however, the loosestrife became less common and eventually disappeared. The entire stretch of Whittlesey Creek was not surveyed so it is uncertain whether loosestrife is located further upstream.

If the seeds for many of the surveyed areas are not coming from upstream then there must be other seed sources and means of dispersal. Two important factors appear to be involved in the spread of loosestrife - people and transportation routes. Many Wisconsin and Michigan loosestrife locations were closely associated with both of these factors. For example, nearly the entire shoreline of Portage Lake is built up in a combination of permanent and seasonal homes. Since people cause disturbance to soils by many of their activities (eg. gardening, yard grooming, and building construction) and loosestrife thrives on such disturbed sites, the potential for establishment and spread of loosestrife is clearly present if the seed is there. Loosestrife seed also may be introduced into an area through the fur or feathers of animals, peoples' clothing, vehicles, boats, or purposefully for gardens.

In addition, road construction and mowing of roadside ditches are other mechanisms by which loosestrife seed may be spread. The road construction along Highway 41 in Michigan was taking place in areas which already supported healthy populations of loosestrife. Besides spreading seed mechanically by the movement of machinery, the freshly disturbed ground would provide very favorable habitat for the germination of loosestrife seeds from nearby patches. Mowing of roadside ditches took place in surveyed areas of both Wisconsin and Michigan. Equipment used for mowing likely carries loosestrife seed from one location to another thereby facilitating establishment of new loosestrife populations.

Conclusion and Recommendations

Monitoring and Control

Purple loosestrife is taking a strong foothold in northern Wisconsin and select areas of Michigan's Upper Peninsula. Because a large class 3 plant can produce a seed bank of up to 2,700,000 seeds per plant annually and has the ability to thrive in a variety of habitat types, loosestrife will not be quickly, simply, or completely removed from the areas in which it has become established (Thompson et al. 1987, Skinner et al. 1994). Controlling all populations of loosestrife in the ceded territories is impossible. Therefore, intensive control efforts must be implemented in areas of high value which would be vulnerable to damage caused by loosestrife infestation. Consequently, an effective loosestrife control plan should include treating populations which are located along loosestrife dispersal routes to high value areas. The Whittlesey Creek population is a good example of this, located near Chequamegon Bay, a dispersal route to Kakagon Sloughs.

Small populations should also be treated because a simple herbicide treatment is required to keep the population from getting larger. The loosestrife populations along Beartrap Creek and County Road A in Wisconsin, although not large contributors to the total area of loosestrife found, did have substantial densities of class 1 and class 2 plants. Prompt treatment and future monitoring will keep these populations from becoming major seed sources for continued infestation of Kakagon Sloughs. The patch found along Highway 169 in Wisconsin should also be treated and carefully monitored to avoid spread along this highway and to the Potato River, a tributary of the Bad River.

Since no loosestrife was found in Units 2-8 of the Sturgeon River Sloughs Wildlife Area, but substantial populations were located not far away, close monitoring in the future is critical to keeping loosestrife out of these units.

Treatment and monitoring of the few, scattered loosestrife patches found in upstream locations in Wisconsin and Michigan are important to prevent further spread of seeds throughout these watersheds. Monitoring and treatment should also be a priority in newly disturbed sites such as the Highway 41 road construction in Michigan. Without prompt and aggressive efforts, new populations of loosestrife could quickly become established and spread throughout the roadside ditches in this area.

The large, monotypic loosestrife stands found at some Whittlesey Creek locations and along Highway 13 in Wisconsin, and the large areas covered by loosestrife in parts of the Sturgeon River Sloughs in Michigan, will be more difficult to control and may be impossible to completely eliminate. However, a treatment strategy should be developed and initiated. Control efforts in the Fish Creek Sloughs provide an excellent example of a highly infested area being brought down to a manageable level. The same success may be possible in other areas with very extensive or very dense loosestrife populations.

While control efforts in the Fish Creek Sloughs involved applying herbicides to loosestrife patches, other control methods are also in practice. Biological control (i.e. leaf and root eating beetles) is being experimented with in some areas. The species being used in these control efforts are exotics like purple loosestrife. It is important to recognize the potential negative impacts and evaluate the effects that such control measures may be having on the ecosystem. GLIFWC is not involved with the use of biological control for purple loosestrife.

With the majority of the surveying in the Bad River and Chequamegon Bay watersheds in Wisconsin completed, priority in 1996 should be given to treatment and monitoring of control effects in surveyed areas. However, key contacts and some surveillance should be maintained to search for previously undetected and new infestations. The focus for the Sturgeon River Sloughs and surrounding areas should be to measure density in key areas and continue to conduct distribution surveys. This will allow a better assessment of the situation to be made and thereby aid future decision making about possible treatment of loosestrife in the area. Any loosestrife found in Unit 1 of the Sturgeon River Sloughs should be treated in 1996.

Public Awareness

In addition to monitoring and control efforts, public awareness can play a very important role in a successful loosestrife control program. Landowner contacts in Wisconsin during the 1995 survey demonstrated that there is a beginning knowledge about loosestrife and the ecological consequences it brings to an ecosystem. Landowners may be valuable sources of information about locations of loosestrife stands either on their own land or in areas that they frequent in their outdoor activities. Tapping into this information has been the idea behind one aspect of Minnesota's Purple Loosestrife Control Program. In an effort to inventory loosestrife locations the public and state agencies' staff use report cards to record sightings (Skinner et al. 1994). Implementation of a similar effort in Wisconsin and Michigan could aid survey and treatment crews from GLIFWC or other agencies in the future.

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Appendix 1

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Rob Aho	Michigan DNR - Wildlife Habitat Biologist
Dave Aschenbauer	John F. Kennedy Memorial Airport - owner Skyways North Aviation
Peter David	GLIFWC - Wildlife Biologist
John Denomie	GLIFWC - Wildlife Technician
Mike Donofrio	Keweenaw Bay Indian Community Biologist
Mike Gardner	Whittlesey Creek Watershed Project - Project Manager
Nancy Larson	Wisconsin DNR - Water Resources Management
Owen Larson	GLIFWC - Computer Archive Technician/Network Administrator
Jim Meeker	Northland College - Assistant Professor, Native American Studies Program
Mark Miller	Bad River Tribe - GIS Specialist
Hock Ngu	GLIFWC - Data Analyst
Ron Parisien	GLIFWC - Wildlife Technician
Bruce Swanson	Wisconsin DNR - Brule Area Fisheries Supervisor

Appendix 2 1995 purple loosestrife survey data sheet

GLIFWC PURPLE LOOSESTRIFE SURVEY
BAD RIVER - CHEQUAMEGON BAY WATERSHED

Observers:
Habitat:
T: R: Sec: ¼:
Patch No. : _____ Scattered? Class 1: Total plants /patch:
Class 2:
Class 3:
Dense?

Date:
Location:
Quad Map:

Total Area:

Tran. A	# of Class 1	# of Class 2	# of Class 3	Plants/m²
Plot 1				
Plot 2				
Plot 3				
Plot 4				
Plot 5				
Plot 6				
Plot 7				
Plot 8				
Plot 9				
Plot 10				
Average #				
SD				

Tran. B	# of Class 1	# of Class 2	# of Class 3	Plants/m²
Plot 1				
Plot 2				
Plot 3				
Plot 4				
Plot 5				
Plot 6				
Plot 7				
Plot 8				
Plot 9				
Plot 10				
Average #				
SD				

Appendix 2 cont. 1995 purple loosestrife data sheet

Disturbance:

Canopy Type:

Source of Colonization:

Site Description:

Notes:

Appendix 3 Summary of loosestrife control efforts

The loosestrife control project which began in 1988 in the Fish Creek Sloughs has expanded to include a greater number of areas within the Bad River and Chequamegon Bay watersheds. In 1995 a five-person crew spent approximately 40 hours a week for seven weeks treating loosestrife stands throughout these watersheds. Backpack sprayers were used to apply one of two herbicides depending on the characteristics of the area being treated. Plants were treated individually and every attempt was made to reduce or eliminate damage to non-target vegetation. Large, nearly monotypic stands were treated with a generalist herbicide (Rodeo). This systemic herbicide requires only a small amount to be effective on even large plants but this herbicide killed all vegetation it came into contact with. Smaller plants and seedlings were treated with a dicot-specific herbicide (Garlon 3A). This herbicide required a greater quantity to be effective but did not kill monocots allowing grasses and forbs to colonize the treated area. Garlon 3A was not used on large plants because of the quantity of herbicide required to be effective.

Approximately one week was spent on treatment efforts in the Fish Creek Sloughs in 1995 in an attempt to keep new, young plants from expanding into the population that once threatened the native wetland community. From Fish Creek Sloughs the crew moved around Chequamegon Bay to Whittlesey Creek where three days were spent on treatment efforts. Two weeks were spent treating loosestrife in the Kakagon Sloughs as well as at Highbridge. Silver Creek was treated from Highbridge to the Marengo River. The Bad River, including the Bad River Sloughs, was treated beginning at Government Road. One day was also spent treating stands along Highway 13 south of Ashland.

In addition, four days were spent treating loosestrife at Amnicon and Dowling Lakes in Douglas County. In 1994, interest in GLIFWC's loosestrife control project was expressed by the Amnicon/Dowling Lake Management District, a group of homeowners from the area. Funds for treatment in this area were provided by the Management District.

Because it would be impossible to successfully eliminate every single loosestrife plant from any given area with only one treatment effort, these areas will be treated again next year to remove any newly established plants and plants missed in a previous treatment.