

# Glossy Buckthorn (*Frangula alnus*) Management at Seney National Wildlife Refuge (2007)

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## Introduction

A species native to Eurasia, Glossy Buckthorn (*Frangula alnus*, hereafter GLBT) was introduced to North America in the late nineteenth century for horticultural purposes (Voss 1985). GLBT leaves are 0.5 – 2.8 inches long, alternate, simple, ovate and deeply veined. The tops of the leaves are light to dark green, with a slight gloss and a lighter green below; identification of GLBT is easiest in the fall because it retains green foliage longer than native plant species (Heidorn 1990). Flowering occurs from May to June and the inflorescence consists of perfect five-petal, whitish-yellow flowers. Fruit begins to form in drupes in July and last through September (Barnes 1981). Initially the berries are yellow-green, but ripen to red, then to black, as the season progresses.

The bark of GLBT ranges from reddish-green in younger plants to a darker grey-green in more mature plants. When cut, it can be differentiated from other shrubs and trees because of its distinctive yellow wood. The sap wood is a rich yellow color and the heartwood a pinkish-orange when first cut, fading with time (WI-DNR 2004). The entire shrub may grow as tall as 22 feet with many stems branching from the base. In older shrubs, base stems can be as large as 10 inches in diameter (Heidorn 1990). GLBT's rapid growth and ability to grow densely were characteristics first thought to make it ideal for use as hedgerows and for other landscaping purposes.

GLBT was first documented in Michigan in Delta County in 1934 (Voss 1985). Based on the age of previously cut stems, the arrival of GLBT at Seney National Wildlife Refuge may have occurred in the 1940's or 1950's, although a review of the historical records at the Refuge does not mention this species. A survey conducted by McNeil et al. (1999) indicated that GLBT was present and widespread in Unit 1 of the Refuge and on adjacent Michigan Department of Natural Resources (MDNR) lands (Figure 1). Further work has identified scattered areas of Unit 2 (especially A-2 and C-2 dikes) with this species as well.

Intensive management of GLBT aimed at reducing its extent and abundance at the Refuge began in the summer of 2001. Initial treatments included cutting GLBT and applying a 20% glyphosate mixture to the cut stumps. In the summer of 2002 Refuge staff began spraying GLBT with a glyphosate solution; during that same year, the scorching of seedlings with a propane torch was also utilized. In 2003, the Refuge and the MDNR began a cooperative effort to manage invasive plants, focusing on GLBT. Through this partnership,

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the State provides a prison crew and guard and the Refuge provides a licensed pesticide applicator and the glyphosate-based herbicide and associated equipment. The Refuge began another partnership with Michigan Technological University in 2004 to research the efficacy of different GLBT management treatments (Nagel et. al. *In Review*). Results of this research suggest a combination of stump treatment followed up by spraying any regeneration is most effective at reducing the amount and extent of GLBT at the Refuge.

During the 2007 season the focus was to continue GLBT management efforts in Unit 1 of the Refuge based on occurrence data collected in 2005. Due to environmental, health, and cost concerns associated with herbicide use, a study was initiated in 2006 to investigate the success of lowering the concentration of glyphosate used for foliage spray application of re-sprouts. The hypothesis of this study was that a solution of glyphosate <5.0% would be as effective at killing GLBT re-sprouts. This study was culminated during the 2007 season.

Presence-absence surveys for GLBT on islands in Unit 1 pools were also conducted during the 2007 season. These surveys were conducted to give a general idea of how widespread and prevalent GLBT is in the Unit 1 Pool System. During the process of carrying out these surveys a hypothesis was formed regarding whether or not the distance from the Refuge Headquarters played a role in the presence/absence of GLBT on the islands. The hypothesis formed is that pools with islands closer to the Refuge Headquarters are more likely to have GLBT present. This is based on the belief that GLBT originated on the refuge in the area of the Refuge Headquarters.

## **Methods**

### **Herbicide Concentration Study**

The study plots that were established along the North Show Pool West Dike were revisited this season. Three treatments and a control were represented in these plots. A study plot consisted of one GLBT stem cluster base with at least three main stems. Each treatment (including the control) had 15 plot replicates, for a total of 60 plots. The plots were systematically distributed within the study area and marked by a color-coded rebar (white: control; green: 1.25% glyphosate; orange: 2.5% glyphosate; blue: 5% glyphosate). The plots were spaced at least 1.65 feet apart from cluster bases.

On 9 June 2006, GLBT in the treatment plots were sprayed with a hand-held (low-volume) pump once with a 0%, 1.25%, 2.5%, or 5% glyphosate solution diluted with tap water and surfactant (0.05% surfactant). The study plots were monitored once a week for the duration of the 2006 field season. The number of GLBT dead stems and change in general plant characteristics (i.e., browning or shriveling leaves) was recorded during each monitoring period. Stems were classified as dead if they had at least 75% of leaves shriveled, brown or fallen. The percent stem death was calculated as a measurement of treatment success. A treatment was determined a success if more than 50% of stems were dead.

On April 20, 2007 a prescribed fire was conducted in the study area. The objective of this fire was to suppress Glossy Buckthorn along the dikes surrounding the Show Pool area. The fire totaled approximately 9 acres on the Show Pool Dike System. The fire was initiated at 1230 hrs. The Fire Danger Rating at that time was very high. The temperature was 69°F with 26% relative humidity. The wind was 8 mph coming from the southeast.

Following the prescribed fire the plots were once again monitored on 5 June 2007. The temperature at the time of monitoring was 55°F, with 15 to 20 mph winds and 50% to 75% cloud cover. As a result of the controlled burn the flagging identifying individual plots was destroyed. However, the color-coded rebar still indicated control and treatments. Therefore, all of the plots associated with the each test variable and control were grouped together in respective categories. The number dead stems and the total number of stems were recorded and used to calculate the percent of dead stems for each treatment and the control.

### **Management**

The 2007 GLBT management season began on 22 May 2007 and ended on 10 September 2007. General management treatments were similar to previous years (i.e., 20% sponge stump, but with a 2.5% foliage spray application of glyphosate instead of 5.0% spray application as was done in previous years). Detailed instructions on the Rodeo label were followed regarding preparation and application of the glyphosate. Spraying devices included a hand pump and power sprayer. The prison crew used chainsaws to cut any GLBT plants measuring >1 inch in diameter or >7 feet in height. Once the stumps were cut, a 20% glyphosate solution was applied to each stump. When spraying occurred in pedestrian concentrated areas, signs were placed at appropriate increments and left for at least 24 hours to notify the public that herbicide had been applied to an area.

GLBT treatment areas were primarily located within four areas stretching along Michigan Highway 77 (Figure 2). The first treatment area was concentrated along Holland Creek at M-77. Areas extending a quarter mile to the east along the north and south banks of Holland Creek were cut and sprayed on the MDNR side of M-77. On the Seney NWR side of M-77, an area between Refuge Entrance Rd. and North Entrance Rd. was similarly treated. The second treatment area was focused around the Show Pools. Both the East and West Show Pool Dikes were sprayed along their entire length. GLBT areas immediately south of the Wigwam were also sprayed. The third GLBT treatment area originated on the first pine ridge north of the footbridge and extended for approximately one mile northward along the Seney NWR side of M-77. The majority of this area lies within 100 yards of M-77. Finally, GLBT between M-77 and the ditch on the west side of the highway extending from the north Seney NWR property line south to the exit of the Marshland Drive was sprayed.

However, due to limited time GLBT was not sprayed along the Wildlife Drive or the Fishing Loop, although it was sprayed along the C-2 Pool dike. There was also some multiflora rose (*Rosa multiflora*) and tartarian honeysuckle (*Lonicera tatarica*) that was also sprayed at C-2 Pool.

### **Island Monitoring**

In order to ascertain how widespread GLBT is in Unit 1 of the Refuge, presence-absence surveys for GLBT on islands in all of the pools within Unit 1 were conducted. The surveys began 30 May 2007 and ended 5 July 2007. The timing of the survey was carefully considered to reduce potential impacts on nesting Common Loon (*Gavia immer*) pairs. The surveys were conducted by canoeing to the islands and recording general characteristics of any GLBT present. The estimated average stem diameter, percent coverage, and Global Positioning System (GPS) coordinates were recorded.

These coordinates were then overlaid onto a Digital Orthophoto Quadrangle using ArcGIS 9.2. Using this aerial photo data layer, it was possible to examine the relationship between the distance of island location from the Refuge Headquarters and whether an island had GLBT present or not. In order to examine this relationship, a series of circles were set up with the center being the Refuge Headquarters. The circles had radii which increased incrementally by 0.5 miles. The number of islands with GLBT present was totaled for each circle and a percent of total was derived for each area (Figure 3).

## **Results**

### **Herbicide Concentration Study**

At the end of the 2006 season, all of the treatment plots had 100% stem mortality. This trend continued into 2007, but the study was altered by the presence of the controlled burn. All of the treatments showed 100% stem mortality and the control showed 90.6% stem mortality (Table 1). The stem mortality in the control plots is almost certainly the effect of the controlled burn because in 2006 there was 0% stem mortality in the control plots. Thus, a combination of treatments seems to be an effective management approach for reducing the extent and abundance of GLBT at the Refuge.

### **Management**

During 2007 a total of 46 days were spent managing GLBT (Table 2). The largest and most dense stands of GLBT were encountered on the north side of Holland Creek on MDNR property. The GLBT on the Refuge was generally smaller and more sporadic. However, well established stands were encountered between Refuge Entrance Rd. and North Entrance Rd, along the Nature Trail Boardwalk, behind Quarters #1, and on the backside and islands of most pools in Unit 1. Sporadic stands of established GLBT were also encountered in areas along the west side of M-77 north of the footbridge.

A total of 154 hours were spent during 2007 on managing GLBT. A total of 21 days were spent working with the prison crew with the average prison crew size being 6 men running 3 chainsaws. During the

2007 season 210 ounces of 20% glyphosate was applied to cut stumps. Also during the 2007, 394 ounces of 5% and 23,594 ounces of 2.5% glyphosate were sprayed on GLBT.

### **Island Monitoring**

A total of 75 islands in Unit 1 were found to have GLBT (Figure 3 and Table 3). F Pool had 19 islands with GLBT present (Table 3). Estimated diameters of single stems in F Pool ranged up to five or six inches. I Pool also had well established GLBT present. GLBT was present on 20 of the islands in I Pool, with nine of those having 20% or greater coverage of GLBT. Two of those islands had 90% coverage of GLBT, with estimated average stem diameters of 1 -2 inches. The only pool with out GLBT present was A Pool.

The analysis of spatial data showed the majority of islands (56%) with GLBT were within one mile of the Refuge Headquarters (Figure 3). Of the islands with GLBT present, 24% were located within a half mile of the Refuge Headquarters, and 32% were between a half and one mile. The pools that fall in this range are Upper F and North Show Pool, and portions of South Show Pool, C-1, E, F and I Pools fall in this range.

### **Discussion**

The results of the herbicide concentration study indicate a solution with as low as 1.25% concentration of glyphosate is effective at controlling GLBT regeneration. In order to ensure consistent GLBT control, however, it is recommended that a 2.5% concentration of glyphosate solution to be used for future GLBT regeneration management because in some instances relatively large stems may be treated by spraying. The results of the study also show support for the possibility of using prescribed fire as part of an integrated pest management philosophy. However, more in depth research is needed to further substantiate the use of controlled burns in managing GLBT.

The 2007 GLBT management season revisited areas treated in previous years, but also expanded treatment into areas previously unvisited. The major areas that had not seen previous management were west of M-77 in Section 9, T45N-R13W and east of M-77 along Holland Creek. The discovery of a seven inch stem of GLBT along Holland Creek supports that these areas had not been treated previously.

The island monitoring project yielded valuable information about the establishment of GLBT on Unit 1 pools. The presence/absence surveys indicate GLBT is well established on several of the pools in Unit 1. I and F pools have significant amounts of GLBT present. The analysis of the GPS coordinate data supported the hypothesis that GLBT is more prevalent on islands closer to the Refuge Headquarters. This lends support to the belief that GLBT originated on the refuge in the area of the headquarters. The island monitoring project shows a definite need to manage these islands with GLBT present.

During the 2008 GLBT management season it is recommended that all of the islands with GLBT in Unite 1 be treated. The majority of these islands can be treated via spraying a 2.5% concentration of glyphosate solution. However, some of the islands may require cutting and stump application of a 20% concentration of

glyphosate solution. As in previous years, it is also recommended that areas previously treated in 2005, 2006, or 2007 be revisited with a spray of 2.5% concentration of glyphosate solution. Work with the prison crew should focus on areas not previously treated or in areas where regeneration exceeds the limits of what can be sprayed. Finally, some thought should be put into dividing areas of confirmed GLBT into separate compartments that can be treated on rotation. This would simplify planning of treatment areas and promote regular revisits to areas of GLBT regeneration.

### Work Priorities for 2008

Spraying resprouts and other small GLBT plants at the Refuge and on MDNR lands with 2.5% concentrate needs to be the priority in 2008. Windy conditions in 2007 precluded spraying on many days. In 2008, work needs to be done on tough-to-reach areas between Refuge Entrance Rd. and North Entrance Rd, along the Nature Trail Boardwalk, behind Quarters #1, and on the backside and islands of most pools in Unit 1.

### Literature Cited

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Table 1. Glossy Buckthorn stem mortality resulting from the herbicide concentration study at Seney National Wildlife Refuge.

Treatment	Total Number of Stems	Total Number of Dead Stems	Total Percent Dead Stems
C (Control)	286	259	90.56
T1 (1.25%)	78	78	100.00
T2 (2.50%)	82	82	100.00
T3 (5.0%)	70	70	100.00

Table 2. Summary of glyphosate use at Seney National Wildlife Refuge during 2007.

Date	Amount (oz.)	Concentration (%)	Location	Prison Crew
5/22/2007	19	20		
5/22/2007	32	5	Sec. 9, T45N R13W	5
5/23/2007	19	20	Sec. 9, T45N R13W	5
5/24/2007	19	20		
5/24/2007	64	5	Sec. 9, T45N R13W	5
5/25/2007	16	20		
5/25/2007	170	5	Sec. 9, T45N R13W	5
5/29/2007	128	5		
5/29/2007	256	2.5		
5/29/2007	19	20	Sec. 22, T45N R13W	6
5/30/2007	384	2.5	Sec. 21, T45N R13W	0
5/31/2007	384	2.5	Sec. 21, T45N R13W	0
6/6/2007	512	2.5	Sec. 16, T45N R13W	0
6/7/2007	128	2.5	Sec. 16, T45N R13W	0
6/8/2007	8	20	Sec. 22, T45N R13W	8
6/11/2007	768	2.5	Sec. 9, 16, 21, T45N R13W	0
6/12/2007	64	2.5	Sec. 21, 28, T45N R13W	0
6/13/2007	288	2.5	Sec. 16, T45N R13W	0
6/18/2007	19	20	Sec. 22, T45N R13W	6
6/21/2007	128	2.5	Sec. 16, T45N R13W	0
6/22/2007	576	2.5	Sec. 9, 16 T45N R13W	7
6/25/2007	9	20		
6/25/2007	128	2.5	Sec. 9, T45N R13W	7
6/26/2007	8	20		
6/26/2007	48	2.5	Sec. 9, T45N R13W	7
6/27/2007	12	20		
6/27/2007	48	2.5	Sec. 9, T45N R13W	7
6/28/2007	8	20		
6/28/2007	32	2.5	Sec. 21, T45N R13W	6
7/2/2007	10	20		
7/2/2007	20	2.5	Sec. 21, T45N R13W	8
7/5/2007	768	2.5	Sec. 21, T45N R13W	0
7/9/2007	12	20		
7/9/2007	16	2.5	Sec. 21, T45N R13W	7
7/10/2007	12	20	Sec. 21, T45N R13W	7
7/12/2007	12	20		
7/12/2007	32	2.5	Sec. 21, T45N R13W	6
7/16/2007	8	20		
7/16/2007	32	2.5	Sec. 21, T45N R13W	7
7/20/2007	512	2.5	Sec. 9, T45N R13W	6
7/23/2007	288	2.5	Sec. 16, T45N R13W	6
7/24/2007	96	2.5	Sec. 16, T45N R13W	0
7/25/2007	970	2.5	Sec. 16, T45N R13W	5
7/26/2007	1068	2.5	Sec. 21, T45N R13W	0
7/30/2007	128	2.5	Sec. 21, T45N R13W	0

7/31/2007	928	2.5	Sec. 21, T45N R13W	0
8/1/2007	896	2.5	Sec. 21, T45N R13W	0
8/15/2007	64	2.5	Sec. 21, T45N R13W	0
8/16/2007	128	2.5	Sec. 21, T45N R13W	0
8/17/2007	16	2.5	Sec. 21, T45N R13W	0
8/18/2007	1664	2.5	Sec. 16, T45N R13W	0
8/21/2007	448	2.5	Sec. 16, T45N R13W	0
8/23/2007	960	2.5	Sec. 16, T45N R13W	0
8/24/2007	576	2.5	Sec. 16, T45N R13W	0
8/26/2007	768	2.5	Sec. 17, T45N R13W	0
8/29/2007	1280	2.5	Sec. 21, T45N R13W	0
9/3/2007	384	2.5	Sec. 22, T45N R13W	0
9/5/2007	2688	2.5	Sec. 21 22, T45N R13W	0
9/6/2007	1920	2.5	Sec 16 22, T45N R13W	0
9/10/2007	3200	2.5	Sec 16 22, T45N R13W	0

Table 3. Summary of Glossy Buckthorn presence on islands in the Unit 1 Pool System at Seney National Wildlife Refuge during 2007.

Pool	Number of Islands With GLBT	Number of Islands with Percent Coverage of			Greatest Est. Avg. Stem Diameter (Inch)
		0-10%	11-20%	>20%	
A-1	0	0	0	0	0
B	1	1	0	0	<1
C-1	2	2	0	0	1
D	3	3	0	0	1
E	7	5	2	0	2.5
F	19	15	2	2	3
G	5	5	0	0	1.5
H	7	7	0	0	2
I	20	11	4	5	2
J	7	6	1	0	2
Upper F	1	0	0	50	<1
North Show	2	2	0	0	1
South Show	1	1	0	0	1

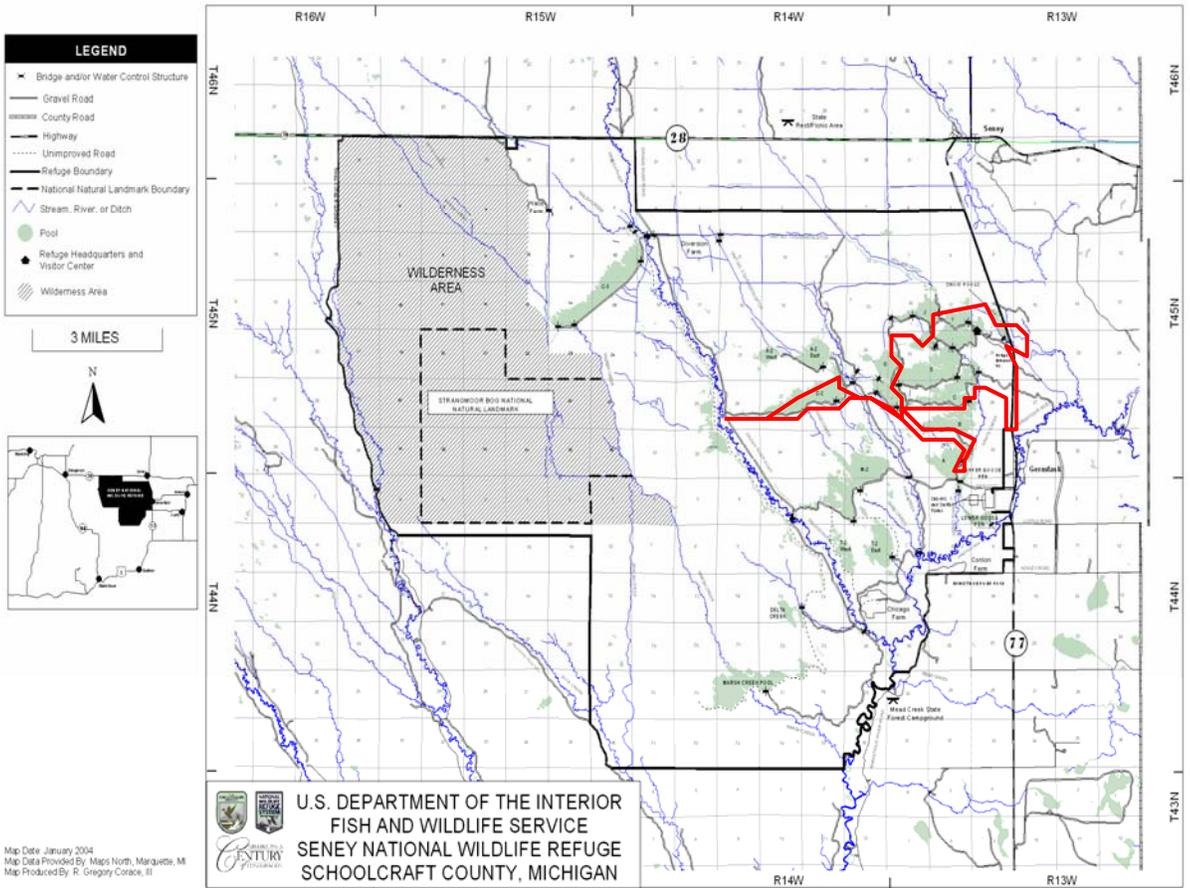
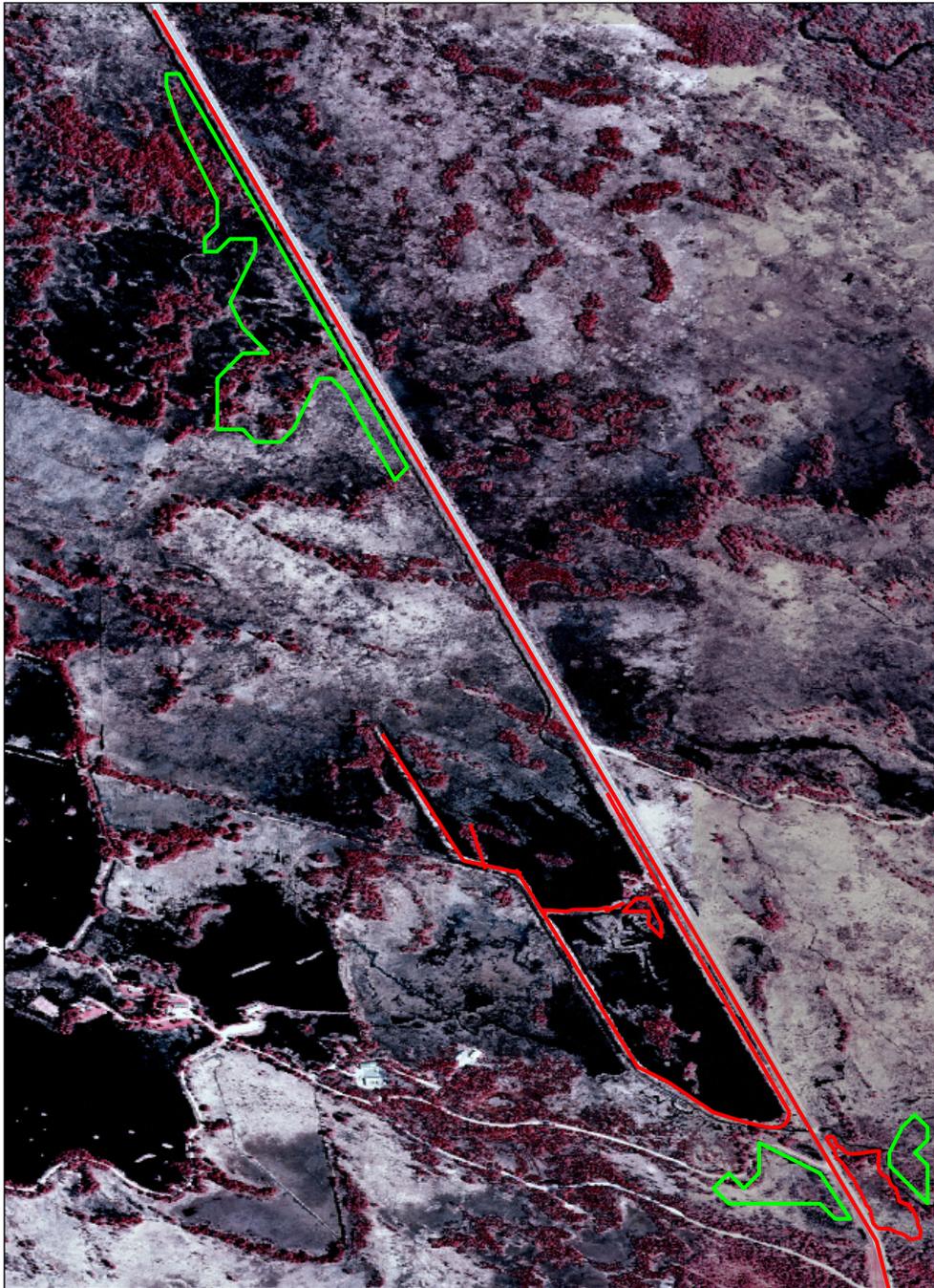


Figure 1. General invasive plant treatment area at Seney National Wildlife Refuge indicated by the red polygon.



**Legend Data**

Locations of 2007 Treatments  
 1998 Digital Orthophoto

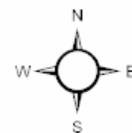
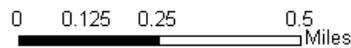


Figure 2. Approximate locations of Glossy Buckthorn treatments areas on Seney National Wildlife Refuge and adjacent Michigan Department of Natural Resources (2007). Not shown are areas sprayed along the Entrance Rds., the Nature Trail, and around buildings in Unit 1.

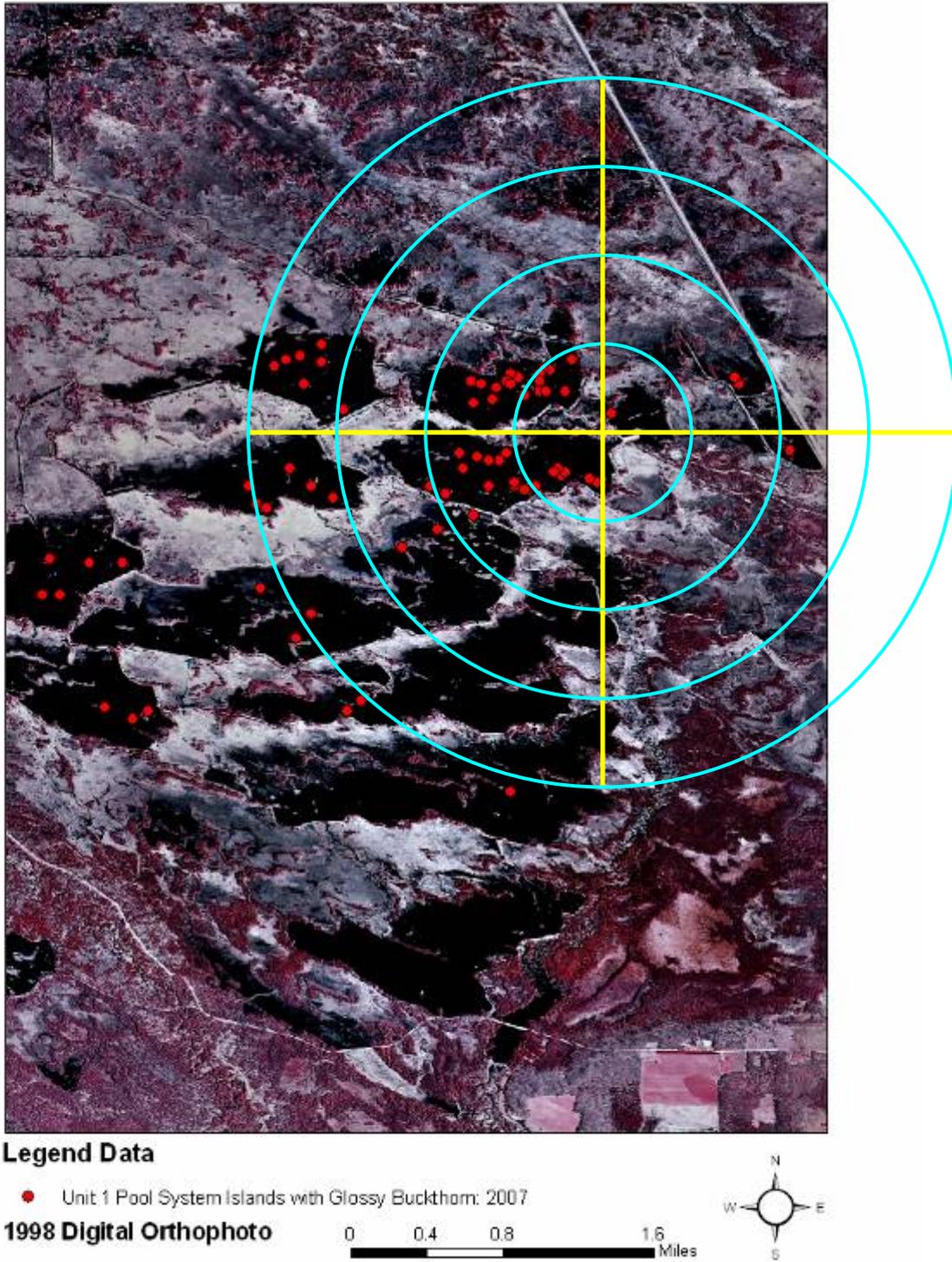


Figure 3. Locations of Unit 1 Pool System islands at Seney National Wildlife Refuge with Glossy Buckthorn present during 2007. Circles overlaid and originating from the Refuge Headquarters have ½-mile radii.